ANNA UNIVERSITY, CHENNAI
NON AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS – 2021

B.E. GEOINFORMATICS ENGINEERING

CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. To prepare the students for successful careers in Geospatial Industries and Information Technology that meet the needs of India and other Countries.
II. To develop the professional ability among the students to collect various Geospatial relates from various platform, data, analysis and synthesis that create user oriented real world applications.
III. To provide an opportunity for students to work as part of teams on multidisciplinary projects.
IV. To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering and multidisciplinary problems and to prepare them for graduate studies.
V. To promote students awareness of the life-long learning and to introduce them to professional ethics and codes of professional practice.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Graduates of B.E. Geoinformatics students will be able to

PSO1 Knowledge of Geoinformatics discipline

Demonstrate in-depth knowledge of Geoinformatics engineering discipline with an ability to evaluate, analyze and synthesize existing and new knowledge.

PSO2 Critical analysis of Geoinformatics Engineering problems and innovations

Critically analyze complex Geoinformatics problems and apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical policy context.

PSO3 Conceptualization and evaluation of engineering solutions to Geoinformatics engineering issues

Conceptualize and solve Geoinformatics engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety and socio cultural factors.

PEOS & Pos
The B.E (Geoinformatics) Program outcomes leading to the achievements of the objectives are summarized in the following table.

Programme Educational Objectives	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
I	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3
II	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3
III	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3
IV	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3
V	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Year	Semester	Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
YEAR 1	SEMESTER 1	Professional English - I	1.6	2.2	1.8	2.2	1.5	3	3	3	1.6	3	3	3	-	-	-
		Matrices and Calculus	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
		Engineering Physics	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-
		Engineering Chemistry	2.8	1.3	1.6	1	-	1.5	1.8	-		-	-	1.5	-	-	-
		Problem Solving and Python Programming	2	3	3	3	2	-	-	-	-	-	2	2	3	3	
		தமிழர் மரபு /Heritage of Tamils															
		Problem Solving and Python Programming Laboratory	2	3	3	3	2	-	-	-	-	-	2	2	3	3	
		Physics and Chemistry Laboratory	3	2.4	2.6	1	1										
			2.6	1.3	1.6	1	1	1.4	1.8	-	-	-	-	1.3	-	-	-
		English Laboratory$	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
	SEMESTER 2	Professional English - II	3	3	3	3	2.75	3	3	3	2.2	3	3	3	-	-	-
		Statistics and Numerical Methods	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
		Physics for Geoinformatics Engineering	3	1.8	2	1	1	1	1					1			
		Basic Electrical, Electronics and Instrumentation Engineering	2	1	1					1					-	-	-
		Geoinformatics Systems	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		Engineering Graphics	3	1	2		2					3		2	2	2	
		NCC Credit Course Level 1#															
		தமிழரும் தொழில்நுட்பமும் / Tamils and Technology															
		Engineering Practices Laboratory	3	2			1	1	1					2	2	1	1
		Basic Electrical, Electronics and Instrumentation Engineering Laboratory	1.6	1.4	0.8	1.6				1.2	1.6						
		Communication Laboratory / Foreign Language $	2.4	2.8	3	3	1.8	3	3	3	3	3	3	3	-	-	-

YEAR 2	SEMESTER 3	Transforms and Statistics	3	2	0	0	0	0	0	0	2	0	0	2			
		Spatial Database Management System	2	2	2	3	2			1			2	2	2	2	2
		Surveying	3	2	3	2	3	3	2	2	2		2	2	3	3	3
		Remote Sensing	3	2	2	2	3	3	2	2	2	2	2	1	3	3	3
		Photogrammetry	3	2	3	3	3	3	2	3	2	2	2	2	3	3	3
		Geodesy	3	3	3	3	2				2			2	3	3	2
		Surveying Laboratory I	3	2	3	3	3	3	3	3	3	3	3	1	3	3	3
		Remote sensing and Photogrammetry Laboratory	1	1	2	2	2	1	1	1	2	1	2	2	2	2	1
		Professional Development [$]															
	SEMESTER 4	Cartography and GIS	2	1	2	1	2	1							3	2	2
		Sensors and Data Products	2	2	2	2	2	2	2	2	2	2	2		3	3	3
		Total station and GPS Surveying	3	2	3	2	2	2			1			2	3	3	3
		Digital Image Processing	3	3	2	2	2	3	3	2	2	2	2	3	3	2	3
		Microwave Remote Sensing	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		Environmental Sciences and Sustainability	2.8	1.8	1	1	-	2.2	2.4	-	-	-	-	1.8	-	-	-
YEAR 3		NCC Credit course level 2[#]															
		Total Station and GPS Surveying Laboratory	3	2	3	2	3	2			2			2	3	3	3
		Cartography and GIS Laboratory	3	2	2	1	2	1			2	3	2		3	2	1
		Digital Image Processing Laboratory	3	3	3	3	3	2	2	2	2	2	3	3	3	2	2
	SEMESTER 5	Spatial analysis and Applications	2	3	2	3	2					1		2	2	2	2
		Mapping Toolboxes for Geomatics	3	2	2	3	3	3	1	1	3	2	2	3	3	3	
		Professional Elective I															
		Professional Elective II															
		Professional Elective III															
		Professional Elective IV															
		Mandatory course-I[&]															
		Mapping Toolboxes Laboratory	1	3	3	3	3	2	1	1	3	1	2	3	3	3	2

	SEMESTER 6	Geospatial Analysis with R programming	2	3	2	2		1				2	1	2	1	2	1
		Airborne and Terrestrial Laser Mapping	3	3	3	3	3	3					3	3	3	3	3
		Open Elective-I *															
		Professional Elective V															
		Professional Elective VI															
		Professional Elective VII															
		Mandatory course-I&															
		NCC Credit course level 3#															
		Spatial Analysis and Applications Laboratory	1	3	3	1	3		1		1	1	2	3	3	1	3
		Survey Camp (2 Weeks)	3	3	2	3	3	2	2	2	2	2	2	3	3	3	3
YEAR 4	**SEMESTER 7**	Spatial data adjustment	1	1	1	1	1	2			2	3		2	1	1	2
		Web GIS	3	2	2	3								3	2	2	2
		Human values and Ethics															
		Total Quality Management	2.5	3		3	2.6	3	2	3			3	2.5	2	3	
		Open Elective II*															
		Open Elective III*															
		Open Elective IV*															
		Customization laboratory	3	3	3	3	3	3	2		2	3		3	3	3	3
	SEMESTER 8	Project Work/Internship															

1 – Low; 2 – Medium; 3 – High; '- "– No correlation

PROFESSIONAL ELECTIVE COURSES: VERTICALS

S. No.	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	Terrestrial and close-range photogrammetry	3	3	3	3	2						3		3	3	3
2.	GPS Surveying	3	3	3	2	3	2						2	3	3	3
3.	Terrestrial and Bathymetric Laser Scanning	2	2	3	3	3						2	3	3	3	3
4.	Unmanned Aerial Vehicle (UAV) for large scale mapping	3	1	2	2	3	2					2		3	2	2
5.	Sub surface survey methods	3	2	3	3	3	2						2	3	2	3
6.	Cadastral Surveying	2	2	2	3	2	2	2	3	2	2	3	3	3	3	3
7.	Advanced surveying techniques	3	3	2	3	3	2			2			2	3	3	3
8.	GIS Customization & Scripting	2	2	3	2	3			1	2	1	1	2	2	3	2
9.	Open-source GIS	2	2	2	2	3	1	1	2	2	2		3	2	2	3
10.	Location Based GIS	3	2	2	2	3	2							3	2	2
11.	Enterprise GIS	2	2	2	2	3	2					1	2	3	2	3
12.	GIS based Utility and Asset Management	3	3	3	3	3						3	3	3	3	3
13.	Geo computing	3	3	3	3	3	3						3	3	3	3
14.	Geo spatial modelling and Simulation	2	3	3	3	2	3				2	2	3	3	3	3
15.	Soft computing techniques	3	2	2	2	3	3	2	2	2	2	2	3	3	3	3
16.	Thermal Hyperspectral & planetary Remote sensing	2	3	2	2	2	1	3		2			2	3	2	2
17.	Polarimetry and Interferometry	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
18.	AI / DL for image processing	3	3	3	2	3	2			2	2	2	3	3	3	2
19.	Pattern Recognition	3	3	2	3	3	2	2	2	2	2	2	3	3	3	2
20.	Raster data modelling	3	2	3	2	3	2	3	2	3	2	2		3	3	3
21.	SDG and Geomatics	3	2	2	2	3	3	3	2	2	2	2	2	3	3	3
22.	Environmental Geoinformatics	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
23.	Geomatics for urban infrastructure	3	2	3	2	3	3	3	1	2	2	2	3	3	2	2

24.	Geomatics for Hydrology and water resources	3	3	3	3	3								3	3	3
25.	Satellite Meteorology	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
26.	Geomatics for Disaster and risk mitigation	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
27.	Geomatics for agriculture and forest	2	2	3	2	2	2	2	2	2	1		2	3	2	2
28.	Geomatics for ocean and coastal applications	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
29.	Advanced Geodesy	3	3	2	2	1								3	2	2
30.	Satellite Geodesy	3	3	2	2	3								3	2	2
31.	Physical Geodesy	3	2	2	1	1	1			2				3	2	1
32.	Geodetic Interferometry	3	3	2	2	2		1		2			2	3	2	2
33.	Environmental Geodesy	2	2	2	3	2	1	2		1				2	2	2
34.	Geodetic Control Survey and Adjustment	3	3	2	2	2				2		1		3	3	2
35.	Geodetic Astronomy	3	2	2	2	2								2	2	2

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NON-AUTONOMOUS AFFILIATED COLLEGES
B.E. GEOINFORMATICS ENGINEERING
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3152	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3152	தமிழர் மரபு /Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9.	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10.	GE3172	English Laboratory$	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

$ Skill Based Course

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3252	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3203	Physics for Geoinformatics Engineering	BSC	3	0	0	3	3
4.	BE3252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	3	3
5.	GI3201	Geoinformatics Systems	PCC	3	0	0	3	3
6.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
7.		NCC Credit Course Level 1#	-	2	0	0	2	2#
8.	GE3252	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	1	1
PRACTICALS								
9.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
10.	BE3272	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	0	0	4	4	2
11.	GE3272	Communication Laboratory / Foreign Language $	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**16**	**34**	**26**

 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA
$ Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3302	Transforms and Statistics	BSC	3	1	0	4	4
2.	GI3301	Spatial Database Management system	PCC	3	0	0	3	3
3.	GI3302	Surveying	PCC	3	0	0	3	3
4.	GI3303	Remote Sensing	PCC	3	0	0	3	3
5.	GI3304	Geodesy	PCC	3	0	0	3	3
6.	GI3391	Photogrammetry	PCC	3	0	0	3	3
PRACTICALS								
8.	GI3311	Surveying Laboratory I	PCC	0	0	4	4	2
9.	GI3312	Remote Sensing and Photogrammetry Laboratory	PCC	0	0	2	2	1
10.	GE3361	Professional Development $	EEC	0	0	2	2	1
			TOTAL	**18**	**1**	**8**	**27**	**23**

$ Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	GI3401	Sensors and Data products	PCC	3	0	0	3	3
2.	GI3402	Digital Image Processing	PCC	3	0	0	3	3
3.	GI3403	Microwave Remote Sensing	PCC	3	0	0	3	3
4.	GI3491	Cartography and GIS	PCC	3	0	0	3	3
5.	GI3492	Total Station and GPS Surveying	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit course level 2#		3	0	0	3	3#
PRACTICALS								
8.	GI3411	Total Station and GPS Surveying Laboratory	PCC	0	0	4	4	2
9.	GI3412	Cartography and GIS Laboratory	PCC	0	0	2	2	1
10.	GI3413	Digital Image Processing Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**0**	**10**	**27**	**22**

 # NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	GI3501	Spatial Analysis and Applications	PCC	3	0	0	3	3
2.	GI3502	Mapping toolboxes for Geomatics	PCC	3	0	0	3	3
3.		Professional Elective I	PEC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Professional Elective IV	PEC	3	0	0	3	3
7.		Mandatory course-I[&]	MC	3	0	0	3	Non-credit course
PRACTICALS								
9.	GI3511	Mapping toolboxes Laboratory	PCC	0	0	2	2	1
			TOTAL	**21**	**0**	**6**	**27**	**19**

[&] Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	GI3601	Geospatial analysis with R programming	PCC	2	0	2	4	3
2.	GI3691	Airborne and Terrestrial Laser Mapping	PCC	3	0	0	3	3
3.		Open elective-I*	OEC	3	0	0	3	3
4.		Professional Elective V	PEC	3	0	0	3	3
5.		Professional Elective VI	PEC	3	0	0	3	3
6.		Professional Elective VII	PEC	3	0	0	3	3
7.		Mandatory course-II[&]	MC	3	0	0	3	Non-credit course
		NCC Credit course level 3[#]	-	3	0	0	3	3[#]
PRACTICALS								
8.	GI3611	Spatial Analysis and Applications Laboratory	PCC	0	0	4	4	2
9.	GI3612	Survey Camp (2 Weeks)	EEC	-	-	-	-	1
			TOTAL	**20**	**0**	**6**	**26**	**21**

***Open Elective – I shall be chosen from the emerging technologies**

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC-II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER VII/VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	GI3701	Spatial data adjustment	PCC	3	0	0	3	3
2.	GI3702	Web GIS	PCC	3	0	0	3	3
3.	GE3791	Human Values and Ethics	HSMC	2	0	0	2	2
4.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
5.		Open Elective II**	OEC	3	0	0	3	3
6.		Open Elective III***	OEC	3	0	0	3	3
7.		Open Elective IV***	OEC	3	0	0	3	3
PRACTICALS								
8.	GI3711	Customization laboratory	PCC	0	0	2	2	1
			TOTAL	**20**	**0**	**2**	**22**	**21**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VII**
****Open Elective – II shall be chosen from the emerging technologies**
*****Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes**

SEMESTER VIII/VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	GI3811	Project Work/Internship	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII**

TOTAL NO. OF CREDITS: 164

MANDATORY COURSES I*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS
				L	T	P	
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3
2.	MX3082	Elements of Literature	MC	3	0	0	3
3.	MX3083	Film Appreciation	MC	3	0	0	3
4.	MX3084	Disaster Risk Reduction and Management	MC	3	0	0	3

***Mandatory Courses are offered as Non-Credit Courses**

MANDATORY COURSES II*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS
				L	T	P	
1.	MX3085	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	0	0	3
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3
5.	MX3089	Industrial Safety	MC	3	0	0	3

***Mandatory Courses are offered as Non-Credit Courses**

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I (Surveying & Mapping)	VERTICALII (Geospatial Data Analytics)	VERTICAL III (Image Processing and Analysis)	VERTICAL IV (Geo Spatial Applications)	VERTICAL V (Geodesy)
Terrestrial and Close Range Photogrammetry	GIS Customization and Scripting	Soft Computing Techniques	Environmental Geoinformatics	Advanced Geodesy
GPS Surveying	Open Source GIS	Thermal, Hyperspectral and Planetary Remote Sensing	Geomatics for Urban Infrastructure	Satellite Geodesy
Terrestrial and Bathymetric Laser Scanning	Location Based GIS	Polarimetry and Interferometry	Geomatics for Hydrology and Water Resources	Physical Geodesy
Unmanned Aerial Vehicle (UAV) for Large Scale MAPPING	Enterprise GIS	AI / DL for image Processing	Satellite Meteorology	Geodetic Interferometry
Sub surface Survey Methods	GIS based Utility and Asset Management	Pattern Recognition (Satellite, Aerial, UAV)	Geomatics for Disaster and Risk Mitigation	Environmental Geodesy
Cadastral Surveying	Geo Computing	Raster Data Modelling	Geomatics for Agriculture and Forestry	Geodetic Control Survey and Adjustment
Advanced Surveying Techniques	Geo Spatial Modelling and Simulation	SDG and Geomatics	Geomatics for ocean and Coastal Applications	Geodetic Astronomy

Registration of Professional Elective Courses from Verticals:

Refer to the Regulations 2021, Clause 6.3. (Amended on 27.07.2023)

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL I: SURVEYING & MAPPING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI3001	Terrestrial and Close Range Photogrammetry	PEC	3	0	0	3	3
2.	GI3002	GPS Surveying	PEC	3	0	0	3	3
3.	GI3003	Terrestrial and Bathymetric Laser Scanning	PEC	3	0	0	3	3
4.	GI3004	Unmanned Aerial Vehicle (UAV) for Large Scale Mapping	PEC	3	0	0	3	3
5.	GI3005	Subsurface Survey Methods	PEC	3	0	0	3	3
6.	GI3006	Cadastral Surveying	PEC	3	0	0	3	3
7.	GI3007	Advanced Surveying Techniques (Mining, Hydrology, Route, Astronomy)	PEC	3	0	0	3	3

VERTICAL II: GEOSPATIAL DATA ANALYTICS

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI3008	GIS Customization and Scripting	PEC	3	0	0	3	3
2.	GI3009	Open Source GIS	PEC	3	0	0	3	3
3.	GI3010	Location Based Services	PEC	3	0	0	3	3
4.	GI3011	Enterprise GIS (API, rest soap SOA, SAS, OGC, Web services)	PEC	3	0	0	3	3
5.	GI3012	GIS based Utility and Asset Management	PEC	3	0	0	3	3
6.	GI3013	Geo Computing	PEC	3	0	0	3	3
7.	GI3014	Geospatial Modelling and Simulation	PEC	3	0	0	3	3

VERTICAL III: IMAGE PROCESSING AND ANALYSIS

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI3015	Soft Computing Techniques	PEC	3	0	0	3	3
2.	GI3016	Thermal Hyperspectral and Planetary Remote Sensing	PEC	3	0	0	3	3
3.	GI3017	Polarimetry and Interferometry	PEC	3	0	0	3	3
4.	GI3018	AI / DL for image Processing	PEC	3	0	0	3	3
5.	GI3019	Pattern Recognition (Satellite, Aerial, UAV)	PEC	3	0	0	3	3
6.	GI3020	Raster Data Modelling	PEC	3	0	0	3	3
7.	GI3021	SDG and Geomatics	PEC	3	0	0	3	3

VERTICAL IV: GEO SPATIAL APPLICATIONS

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI3022	Environmental Geoinformatics	PEC	3	0	0	3	3
2.	GI3023	Geomatics for Urban Infrastructure	PEC	3	0	0	3	3
3.	GI3024	Geomatics for Hydrology and Water Resources	PEC	3	0	0	3	3
4.	GI3025	Satellite Meteorology	PEC	3	0	0	3	3
5.	GI3026	Geomatics for Disaster and Risk Mitigation	PEC	3	0	0	3	3
6.	GI3027	Geomatics for Agriculture and Forestry	PEC	3	0	0	3	3
7.	GI3028	Geomatics for Ocean and Coastal Applications	PEC	3	0	0	3	3

VERTICAL V:GEODESY

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI3029	Advanced Geodesy	PEC	3	0	0	3	3
2.	GI3030	Satellite Geodesy	PEC	3	0	0	3	3
3.	GI3031	Physical Geodesy	PEC	3	0	0	3	3
4.	GI3032	Geodetic Interferometry	PEC	3	0	0	3	3
5.	GI3033	Environmental Geodesy	PEC	3	0	0	3	3
6.	GI3034	Geodetic Control Survey and Adjustment	PEC	3	0	0	3	3
7.	GI3035	Geodetic Astronomy	PEC	3	0	0	3	3

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories)

OPEN ELECTIVE I AND II
(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	CCS333	Augmented Reality /Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
3.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
4.	CME365	Renewable Energy Technologies	OEC	3	0	0	3	3
5.	OME354	Applied Design Thinking	OEC	3	0	0	3	3
6.	MF3003	Reverse Engineering	OEC	3	0	0	3	3
7.	OPR351	Sustainable Manufacturing	OEC	3	0	0	3	3
8.	AU3791	Electric and Hybrid Vehicles	OEC	3	0	0	3	3
9.	OAS352	Space Engineering	OEC	3	0	0	3	3
10.	OIM351	Industrial Management	OEC	3	0	0	3	3
11.	OIE354	Quality Engineering	OEC	3	0	0	3	3
12.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
13.	OML351	Introduction to Non-Destructive Testing	OEC	3	0	0	3	3
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
17.	OCE353	Lean Concepts, Tools and Practices	OEC	3	0	0	3	3
18.	OAI351	Urban Agriculture	OEC	3	0	0	3	3

19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle Technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OCH351	Nano Technology	OEC	3	0	0	3	3
23.	OCH352	Functional Materials	OEC	3	0	0	3	3
24.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
25.	OFD353	Introduction to Food Processing	OEC	3	0	0	3	3
26.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
27.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
28.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
29.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
30.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
31.	CPE334	Energy Conservation and Management	OEC	3	0	0	3	3
32.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
33.	OEC351	Signals and Systems	OEC	3	0	0	3	3
34.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
35.	CBM348	Foundation Skills in Integrated Product Development	OEC	3	0	0	3	3
36.	CBM333	Assistive Technology	OEC	3	0	0	3	3
37.	OMA352	Operations Research	OEC	3	0	0	3	3
38.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
39.	OMA354	Linear Algebra	OEC	3	0	0	3	3
40.	OBT352	Basics of Microbial Technology	OEC	3	0	0	3	3
41.	OBT353	Basics of Biomolecules	OEC	3	0	0	3	3
42.	OBT354	Fundamentals of Cell and Molecular Biology	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
3.	OMA356	Random Processes	OEC	3	0	0	3	3

4.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
5.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
6.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
7.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
8.	CME343	New Product Development	OEC	3	0	0	3	3
9.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	3	0	0	3	3
10.	MF3010	Micro and Precision Engineering	OEC	3	0	0	3	3
11.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
12.	AU3002	Batteries and Management System	OEC	3	0	0	3	3
13.	AU3008	Sensors and Actuators	OEC	3	0	0	3	3
14.	OAS353	Space Vehicles	OEC	3	0	0	3	3
15.	OIM352	Management Science	OEC	3	0	0	3	3
16.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
17.	OIE353	Operations Management	OEC	3	0	0	3	3
18.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
19.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
20.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
21.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
22.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
23.	OMR353	Sensors	OEC	3	0	0	3	3
24.	ORA352	Concepts in Mobile Robots	OEC	3	0	0	3	3
25.	MV3501	Marine Propulsion	OEC	3	0	0	3	3
26.	OMV351	Marine Merchant Vessels	OEC	3	0	0	3	3
27.	OMV352	Elements of Marine Engineering	OEC	3	0	0	3	3
28.	CRA332	Drone Technologies	OEC	3	0	0	3	3
29.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
30.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
31.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3

32.	OEE353	Introduction to Control Systems	OEC	3	0	0	3	3
33.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
34.	OCH353	Energy Technology	OEC	3	0	0	3	3
35.	OCH354	Surface Science	OEC	3	0	0	3	3
36.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
37.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
38.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
39.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
40.	FT3201	Fibre Science	OEC	3	0	0	3	3
41.	OTT355	Garment Manufacturing Technology	OEC	3	0	0	3	3
42.	OPE353	Industrial Safety	OEC	3	0	0	3	3
43.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
44.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
45.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
46.	OEC353	VLSI Design	OEC	3	0	0	3	3
47.	CBM370	Wearable Devices	OEC	3	0	0	3	3
48.	CBM356	Medical Informatics	OEC	3	0	0	3	3
49.	OBT355	Biotechnology for Waste Management	OEC	3	0	0	3	3
50.	OBT356	Lifestyle Diseases	OEC	3	0	0	3	3
51.	OBT357	Biotechnology in Health Care	OEC	3	0	0	3	3

SUMMARY

S.No.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII/VIII	VIII/VII	
1.	**HSMC**	4	3					5		**12**
2.	**BSC**	12	7	4	2					**25**
3.	**ESC**	5	11							**16**
4.	**PCC**		3	18	20	7	8	7		**63**
5.	**PEC**					12	9			**21**
6.	**OEC**						3	9		**12**
7.	**EEC**	1	2	1			1		10	**15**
	Total	**22**	**26**	**23**	**22**	**19**	**21**	**21**	**10**	**164**
8.	Mandatory Course (Non Credit)					✓	✓			

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 (Amendments) of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In addition to all the verticals of other programmes)

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2.	CMG338	Team Building and Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity and Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL 3: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL 4: BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics for Management	PEC	3	0	0	3	3
2.	CMG350	Datamining for Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation and Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

IP3151 **INDUCTION PROGRAMME**

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

“Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.”

“One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. “

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and
also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.
Discussions would be conducted in small groups of about 20 students with a faculty
mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References:

Guide to Induction program from AICTE

HS3152	**PROFESSIONAL ENGLISH I**	**L T P C** **3 0 0 3**

COURSE OBJECTIVES:

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 9

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9

Reading – Newspaper articles; Journal reports –and Non Verbal Communication (tables, pie charts etc,). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart , graph etc, to verbal mode)
Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT V EXPRESSION 9

Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.

TOTAL : 45 PERIODS

LEARNING OUTCOMES :

At the end of the course, learners will be able

CO1: To use appropriate words in a professional context
CO2: To gain understanding of basic grammatical structures and use them in right context.
CO3: To read and infer the denotative and connotative meanings of technical texts
CO4: To read and interpret information presented in tables, charts and other graphic forms
CO5: To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS :

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.
   Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1. Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
2	1	1	1	1	1	3	3	3	1	3	-	3	-	-	-
3	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
4	2	3	2	3	2	3	3	3	2	3	3	3	-	-	-
5	2	3	3	3	-	3	3	3	2	3	-	3	-	-	-
AVg.	**1.6**	**2.2**	**1.8**	**2.2**	**1.5**	**3**	**3**	**3**	**1.6**	**3**	**3**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

MA3151 MATRICES AND CALCULUS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES::

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications : Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS 9+3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 9+3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications : Hydrostatic force and pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS 9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications : Moments and centres of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

At the end of the course the students will be able to

CO1 Use the matrix algebra methods for solving practical problems.

CO2 Apply differential calculus tools in solving various application problems.

CO3 Able to use differential calculus ideas on several variable functions.

CO4 Apply different methods of integration in solving practical problems.

CO5 Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS :

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2018.
3. James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :

1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2. Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
4. Narayanan. S. and Manicavachagom Pillai. T. K.,“Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Srimantha Pal and Bhunia. S.C, " Engineering Mathematics " Oxford University Press, 2015.
7. Thomas. G. B., Hass. J, and Weir. M.D, " Thomas Calculus ", 14th Edition, Pearson India, 2018.

CO's-PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO2	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO3	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO4	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
CO5	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
Avg	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-

PH3151 ENGINEERING PHYSICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS 9

Multiparticle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 Understand the importance of mechanics.

CO2 Express their knowledge in electromagnetic waves.

CO3 Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4 Understand the importance of quantum physics.

CO5 Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

CO's-PO's & PSO's MAPPING

CO's	**PO's**												**PSO's**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
2	3	3	2	1	2	1	-	-	-	-	-	-	-	-	-
3	3	3	2	2	2	1	-	-	-	-	-	1	-	-	-
4	3	3	1	1	2	1	-	-	-	-	-	-	-	-	
5	3	3	1	1	2	1	-	-	-	-	-	-	-	-	-
AVG	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-

1-Low,2-Medium,3-High,"-"-no correlation

Note: the average value of this course to be used for program articulation matrix.

CY3151 ENGINEERING CHEMISTRY L T P C

3 0 0 3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, **Water quality parameters:** Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination)**. Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; **Constitution**: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites** - definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.**

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus: mass defect (problems), binding energy;Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells**; Recent developments in solar cell materials. Wind energy; Geothermal energy;Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able:

CO1 To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2 To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3 To apply the knowledge of phase rule and composites for material selection requirements.

CO4 To recommend suitable fuels for engineering processes and applications.

CO5 To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, “Engineering Chemistry”, 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, “A text book of Engineering Chemistry”, S. Chand Publishing, 12th Edition, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
2	2	-	-	1	-	2	2	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
5	3	1	2	1	-	2	2	-	-	-	-	2	-	-	-
Avg.	**2.8**	**1.3**	**1.6**	**1**	**-**	**1.5**	**1.8**	**-**		**-**	**-**	**1.5**	-	-	-

- 1-low, 2-medium, 3-high, ‘-“- no correlation

GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs using conditionals and looping for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, “Think Python : How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and programming”, 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill,2018.

COs- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	2	-	-	2	-	-	-	-	-	1	-	2	-	-
AVg	2	3	3	3	2	-	-	-	-	-	2	2	3	3	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

GE3152 தமிழர் மரபு L T P C

1 0 0 1

அலகு I மொழி மற்றும் இலக்கியம்: 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE3152 HERITAGE OF TAMILS L T P C
1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)

9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems..
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, "Think Python : How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

COs- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3	-	-	-	-	-	3	2	3	3	-
2	3	3	3	3	3	-	-	-	-	-	3	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	3	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	-	-	-	2	-	-	-	-	-	1	-	2	-	-
AVg.	**2**	**3**	**3**	**3**	**2**	-	-	-	-	-	**2**	**2**	**3**	**3**	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

BS3171 **PHYSICS AND CHEMISTRY LABORATORY** **L T P C**
0 0 4 2

PHYSICS LABORATORY (Any Seven Experiments)

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

CO1 Understand the functioning of various physics laboratory equipment.
CO2 Use graphical models to analyze laboratory data.
CO3 Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4 Access, process and analyze scientific information.
CO5 Solve problems individually and collaboratively.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-
AVG	3	2.4	2.6	1	1										

- **1-Low,2-Medium,3-High,"-"-no correlation**
- **Note: the average value of this course to be used for program articulation matrix.**

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL : 30 PERIODS

COURSE OUTCOMES :

CO1 To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.

CO2 To determine the amount of metal ions through volumetric and spectroscopic techniques

CO3 To analyse and determine the composition of alloys.

CO4 To learn simple method of synthesis of nanoparticles

CO5 To quantitatively analyse the impurities in solution by electroanalytical techniques''

TEXT BOOKS :

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
2	3	1	2	-	-	1	2	-	-	-	-	1	-	-	-
3	3	2	1	1	-	-	1	-	-	-	-	-	-	-	-
4	2	1	2	-	-	2	2	-	-	-	-	-	-	-	-
5	2	1	2	-	1	2	2	-	-	-	-	1	-	-	-
Avg.	**2.6**	**1.3**	**1.6**	**1**	**1**	**1.4**	**1.8**	**-**	**-**	**-**	**-**	**1.3**	-	-	-

- **1-low, 2-medium, 3-high, '-"- no correlation**

GE3172 ENGLISH LABORATORY L T P C
0 0 2 1

COURSE OBJECTIVES

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions (filling out a bank application for example).

UNIT II NARRATION AND SUMMATION 6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V EXPRESSION 6

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website-describing processes

TOTAL : 30 PERIODS

LEARNING OUTCOMES:

At the end of the course, learners will be able

CO1 To listen to and comprehend general as well as complex academic information
CO2 To listen to and understand different points of view in a discussion
CO3 To speak fluently and accurately in formal and informal communicative contexts
CO4 To describe products and processes and explain their uses and purposes clearly and accurately
CO5 To express their opinions effectively in both formal and informal discussions

ASSESSMENT PATTERN

- One online / app based assessment to test listening /speaking
- End Semester **ONLY** listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
AVg.	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

HS3252 PROFESSIONAL ENGLISH II **L T P C**
2 0 0 2

COURSE OBJECTIVES:

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT I MAKING COMPARISONS 6

Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 6

Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III PROBLEM SOLVING 6

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

UNIT IV REPORTING OF EVENTS AND RESEARCH 6

Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions

UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 6

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

TOTAL : 30 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able
CO1 To compare and contrast products and ideas in technical texts.
CO2 To identify and report cause and effects in events, industrial processes through technical texts
CO3 To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
CO4 To present their ideas and opinions in a planned and logical manner
CO5 To draft effective resumes in the context of job search.

TEXT BOOKS :
1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:
1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
2	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	2	3	3	3	-	-	-
4	3	3	3	3	2	3	3	3	2	3	3	3	-	-	-
5	-	-	-	-	-	-	-	-	3	3	3	3	-	-	-
AVg.	3	3	3	3	2.75	3	3	3	2.2	3	3	3	-	-	-

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

MA3251 STATISTICS AND NUMERICAL METHODS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:
- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.

- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9+3

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students will be able to:

CO1 Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO2 Apply the basic concepts of classifications of design of experiments in the field of agriculture.
CO3 Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO4 Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5 Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.

4. Gupta S.C. and Kapoor V. K., " Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

CO's-PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO2	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO3	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO4	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
CO5	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
Avg	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-

PH3203 PHYSICS FOR GEO - INFORMATICS ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of electromagnetic radiation, measurement of radiation and physical laws.
- To introduce the concepts of atmosphere and scattering principles. To understand the interaction of EMR with atmosphere and to introduce the concept of imaging and non-imaging sensors for atmospheric probing.
- To gain knowledge about basic optical principles in remote sensing and to introduce the concept of photography and its development.
- To understand the basics of gravitation and the physics behind it, and to introduce satellites and its effectiveness in earth monitoring.
- To understand the different types of electro-optic sensors and its detection mechanism

UNIT I ELECTROMAGNETIC RADIATION 9

Electromagnetic Spectrum - radiation quantities - spectral quantities - relationship between luminous and radiant quantities - hemispherical reflectance, transmittance and absorbance, measurement of electromagnetic radiation - responsivity - normalization, radiating structures - thermal emission - fluorescent emission - Radiation principles - Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law.

UNIT II INTERACTION OF EMR WITH ATMOSPHERE AND EARTH'S SURFACE 9

Introduction to atmosphere, atmospheric composition, atmospheric scattering, Raleigh scattering, Mie scattering, non-selective scattering -atmospheric absorption - atmospheric windows, refraction - interaction of EMR earth's surface - reflection - transmission - spectral signature - Reflectance characteristics of Earth's cover type: Vegetation, water, soil - Interaction of microwave with atmosphere and Earth's surface – Radar - Radar operating principle - radar equation - Side Looking Airborne Radar - Definitions: Incidence angle, look angle, depression angle, Azimuth angle – Spatial resolution in radar - Synthetic Aperture radar.

UNIT III OPTICS FOR REMOTE SENSING 9

Lenses, mirrors, prisms - Defects of lens - chromatic aberration - longitudinal chromatic aberration - achromatism of lenses - achromatism for two lenses in contact - separated by a distance - spherical aberration - minimization of Spherical aberration - coma astigmatism - Radiative Transfer Functions, Lamella Pack, Volume scattering - Principles of photography: black and white photography - sensitivity - speed - characteristic curve - developing and printing - basic colour photography - construction of colour films - film type - types of filter - and its uses.

UNIT IV GRAVITATION AND SATELLITES 9

Newton‘s law of gravitation - Gravitational field and potential - Determination of gravity, variation of acceleration due to gravity of the earth with depth and with altitude - Variation of acceleration due to gravity due to rotation of the earth – Refraction. Diffraction - Fresnel theory, Circular diffraction, Polarisation double refraction - Escape velocity - Kepler‘s law of planetary motion - Doppler effect – Satellites andits functions - Types of satellites –Indian satellites and their functions – contribution in earth observation, communication, navigation, weather, military and scientific purpose.

UNIT V ELECTRO - OPTIC SENSORS 9

Photomultipliers, photo resistors, photodiodes, nonselective detectors - Optical receivers, PIN and APD, optical preamplifiers, Detectors: Basic detector mechanisms, noise in detectors. Thermal and photo emissive detectors, Photoconductive and photovoltaic detectors, performance limits, Photographic, - Sensitivity, time and frequency response - hybrid photo detectors - Imaging detectors - eye and vision, photographic film. Camera tubes, solid-state arrays, video, Detector electronics, detector interfacing - Different CCD cameras.Orbital Mechanics, Concept of orbits- propulsion, aero dynamics, navigation guidance and control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 The students will gain knowledge about electromagnetic radiation and its principles.

CO2 The students will be able to understand the physics of atmosphere and the use of imaging and non-imaging sensor in atmospheric probing.

CO3 The students will gain knowledge about remote sensing and photography.

CO4 The students will be encouraged to learn the development of satellite technology in geo-informatics.

CO5 The students will gain knowledge about different electro optic sensors.

TEXT BOOKS:

1. T.M.Lillesand, R.W.Kiefer and J.W.Chipman. Remote Sensing and Image Interpretation. Wiley, 2011.
2. Manual of Remote Sensing. American Society of Photogrammetry, 2016.
3. M.Anij Reddy. Textbook of Remote Sensing and Geographical Information systems. BS Publications, 2012.

REFERENCES:

1. D.G.Andrews. An Introduction to Atmospheric Physics. Cambridge University Press, 2010.
2. Murry L. Salby, Physics of the Atmosphere and Climate, Cambridge Univ. Press, 2012.
3. F.G.Smith,T.A.King and D.Wilkins. Optics and Photonics: An Introduction. Wiley-Blackwell , 2007.
4. Hengnian Li, Geostationary Satellites Collocation, Springer, 2014.
5. Silvano Donati, Electro-optical Instrumentation: Sensing and measuring with Lasers, Prentice Hall, 2004.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	1	1	-	-	-	-	-	-	-	-	-
2	3	2	2	1	1	1	1	-	-	-	-	-	-	-	-
3	3	2	2	1	1	1	1	-	-	-	-	-	-	-	-
4	3	1	2	1	1	1	1	-	-	-	-	-	-	-	-
5	3	2	2	1	1	1	-	-	-	-	-	1	-	-	-
AVG	3	1.8	2	1	1	1	1					1			

1-Low,2-Medium,3-High,"-"-no correlation

Note: the average value of this course to be used for program articulation matrix.

BE3252 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING **L T P C 3 0 0 3**

COURSE OBJECTIVES :

- To introduce the basics of electric circuits and analysis
- To impart knowledge in domestic wiring
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To introduce the functional elements and working of sensors and transducers.

UNIT I ELECTRICAL CIRCUITS 9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Three phase supply – star and delta connection – power in three-phase systems

UNIT II MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS 9

Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems.

Domestic wiring , types of wires and cables, earthing ,protective devices- switch fuse unit- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

UNIT III ELECTRICAL MACHINES 9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT IV ANALOG ELECTRONICS 9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters, harmonics

UNIT V SENSORS AND TRANSDUCERS 9

Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors,Strain gauge, LVDT, differential pressure transducer,optical and digital transducers, Smart sensors, Thermal Imagers.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

After completing this course, the students will be able to

CO1: Compute the electric circuit parameters for simple problems
CO2: Explain the concepts of domestics wiring and protective devices
CO3: Explain the working principle and applications of electrical machines
CO4: Analyze the characteristics of analog electronic devices
CO5: Explain the types and operating principles of sensors and transducers

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020

2. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4. James A Svoboda, Richard C. Dorf, Dorf's Introduction to Electric Circuits, Wiley,2018

REFERENCES:

1. John Bird, "Electrical Circuit theory and technology", Routledge; 2017.
2. Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
3. Albert Malvino, David Bates, '**Electronic Principles**, McGraw Hill Education; 7th edition, 2017
4. Muhammad H.Rashid, "Spice for Circuits and electronics", 4th Edition., Cengage India,2019.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

CO's, PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1					1					-	-	-
2	2	1	1					1					-	-	-
3	2	1	1					1					-	-	-
4	2	1	1					1					-	-	-
5	2	1	1					1					-	-	-
Avg.	2	1	1					1					-	-	-

GI3201 GEOINFORMATICS SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the information concepts and systems used in Geoinformatics
- To familiarize the role of Internet and Networks in Geoinformatics.
- To familiarize web data services and geoinformation

UNIT I COMPUTER SYSTEMS 9

Computers - types - components - CPU - memory - Input devices-Output devices - Operating Systems: Windows, Linux–fundamentals - software - system software, application software - file operations.

UNIT II DATA ACQUISITION 9

Acquisition and storage of Numeric data- Textual data - image data - Audio data - Animation and Video data - Data formats - fundamentals of image and video compression - introduction to geospatial data- remote sensing sensors, data organization

UNIT III NETWORKS AND COMMUNICATION 9

Fundamental computer network concepts - Network layers - TCP/IP model - LAN, WAN, WLAN, intranet, Internet - Applications - Essentials of internet - Ethernet - Network Routing - Switching - Data transportation through Network - protocols - Cell phone working fundamentals - Cell phone frequencies & channels - Digital cell phone components - Cell phone network technologies / architecture.

UNIT IV WEB DATA AND SERVICES 9

Browser fundamentals - Client - Server - Architecture - web site essentials - Web development - Platforms - Tools - Languages - HTML PHP - client side scripting - javascript - database - Postgresql - MySQL - Web server - Application Server - Data server - Data services - Big data - cloud storage

UNIT V GEOINFORMATION **9**

Information System - GIS - GPS - Information retrieval system - Geo-database - interactive applications - Multimedia applications - Earth resource platform - Google maps and Google earth - LBS - Introduction to Integration of Geo-database and Social networking applications

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1 Understand Computer systems and data formats

CO2 Understand basics of Geoinformation

CO3 Understand the role of network systems that handles Geoinformation.

CO4 Understand data and technologies related to Geoinformation .

TEXT BOOKS:

1. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'Reilly, 2014.
2. James F. Kurose, "Computer Networking: A Top-Down Approach" Sixth Edition, Pearson, 2012.

REFERENCES:

1. Gottapu Sasibhushana Rao, "Mobile Cellular Communication", Pearson, 2012.
2. Peter Norton, "Introduction to Computers" Sixth edition, Tata McGraw – Hill, 2008.
3. R. Kelly Rainer, Casey G. Cegielski, Brad Prince, "Introduction to Information Systems", Fifth Edition, Wiley Publication, 2014.

CO's-PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3		3	2	3
PO2	Problem Analysis			3	2	3	3
PO3	Design/Development of Solutions			3	3	3	3
PO4	Conduct Investigations of Complex Problems			3	3	3	3
PO5	Modern Tool Usage	2		3	3	3	3
PO6	The Engineer and Society			2	3	3	3
PO 7	Environment and Sustainability			2		3	3
PO 8	Ethics	3		3		3	3
PO 9	Individual and Team Work			3	3	3	3
PO 10	Communication	2	3	3	2	3	3
PO 11	Project Management and Finance	3	2	3	3	3	3
PO 12	Life-long Learning	2		3	2	3	3
PSO 1	Knowledge of Geoinformatics discipline		3	2	2	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations		2	2	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

GE3251 ENGINEERING GRAPHICS

L	T	P	C
2	0	4	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale —Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL: (L=30+P=60) 90 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 Use BIS conventions and specifications for engineering drawing.
CO2 Construct the conic curves, involutes and cycloid.
CO3 Solve practical problems involving projection of lines.
CO4 Draw the orthographic, isometric and perspective projections of simple solids.
CO5 Draw the development of simple solids.

TEXT BOOKS:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2. Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

REFERENCES:

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.
6. Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 — 2001: Technical products Documentation — Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2		2					3		2	2	2	
2	3	1	2		2					3		2	2	2	
3	3	1	2		2					3		2	2	2	
4	3	1	2		2					3		2	2	2	
5	3	1	2		2					3		2	2	2	
Avg	**3**	**1**	**2**		**2**					**3**		**2**	**2**	**2**	
Low (1) ; Medium (2) ; High (3)															

NCC Credit Course Level 1*

		L	T	P	C
NX3251	**(ARMY WING) NCC Credit Course Level - I**	**2**	**0**	**0**	**2**

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

NATIONAL INTEGRATION AND AWARENESS		4
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour ' Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL: 30 PERIODS

NCC Credit Course Level 1*

NX3252	(NAVAL WING) NCC Credit Course Level - I	L	T	P	C
		2	0	0	2

NCC GENERAL		6
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT **8**

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

NCC Credit Course Level 1*

NX3253	(AIR FORCE WING) NCC Credit Course Level - I	L	T	P	C
		2	0	0	2

NCC GENERAL **6**

NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

NATIONAL INTEGRATION AND AWARENESS **4**

NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1

PERSONALITY DEVELOPMENT **7**

PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2

LEADERSHIP **5**

L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT **8**

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

GE3252	தமிழரும் தொழில்நுட்பமும்	L T P C
		1 0 0 1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: **3**

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: **3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்: **3**

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: **3**

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: **3**

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE3252 TAMILS AND TECHNOLOGY L T P C
1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE3271 ENGINEERING PRACTICES LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in commonhousehold wood work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES **15**

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers,elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used inhousehold appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES **15**

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an airconditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an elements of smart phone..
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2 Wire various electrical joints in common household electrical wire work.

CO3 Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.

CO4 Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2			1	1	1					2	2	1	1
2	3	2			1	1	1					2	2	1	1
3	3	2			1	1	1					2	2	1	1
Avg	**3**	**2**			**1**	**1**	**1**					**2**	**2**	**1**	**1**
Low (1) ; Medium (2) ; High (3)															

BE3272 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES:

- To train the students in conducting load tests electrical machines
- To gain practical experience in experimentally obtaining the characteristics of electronic devices and rectifiers
- To train the students to measure three phase power and displacement

List of Experiments

1. Verification of ohms and Kirchhoff's Laws.
2. Three Phase Power Measurement
3. Load test on DC Shunt Motor.
4. Load test on Self Excited DC Generator
5. Load test on Single phase Transformer
6. Load Test on Induction Motor
7. Characteristics of PN and Zener Diodes
8. Characteristics of BJT, SCR and MOSFET
9. Design and analysis of Half wave and Full Wave rectifiers
10. Measurement of displacement of LVDT

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1: Use experimental methods to verify the Ohm's law and Kirchhoff's Law and to measure three phase power

CO2: Analyze experimentally the load characteristics of electrical machines

CO3: Analyze the characteristics of basic electronic devices

CO4: Use LVDT to measure displacement

CO's, PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	1	2				1.5	2				-	-	-
2	2	3	1	2				1.5	2				-	-	-
3	2	3	1	2				1.5	2				-	-	-
4	2	3	1	2				1.5	2				-	-	-
Avg.	1.6	1.4	0.8	1.6				1.2	1.6						

GE3272 COMMUNICATION LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT I **12**

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life- discussing past events-Writing: writing emails (formal & semi-formal).

UNIT II **12**

Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.

UNIT III **12**

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

UNIT IV **12**

Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules-(example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.

UNIT V **12**

Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing:
job application(Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES

At the end of the course, learners will be able

CO1 Speak effectively in group discussions held in ~~a~~ formal/semi formal contexts.

CO2 Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions

CO3 Write emails, letters and effective job applications.

CO4 Write critical reports to convey data and information with clarity and precision

CO5 Give appropriate instructions and recommendations for safe execution of tasks

Assessment Pattern

- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

CO's, PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
2	2	3	3	3	1	3	3	3	3	3	3	3	-	-	-
3	2	2	3	3	1	3	3	3	3	3	3	3	-	-	-
4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
AVg.	**2.4**	**2.8**	**3**	**3**	**1.8**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

MA3302 **TRANSFORMS AND STATISTICS** **L T P C**
3 1 0 4

COURSE OBJECTIVES

- To acquaint the student with Fourier Series techniques used in wide variety of situations in which the functions used are not periodic and to solve boundary value problems.
- To understand the Fourier transform techniques to solve boundary value problems.
- To introduce the concept of Probability and random variables in Statistics which is central to many geometric applications.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.

UNIT I FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Root mean square value - Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM 9+3

Fourier integral theorem – Fourier transform pair - Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT III RANDOM VARIABLES 9+3

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

UNIT IV TWO-DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT V ESTIMATION THEORY 9+3

Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments - Method of maximum Likelihood - Interval estimation of Means - Differences between means, variations and ratio of two variances.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Apply Fourier series techniques used in wide variety of situations in which the functions used are not periodic and to solve boundary value problems.
CO2 Apply the Fourier transform techniques to solve boundary value problems.
CO3 To understand and apply the concept of Probability and random variables in Statistics which is central to many geometric applications.
CO4 To apply the basic concepts of two dimensional random variables.
CO5 To understand the knowledge of applying the concept of estimation theory which plays an important role in real life problems.

TEXTBOOKS:

1. Grewal. B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
2. John E. Freund's "Mathematical Statistics with Applications", 8th Edition, Pearson Education, New Delhi, 2017.
3. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.

REFERENCES:
1. James. G., "Advanced Modern Engineering Mathematics ", 4th Edition, Pearson Education, New Delhi, 2016.
2. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, New Delhi, 2014.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 8th Edition, 2012.
4. Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 5th Edition, 2014.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

CO's, PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	0	0	0	0	0	0	2	0	0	2			
CO2	3	2	0	0	0	0	0	0	2	0	0	2			
CO3	3	2	0	0	0	0	0	0	2	0	0	2			
CO4	3	2	0	0	0	0	0	0	2	0	0	2			
CO5	3	2	0	0	0	0	0	0	2	0	0	2			
Avg	**3**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**			

GI3301 SPATIAL DATABASE MANAGEMENT SYSTEM **L T P C**
3 0 0 3

COURSE OBJECTIVES:
- Introduce the students to the concepts of DBMS, Spatial Database Management System (SDBMS), Spatial Database design, basic application program development and user interfaces.

UNIT I INTRODUCTION 9
Data — Information - File system Vs DBMS — Database Management Systems — Database architectures, users and administrators — Classification of Database Management Systems – Spatial Data - Points, Lines, Polygons – definition of SDBMS – user classes of SDBMS – Multilayer architecture of SDBMS – GIS and SDBMS.

UNIT II SPATIAL CONCEPTS AND DATA MODELS 9
Field based model – object based model – spatial data types – operations on spatial objects - Entity Relationship Model (ER Model) – Relational Model – Constraints and Normal forms of Relational Model - mapping ER model to Relational model – ER model with spatial concepts – Object-oriented data modeling with Unified Modeling Language(UML).

UNIT III QUERY LANGUAGE 9
SQL — Data Definition — Data Manipulation - Basic structure of SQL — Set operations — Aggregate Functions – Simple queries – spatial Vs non spatial - Nested sub queries – Complex queries – Views – Trigger - OGIS standard for extending SQL - example spatial SQL queries – Object relational SQL.

UNIT IV SPATIAL STORAGE AND INDEXING 9
Disk geometry — Buffer manager – Field-Record — File — File Structure — Clustering – Basic concepts of file organizations, indexing – Spatial Indexing – Grid files – R Tree – Concurrency support – Spatial Join index – Database recovery techniques – Database Security.

UNIT V SPATIAL DATABASE SYSTEMS AND APPLICATION DESIGN AND DEVELOPMENTS 9

Exploring Spatial Geometry – Organizing spatial data - spatial data relationships and functionalities of any one commercial and one FOS SDBMS each – Application program and user Interfaces.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the concepts, classification, architectures of DBMS, SDBMS
CO2 Provide the information on Field Based, Object Based, ER, Relational and UML models.
CO3 Enable the SQL, Extended SQL for handling Spatial and Non-Spatial Queries.
CO4 Show the methods of Storing, Indexing, Database Recovery and Data Security concepts
CO5 Give the Design and Development Environment of Spatial Data

TEXTBOOKS:

1. Shashi Shekhar, Sanjay Chawla,"Spatial Databases a Tour" Prentice Hall, 1st edition, 2003.
2. Philippe Rigaux, Michel Scholl, Agnès Voisard "Spatial Databases" Morgan Kaufmann,2001

REFERENCES:

1. Abraham Silberschatz, Henry F. Korthand S. Sudharshan,"Database System Concepts", 7th edition, McGraw Hill, 2020.
2. Ravi Kothuri, Albert Godfrind, Euro Beinat "Pro Oracle Spatial for Oracle Database 11g", Apress, 2019.
3. Regina, Leo Hsu "Post GIS in Action", Oreilly&AssociatesInc., third edition (2021).
4. Vijay Gandhi; James Kang; Shashi Shekhar, "Spatial Databases." Minnesota univ minneapolis dept of electrical and computer engineering, 2007
5. Albert K. W. Yeung & G. Brent Hall ," Spatial Data and Spatial Database Systems", 2007

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	2	2	2	2	2
PO2	Problem Analysis		2	2	1	2	2
PO3	Design/Development of Solutions	1	3	2	2	3	2
PO4	Conduct Investigations of Complex Problems	2	3	3	2	3	3
PO5	Modern Tool Usage	3	3	2	3	2	3
PO6	The Engineer and Society				1	2	2
PO7	Environment and Sustainability						
PO8	Ethics						
PO9	Individual and Team Work		1			1	1
PO10	Communication						
PO11	Project Management and Finance						
PO12	Life-long Learning	2	2	2	2	3	2
PSO1	Knowledge of Geoinformatics discipline	2	1	3	1	1	2
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	1	1	3	2	2	2
PSO3	Conceptualization and evaluation of Design solutions	1	1	3	1	2	2

GI3302 **SURVEYING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the rudiments of surveying and its principles to Geoinformatics Engineers.
- To learn the various methods of surveying to solve the real-world problems.
- To introduce the concepts of control surveying
- To introduce the basics of cadastral Surveying

UNIT I FUNDAMENTALS OF CONVENTIONAL SURVEYING 9

Definition – Classifications – Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging – well conditioned triangles – Chain traversing – Compass – Basic principles – Types – Bearing – System and conversions – Sources of errors and Local attraction - Magnetic declination – Dip – compass traversing – Plane table and its accessories – Merits and demerits - Radiation – Intersection – Resection – Plane table traversing.

UNIT II LEVELLING 9

Level line – Horizontal line – Datum – Benchmarks – Levels and Staves - Temporary and Permanent adjustments – Methods of leveling – Fly leveling – Check leveling – Procedure in leveling – Booking – Reduction – Curvature and refraction – Reciprocal leveling – Precise leveling – Contouring – Methods of interpolating Contours – Characteristics and uses of Contours – Areas enclosed by straight lines – Irregular figures – Volumes – Earth work calculations.

UNIT III THEODOLITE SURVEYING 9

Theodolite – Types – Horizontal and Vertical angle measurements - Temporary and Permanent adjustments – Trigonometric Levelling - Heights and distances – Single Plane method – Double Plane method – Geodetic observation - Tacheometric surveying – Stadia Tacheometry – Subtense method –Tangential Tacheometry.

UNIT IV CONTROL SURVEYING AND ADJUSTMENT 9

Horizontal and Vertical control – Methods – Triangulation – Base line – Instruments and accessories – Corrections – Satellite station – Traversing – Coordinate computation – Gale's table – Omitted measurement – Trilateration – Concepts of measurements and errors – weight of an observation – law of weight – adjustment methods – angles, lengths and levelling network – simple problems

UNIT V CADASTRAL SURVEYING 9

History of cadastral survey – Land Records - FMB Sketch -Tax – Real Property- Legal Cadastral – Graphical and Numerical Cadastre - Legal Characteristics of Records - Torrens System. Cadastral map reproduction – Map projection for cadastral maps - Automated Cadastral map – Land Information System.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

• On completion of the course, the student is expected to

CO1 Understand the rudiments of various surveying and its principles.
CO2 Gain knowledge in computation of levels of terrain and ground features
CO3 Understand the concepts of Theodolite Surveying for complex surveying operations
CO4 Understand the procedure for establishing horizontal and vertical control
CO5 Gain knowledge on cadastral survey

TEXTBOOKS:

1. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 &2, Pune Vidyarthi Griha Prakashan, Pune, 2010, 24th edition.
2. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2016.

REFERENCES:

1. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001.
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.
4. S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India 2004.
5. K. R. Arora, Surveying Vol I & II, Standard Book house, 2019
6. C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	3	3	3	3	3
PO2	Problem Analysis	2	3	3	3	3	2
PO3	Design/Development of Solutions	3	2	3	3	3	3
PO4	Conduct Investigations of Complex Problems	2	2	2	3	3	2
PO5	Modern Tool Usage	2	2	3	3	3	3
PO6	The Engineer and Society	3	3	3	3	3	3
PO 7	Environment and Sustainability				2	2	2
PO 8	Ethics	2	2	2	2	3	2
PO 9	Individual and Team Work	2	2	2	3	2	2
PO 10	Communication						
PO 11	Project Management and Finance	2	2	2	2	2	2
PO 12	Life-long Learning				2	2	2
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

GI3303 REMOTE SENSING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition — components of RS — History of Remote Sensing — Merits and demerits of Data Collation between conventional and remote sensing methods – Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchhoff's law – Radiation sources: active & passive – Radiation Quantities.

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation — Specular and diffuse reflectors — Spectral reflectance&emittance— Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

UNIT III ORBITS AND PLATFORMS 9

Motions of planets and satellites – Newton's law of gravitation – Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types — Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.

UNIT IV SENSING TECHNIQUES 9

Classification of Remote Sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – Microwave sensors – Calibration of sensors – High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites.

UNIT V DATA PRODUCTS AND INTERPRETATION 9

Photographic and Digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the concepts and laws related to remote sensing

CO2 Understand the interaction of electromagnetic radiation with atmosphere and Earth material

CO3 Acquire knowledge about satellite orbits and different types of satellites.

CO4 Understand the different types of remote sensors.

CO5 Gain knowledge about the concepts of interpretation of satellite imagery.

TEXTBOOKS:

1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018.

REFERENCES:

1. Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019, 4th edition
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition.
3. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.
4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2020 third edition.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	2	2	2	3	3	2
PO3	Design/Development of Solutions	2	2	2	3	3	2
PO4	Conduct Investigations of Complex Problems	2	2		2	2	2
PO5	Modern Tool Usage			2	3	3	3

PO6	The Engineer and Society				3	3	3
PO7	Environment and Sustainability				2	2	2
PO8	Ethics				2	2	2
PO9	Individual and Team Work				2	2	2
PO10	Communication	1	1	1	3	3	2
PO11	Project Management and Finance	1	1	1	3	3	2
PO12	Life-long Learning	1	1	1	2	2	1
PSO1	Knowledge of Geoinformatics discipline	2	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions	2	3	3	3	3	3

GI3304 GEODESY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the geometry of the earth, Gravity, and its relationship with nature.

UNIT I FUNDAMENTALS 9

Definitions - Classifications, Problem of Geodesy and purpose of Geodesy Historical development and Organization of Geodesy. Reference Surfaces and their relationship. Applications, Engineering, Lunar, Planetary and interferometric Synthetic aperture radar Geodesy – Local and International Spheroid.

UNIT II GEOMETRIC GEODESY 9

Geometry of ellipsoid, fundamental mathematical relationship of ellipsoid, Geodetic, Geocentric and Reduced latitudes and their relationship. Ellipsoidal Co-ordinates in terms of Reduced, Geodetic and geocentric latitude. Radius of curvature in the meridian & prime vertical and their relationship. Mean Radius of curvature in any azimuth, Length of the meridian arcs and arcs of parallel and Area of trapezium on the ellipsoid. Curves on the ellipsoid, properties of Geodesic.

UNIT III CO-ORDINATE SYSTEMS 9

Natural or Astronomical Co-ordinate System, Geodetic or Geographical co-ordinate System, Rectangular or Cartesian Co-ordinate System and relationship between them. Curvilinear Co-ordinate System. Deflection of Vertical, Spherical excess. Astro-Geodetic method of determining the reference Spheroid.

UNIT IV PHYSICAL GEODESY 9

Basics - INGN -the significance of gravity measurements, Gravity field of earth, Concept of equipotential, Geo potential and Sphero potential Surface - Normal gravity and its computations, Methods of measuring Absolute and Relative gravity- Gravimeters - Reduction of gravity measurements, terrain and Isostasy corrections. Gravity networks. Gravity anomaly and Gravity disturbance - Fundamental equation of Physical Geodesy. Gravimetric determination of Geoid and Deflection of Vertical - Gravimetric satellite.

UNIT V GEODETIC ASTRONOMY 9

Celestial Sphere – Astronomical triangle – celestial coordinates systems and its relationship with Cartesian Co-ordinates and Transformation between them - Special star positions, Major 44 constellations - time systems (sidereal, Universal, atomic and standard) rising and setting of Stars with respect to Declination, hour angle and Azimuth, Culmination, Prime Vertical Crossing and Elongation.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Learn about the fundamentals of Geodesy
CO2 Understand the concepts of geoid, ellipsoid and their interrelationship
CO3 Know about the various types of coordinate systems and relationship between them
CO4 Learn about the methods for measurement of gravity and gravity network
CO5 Understand the concepts of geodetic astronomy

TEXTBOOKS:

1. Wolfgang Torge, Geodesy, Walter De Gruyter Inc., Berlin, 2015 2nd edition.
2. Guy Bomford‖ Geodesy‖ Nabu Press, 2015, ISBN 1172029091.

REFERENCES:

1. PetrVanicek and Edward J. Krakiwsky, Geodesy: The concepts, North-Holland Publications Co., Amsterdam, 2014 2nd edition.
2. Tom Herring, Geodesy Elsevier,2009, ISBN: 0444534601
3. Schwarze, V.S. Geodesy: The challenge of the 3rd millennium, Springer verlag, and 2003.
4. James R.Smith, Introduction to Geodesy, John wiley & Sons Inc. 1997

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	1	3	3	2	3	3
PO3	Design/Development of Solutions	1	2	2	3	2	2
PO4	Conduct Investigations of Complex Problems	1	3	2	3	3	3
PO5	Modern Tool Usage	2	1	2	3	2	2
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work	1	2	2	2	2	2
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning	2	2	2	2	2	2
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	1	2	3	2	2	2

GI3391 PHOTOGRAMMETRY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce basics and concepts of optics, aerial photography acquisition and mapping from aerial photographs.

UNIT I PRINCIPLES AND PROPERTIES OF PHOTOGRAPHY 9

History - Definition, Applications – Types of Photographs, Classification – Photographic overlaps – Camera: metric vs. non-metric, Digital Aerial cameras – Multiple frame and Line cameras – Linear array scanner – Flight Planning – Crab & Drift– Computation of flight plan - Photogrammetry project Planning.

UNIT II GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS 9

Photo coordinate measurement – Vertical photographs -geometry, scale, Coordinate system, Relief displacement – Stereoscopes – Stereoscopic parallax – parallax equations -Geometry, Scale, Coordinate system – Relief displacement –- Photo Interpretation.

UNIT III STEREOPLOTTERS & ORIENTATION 9

Projection system, Viewing, Measuring and Tracing system Stereo plotters–Classification: Analog, semi analytical, Analytical and Digital systems – Interior orientation - Relative orientation – Absolute orientation - Collinearity condition and Coplanarity condition - Orientation: Two-dimensional coordinate transformations –Three-dimensional conformal coordinate transformation

UNIT IV AEROTRIANGULATION, TERRAIN MODELING, ORTHOPHOTO 9

Neat model – Strip and blocks of photographs – Aerotriangulation: strip adjustment, independent model triangulation, Bundle block Adjustment and GPS Aerotriangulation (INS and GNSS integration) - feature collection – DTM generation and Contour mapping – ortho rectification - mono plotting – stereo plotting

UNIT V DIGITAL PHOTOGRAMMETRY 9

Photogrammetric Scanner – Digital Photogrammetry WorkStation – Work Station Basic system function – Storage System – Stereoscopic Viewing and Measuring System – Image properties - Image matching: template matching, feature based matching - DEM and DSM - Satellite photogrammetry principles

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand and appreciate the importance of photography as means of mapping, functional and physical elements of photography.

CO2 Understand the need of the photogrammetric mapping and the relevance of accuracy standards and means to achieve them for precise large-scale maps with scientific methods.

CO3 Evaluate the standards of map based on the state-of-the-art tool and techniques and assess the production standards for photogrammetric map making.

CO4 Acquire knowledge on the current development, issues methods and solutions in map making and evaluate methods of production.

CO5 Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of mapping technology.

TEXTBOOKS:

1. Paul. R Wolf., Bon A. De Witt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4thEdition, 2014.
2. E. M. Mikhail, J. S. Bethel, J. C. McGlone, Introduction to Modern Photogrammetry, Wiley Publisher, 2001.

REFERENCES:

1. Gollfried Konecny, Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC Press, 2nd Edition, 2014.
2. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, Walter de Gruyter GmbH & Co.2nd Edition, 2007.
3. Manual of Photogrammetry – American society of Photogrammetry & amp; R. S by Albert. D, 1980.
4. Digital Photogrammetry – A practical course by Wilfried Linder, 3rd edition, Springer, 2009.
5. Digital Photogrammetry by – Y. Egels& amp; Michel Kasser, Taylor & amp; Francis group, 2003.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	2	3	3	3	3
PO2	Problem Analysis	1	3	2	3	3	2
PO3	Design/Development of Solutions	2	3	3	2	3	3
PO4	Conduct Investigations of Complex Problems	2	3	2	3	3	3
PO5	Modern Tool Usage	2	2	2	3	3	3
PO6	The Engineer and Society	2	3	2	3	3	3
PO 7	Environment and Sustainability	1	1	2	3	3	2
PO 8	Ethics	2	3	2	3	2	3
PO 9	Individual and Team Work	1	3	3	3	2	2
PO 10	Communication	3	2	2	3	2	2
PO 11	Project Management and Finance	2	3	3	2	3	2
PO 12	Life-long Learning	2	3	1	3	2	2
PSO 1	Knowledge of Geoinformatics discipline	3	3	2	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	2	2	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	2	2	3	3	3

GI3311 SURVEYING LABORATORY I **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To familiarize with the various surveying instruments and methods.

EXCERCISES:

1. Chain traversing
2. Compass traversing
3. Centre line marking of a building
4. Planimetric Mapping of an Area using Plane Table Surveying (Radiation, Intersection)
5. Map updation using Plane Table Surveying through Resection (Graphical Method)
6. Plane table surveying – Two point problem
7. Fly and Check Levelling using dumpy level / tilting level
8. Determination of horizontal and vertical angles using theodolite
9. Determination of tacheometric constants using horizontal and inclined line of sight
10. Single plane method using theodolite
11. Double plane method using theodolite
12. Determination of RL of a point on sloping terrain using tacheometric surveying
13. Preparation of Planimetric Map using stadia tacheometry

TOTAL: 60 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Gain knowledge on the usage of basic surveying instruments like chain/tape, compass, plane table and leveling instruments
CO2 Use levelling instrument for surveying operations
CO3 Use theodolite for various surveying operations
CO4 Carry out the necessary surveys for social infrastructures
CO5 Prepare the planimetric maps

REFERENCES:

1. T. P. Kanetkar and S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th Reprint, 2010.
2. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 17th Edition, 2016.
3. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001
4. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004 a. David Clark, Plane and Geodetic Surveying for Engineers, Volume I, Constable and Company Ltd, London, CBS, 6th Edition, 2004.
5. David Clark and James Clendinning, Plane and Geodetic Surveying for Engineers, Volume II, Constable and Company Ltd, London, CBS, 6th Edition, 2004.
6. S. K. Roy, Fundamentals of Surveying, Second Edition, Prentice 'Hall of India 2004
7. K. R. Arora, Surveying Vol. I & II, Standard Book house, 2019.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	2	2	1	3	3	2
PO3	Design/Development of Solutions	3	3	2	2	3	3
PO4	Conduct Investigations of Complex Problems	3			3	2	3
PO5	Modern Tool Usage	2	3	3	2	2	3
PO6	The Engineer and Society	3	3	2	3	3	3
PO 7	Environment and Sustainability	2	3		3	3	3
PO 8	Ethics	3	3		2	2	3
PO 9	Individual and Team Work	3	3	3	3	3	3
PO 10	Communication	3	3		3	3	3
PO 11	Project Management and Finance	3	3		3	3	3
PO 12	Life-long Learning	1	1	2	1	1	1
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

GI3312 REMOTE SENSING AND PHOTOGRAMMETRY LABORATORY

L T P C
0 0 2 1

COURSE OBJECTIVES:

- To facilitate the students with hands on experience on visual interpretation of satellite data products and conventional and digital interpretation of aerial photographs.

REMOTE SENSING EXERCISES

1. Preparation of Base Map from Survey of India Topo sheets
2. Introduction to various satellite data products and image interpretation keys
3. Preparation of Land use/land cover map using Satellite Data / Aerial Photograph.
4. Spectral measurements using spectroradiometer and processing for
    a. Water & Soil
    b. Vegetation
    c. Various surfaces and land cover

PHOTOGRAMMETRY EXERCISES

1. Testing stereovision with Stereogram card
2. Mirror stereoscope- base line, orientation of aerial photographs and Photo Interpretation
3. To find the height of point using Parallax bar
4. Scale of vertical photographs
5. Aerial Triangulation using digital photogrammetry
6. Bundle Block adjustment
7. Generation and editing of DTM and Contour
8. Orthophoto generation and Mosaic
9. Preparation of Planimetric map

TOTAL: 30 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Identify different features from satellite images
CO2 Interpret images to prepare thematic maps
CO3 Determine geometrical elements of aerial photograph
CO4 Analyze the aerial Photograph
CO5 To generate Digital Elevation Model and Ortho photo from Stereo models

TEXTBOOKS:

1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015.
2. Paul. R Wolf., Bon A. De Witt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4th Edition, 2014.

REFERENCES:

1. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition.
2. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.
3. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication
4. Gollfried Konecny, Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC Press, 2nd Edition, 2014.
5. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, WalterdeGruyter GmbH & Co.2nd Edition, 2007.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	1	1	1	1	1	1
PO2	Problem Analysis	1	1	1	1	1	1
PO3	Design/Development of Solutions	1	1	2	2	2	2
PO4	Conduct Investigations of Complex Problems	2	2	2	3	3	2
PO5	Modern Tool Usage	2	2	2	3	3	2
PO6	The Engineer and Society	1	1	1	1	1	1
PO 7	Environment and Sustainability	1	1	1	1	1	1
PO 8	Ethics	1	1	1	1	1	1
PO 9	Individual and Team Work	1	1	2	2	2	2
PO 10	Communication	1	1	1	1	1	1
PO 11	Project Management and Finance	1	1	2	2	2	2
PO 12	Life-long Learning	2	2	2	1	1	2
PSO 1	Knowledge of Geoinformatics discipline	2	2	2	2	2	2

PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	1	1	3	3	2
PSO 3	Conceptualization and evaluation of Design solutions	1	1	2	1	1	1

GI3401 SENSORS AND DATA PRODUCTS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To familiarize the students with principle and operation of available sensing system, access protocols and its applicability.

UNIT I OPTICAL AND IR SENSORS 9

Land observation satellites, IRS series, LANDSAT series, SPOT series, High resolution satellites, character and applications, CARTOSAT series, IKONOS Series, QUICKBIRD series, Weather/Meteorological satellites, INSAT series – data formats

UNIT II MICROWAVE AND THERMAL SENSORS 9

Use of Microwave data - SeaWiFS, OCR, CZCs studies -chlorophyll production index -sea surface temperature (SST) sensors -NIMBUS, RADARSAT, CASI - MESSR, OCTS ATSR -Sensors - OCEANSAT ATSR on ERS TOPEX/Poseidon satellite data – NASA earth data, ESA, NCEL, GLOVIS, NEO, USGSEE - GOOGLE EARTH- SARAL.

UNIT III HYPERSPECTRAL SENSORS 9

Scanner types and characterization - specifications of various sensors Spectrographic imagers-hyperspectral sensors, Design tradeoffs. Data formats and systems, AVIRIS, CASI, NASA Terra Moderate Resolution Imaging Spectrometer (MODIS), Hyperion - VEDAS

UNIT IV GEO PORTALS 9

Open sources satellite imagery - USGS Earth Explorer - NASA Earth data Search - NOAA Data Access Viewer - Bhuvan Indian Geo-Platform of ISRO – Google Earth Engine - Copernicus Open Access Hub – up scaling and downscaling – sample data download and appraisal

UNIT V APPLICATION AREAS 9

Data download – climatic data- oceanic data – coastal data – land data – rainfall data; applications – rainfall vs NDVI, PPI- LST vs land use – wind vector and oceans current; mini project

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Gain knowledge on the current and historic satellite missions and sensors national and international importance and their relevance in the resource application

CO2 Gain information on the various types of primary and derived satellite data for earth resource management and their specifications

CO3 Acquire the knowledge about open geoportals that offer satellite data and related resource data and their applicability

CO4 Acquire knowledge on the methods to download satellite data or how to procure them from the authorized geoportals

CO5 Analyze critically and evaluate the quality, standards of satellite data and to use them for various applications.

TEXTBOOKS:

1. Introduction to Satellite Remote Sensing (Atmosphere, Ocean, Land and Cryosphere Applications), Bill Emery, Adriano Camps, First edition, 2017.
2. Landsat Data Continuity Mission(L1) Data format Control Book – USGS
3. Eni G.Njoku ,"Surface waves and Fluxes: Chapter-Satellite Remote Sensing of Sea Surface Temperature",1990,Volume 8,ISBN: 978-94-010-6769-0.

REFERENCES:

1. Fundamentals of Satellite Remote Sensing: An Environmental Approach, Emilio Chuvieco, Third Edition, 2020.
2. Hyperspectral Remote Sensing: Principles and Applications, Marcus Borengasser, First Edition, 2007.
3. Advances in Environmental Remote sensing: QihaoWeng, 1st Edition. 2017.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	1	1	3	3	2	2
PO2	Problem Analysis	1	3	2	2	3	2
PO3	Design/Development of Solutions	1	2	1	3	3	2
PO4	Conduct Investigations of Complex Problems	1	3	3	2	3	2
PO5	Modern Tool Usage	1	2	3	3	3	2
PO6	The Engineer and Society	2	3	3	2	3	3
PO 7	Environment and Sustainability	1	2	3	3	2	2
PO 8	Ethics		1	2	3	3	2
PO 9	Individual and Team Work	2	3	2	2	3	2
PO 10	Communication	1	3	3	3	2	2
PO 11	Project Management and Finance	1	2	3	3	3	2
PO 12	Life-long Learning	2	3	2	2	3	
PSO 1	Knowledge of Geoinformatics discipline	3	3	2	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	2	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	1	3	3	3	3	3

GI3402 DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the undergraduate Engineering Students understand the concepts, principles, processing of Satellite data in order to extract useful information from them.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Definition - Image Representation - Steps in DIP-– Components – Elements of Visual Perception – Image Formation - Image Sampling and Quantization- Image acquisition, storage and retrieval –– Relationships between pixels - Color image fundamentals - RGB, HSI models- data products – satellite data formats – Digital Image Processing Systems – Hardware and software design consideration.

UNIT II PREPROCESSING 9

Image Characteristics – Histograms – Scattergrams –Initial statistics – Univariate and multivariate statistics-Initial image display- Ideal display, types, Sensor models - spatial, spectral, radiometric, temporal - IFOV, GIFOV& GSI - geometry and Radiometry – Sources of Image degradation and Correction procedures - Atmospheric, Radiometric, Geometric Corrections- Image Geometry Restoration-Interpolation methods and resampling techniques.

UNIT III IMAGE ENHANCEMENT 9

Image characteristics- point, local and regional operation – contrast, spatial feature and multi-image manipulation techniques – level slicing, contrast stretching, spatial filtering, edge detections - Fourier transform-FFT, DFT - Band ratio - Principal Component Analysis (PCA) – Scale-space transform-multi-image fusion.

UNIT IV IMAGE CLASSIFICATION 9

Pattern recognition concepts – Bayes approach – spectral Signature and training sets – Separability test – Supervised Classification – stages – Minimum distance to mean, Parallelepiped, MLC – Unsupervised classifiers – ISODATA, K-means-Support Vector Machine – sub-pixel classifier– Error matrix -Accuracy assessment – accuracy metrics: Kappa statistics, ERGAS, RMS.

UNIT V ADVANCED CLASSIFIERS 9

Texture based classification -Segmentation (Spatial, Spectral)-regions Fuzzy set classification – Object based classifiers – Deep Learning - Artificial Neural nets: Hebbian leaning - Adaline, Madaline, BPN – hybrid classifiers – Neuro - Fuzzy models- Expert system – Knowledge based systems,

TOTAL:45 PERIODS

COURSE OUTCOMES:

- On completion of the course, the student is expected to

CO1 To understand various components and characteristics of image processing systems
CO2 To familiarize the concepts of image geometry and radiometry corrections
CO3 To acquire knowledge about different types of image enhancement techniques used for satellite image processing
CO4 To gain knowledge about Image classification and accuracy assessment of various classifiers
CO5 To acquaint with various advanced classification techniques available for feature extraction

TEXTBOOKS:

1. John,R.Jensen, Introductory Digital Image Processing, Prentice Hall, NewJersey, 2021 Fourth edition.
2. Robert,A.Schowengergt, Techniques for Image Processing and classification in Remote Sensing,1983.

REFERENCES:

1. Robert, G. Reeves,-Manual of Remote Sensing Vol.I &II- American Society of Photogrammetry ,Falls ,Church, USA,1983.
2. John.A Richards, Remote sensing digital Image Analysis – An Introduction Springer-Verlag, Fifth Edition, 2014.
3. Digital Image Processing by Rafael C. Gonzalez, Richard Eugene Woods - Pearson/Prentice Hall,Fourth edition, 2022.
4. Fundamentals of Digital Image Processing by Annadurai Pearson Education (2007)

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	2	3	3	3	3
PO2	Problem Analysis		2	2	3	3	3
PO3	Design/Development of Solutions		1	2	3	3	2

PO4	Conduct Investigations of Complex Problems	1	2	3	3	3	2
PO5	Modern Tool Usage	1	2	3	3	3	2
PO6	The Engineer and Society			2	3	3	3
PO 7	Environment and Sustainability		2		3	3	3
PO 8	Ethics	3	2			2	2
PO 9	Individual and Team Work			2		2	2
PO 10	Communication		1	2	2	3	2
PO 11	Project Management and Finance				2		2
PO 12	Life-long Learning	3	3	3	3	3	3
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	1	1	2	3	3	2
PSO 3	Conceptualization and evaluation of Design solutions			3	3	3	3

GI3403 MICROWAVE REMOTE SENSING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart the knowledge on Microwave Remote Sensing and its applications.

UNIT I FUNDAMENTALS AND ACTIVE SYSTEM 9

Introduction–Radar frequency bands – SLAR - Antenna System – SLAR Imaging Geometry – RADAR equation – Resolution concepts: Range and Azimuth resolution – Synthetic Aperture Radar - Geometric Distortions – Multilook averaging and speckle correction.

UNIT II RADAR INETERACTION WITH EARTH FEATURES 9

System parameters - target parameters: roughness scales and criteria, dielectric constant and penetration depth – Surface backscattering models: Clapp, Facet, Bragg resonance models and Hard targets – Volume backscattering – RADAR Image signatures.

UNIT III IMAGING AND NON IMAGING SENSING 9

SAR Interferometry-Basics- Differential SAR Interferometry-applications polarimetry- Introduction - Polarization Ellipse - Polarization types –- Synthesis and signatures – Polarimetric parameters- Information extraction – Polarimetric Image Interpretation and applications. Altimetry - Principle – Frequency bands – Location Systems- missions, Scatterometry- Scatterometer types and calibration - missions

UNIT IV SAR APPLICATIONS 9

Airborne, Space borne – different platforms and sensors- History- ENVISAT, ASAR, ALOS / PALSAR- RADARSAT , RISAT, GRACE and Sentinel 3 missions - SAR Data products and selection procedure - Applications in Agriculture- Forestry - Geology –Hydrology – snow cover mapping-snow depth estimation – Landuse/landcover mapping – Ocean related studies.

UNIT V PASSIVE SYSTEM 9

Radiometry- Passive microwave sensing components - Blackbody radiation and Grey body radiation – Emissivity, Radiometers – Components - Brightness temperature - Antenna temperature - Power-temperature correspondence, passive microwave interaction with atmospheric constituents - Emission characteristics of various earth features – Data products and Applications - Passive missions-DMSP, TRMM, Aqua missions, AMSR-E, AMSU.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the fundamentals of microwave remote sensing system such as SLAR, RAR and SAR

CO2 Learn the interaction mechanism of Radar with target features

CO3 Understand the principles and applications of Imaging and Non-Imaging observation

CO4 Learn the about the satellite sensing system and applicability of SAR

CO5 Understand the concepts of passive microwave systems and applications

TEXTBOOKS:

1. Ulaby, F.T., Moore, R.K, Fung, A.K, "Microwave Remote Sensing; active and passive, Vol. 1,2 and 3, Addison - Wesley publication company, 2001.
2. John R.Jensen,"Remote Sensing of the Environment: An Earth Resource Perspective",Pearson Education India, 2013.
3. John A.Richards,"Remote Sensing with Imaging RADAR", Springer,2009.

REFERENCES:

1. Prashant Srivastava, Dillep Gupta, Tanvir Islam, Dawei Han,Rajendra Prasad,"RADAR Remote Sensing Application and Challenges", Elsevier,2022.
2. Pranab Kumar Karmakar Microwave Propagation And Remote Sensing Atmospheric Influences With Models And Applications, Taylor & Francis,CRC Press, 2020
3. Alessandro Ferretti ,"Satellite InSAR data: Reservoir monitoring from Space", EAGE Publications, 2014.
4. Jhon R.Schott, Fundamentals of Polarimetric Remote Sensing , SPIE press, 2010
5. Woodhouse Iain. H, "Introduction to Microwave Remote Sensing" Taylor & Francis, 2006.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3		3		3	3
PO2	Problem Analysis	3	3	2	3		3
PO3	Design/Development of Solutions	3		3	3	3	3
PO4	Conduct Investigations of Complex Problems	3	3	2	3	3	3
PO5	Modern Tool Usage	3		3	3	2	3
PO6	The Engineer and Society	3	2	3	3	3	3
PO 7	Environment and Sustainability		3		3	3	3
PO 8	Ethics	3			3	3	3
PO 9	Individual and Team Work	3		3	3		3
PO 10	Communication		3		3	2	3
PO 11	Project Management and Finance	3			3		3
PO 12	Life-long Learning	2		3	3	2	3
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	3	3	2	3
PSO 3	Conceptualization and evaluation of Design solutions	2	3	3	3	2	3

GI3491 CARTOGRAPHY AND GIS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce concepts of Cartography and GIS
- To expose the process of map making and production
- To introduce GIS data structures, data input and data presentation

UNIT I ELEMENTS OF CARTOGRAPHY 9

Definition of Cartography – Maps – Functions – Uses and Types of Maps – Map Scales and Contents – Map Projections – Shape, Distance, Area and Direction Properties – Perspective and mathematical Projections – Indian Maps and Projections – Map Co-ordinate System – UTM and UPS References.

UNIT II MAP DESIGN AND PRODUCTION 9

Elements of a Map – Map Layout Principles – Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization – Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformations.

UNIT III FUNDAMENTALS OF GIS 9

Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models.

UNIT IV DATA INPUT AND TOPOLOGY 9

Scanner – Raster Data Input – Raster Data File Formats – Georeferencing– Vector Data Input – Digitizer– Datum Projection and Reprojection – Coordinate Transformation – Topology - Adjacency, Connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data Linking – Linking External Databases – GPS Data Integration – Raster to Vector and Vector to Raster Conversion.

UNIT V DATA QUALITY AND OUTPUT 9

Assessment of Data Quality - Basic Aspects - Completeness, Logical Consistency, Positional Accuracy, Temporal Accuracy, Thematic Accuracy and Lineage – Metadata – GIS Standards – Interoperability – OGC - Spatial Data Infrastructure – Data Output – Map Compilation – Chart / Graphs.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Be familiar with appropriate map projection and co-ordinate system for production of Maps and shall able to compile and design maps for their required purpose.
CO2 Be familiar with co-ordinate and Datum transformations
CO3 Understand the basic concepts and components of GIS, the techniques used for storage of spatial data and data compression
CO4 Understand the concepts of spatial data quality and data standard
CO5 Understand the concept of spatial data inputs

TEXTBOOKS:

1. Arthur H. Robinson et al, “Elements of Cartography”, 7th Edition, Wiley, 2002.
2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017.
3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.

REFERENCES:

1. John Campbell, "Introductory Cartography", Wm. C.BrownPublishers,3rd Edition,2004
2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	3	2	2	2	2
PO2	Problem Analysis	1	2	1	1	2	1
PO3	Design/Development of Solutions	2	1	1	2	2	2
PO4	Conduct Investigations of Complex Problems	1	1	1	1	1	1
PO5	Modern Tool Usage	1	1	3	2	2	2
PO6	The Engineer and Society	1	1	1	1	2	1
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	2	2	3	2
PSO 3	Conceptualization and evaluation of Design solutions	2	3	2	2	3	2

GI3492 TOTAL STATION AND GPS SURVEYING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the working of Total Station and GPS and solve the surveying problems.

UNIT I FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES 9

Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying - Applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies – Refractive index (RI) – factors affecting RI -Computation of group for light and near infrared waves at standard and ambient conditions – Computation of RI for microwaves at ambient condition – Reference refractive index -Real-time application of first velocity correction. Measurement of atmospheric parameters - Mean refractive index – Second velocity correction -Total atmospheric correction - Use of temperature -pressure, transducers.

UNIT II ELECTRO-OPTICAL AND MICROWAVE 9

Electro - optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments.

Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and Microwave system. Care and maintenance of Total Station instruments.

COGO functions: Area, Inverse / MLM, REM, Resection, offsets and stakeout - Land survey applications.

UNIT III SATELLITE SYSTEM **9**

Basic concepts of GPS – Historical perspective and development – applications -Geoid and Ellipsoid – satellite orbital motion – Keplerian motion – Kepler's Law – Perturbing forces -Geodetic satellite – Doppler effect – Positioning concept – GNSS and IRNSS – SBAS: GAGAN and WAAS Different segments - space, control and user segments – satellite configuration – GPS signal structure – Orbit determination and representation – Anti Spoofing and Selective Availability -Task of control segment – GPS receivers.

UNIT IV GPS DATA PROCESSING **9**

GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – downloading the data – RINEX Format–Differential data processing – software modules - solutions of cycle slips, ambiguities - Multi path and other observational errors – satellite geometry and accuracy measures – Continuously Operating Reference System (CORS)– long base line processing - use of different processing software's: Open Source, Scientific and Commercial.

UNIT V SURVEYING METHODS AND APPLICATIONS **9**

Total Station: Traversing and Trilateration measurement and adjustment –Planimetric map and Contour map and Topography Mapping.

GNSS: Concepts of rapid, static, semi-Kinematic, pure Kinematic and RTK methods. Observation by Radiation, Lee frog and Trilateration measurement and processing -Topography mapping using PPK and RTK methods

Total Station and GNSS applications

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Learn about the fundamental concept of Total station.

CO2 Provide knowledge about electromagnetic waves and its usage in Total station and GNSS.

CO3 Gain Knowledge on basic concepts of GNSS

CO4 Understand the measuring and working principle of electro optical and Microwave Total station and GPS

CO5 Gain knowledge about Total station and GNSS data processing and Mapping.

TEXTBOOKS:

1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th Edition,1996.
2. SatheeshGopi, rasathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2nd Edition,2017. isbn: 978-81317 00679.
3. Gunter Seeber , Satellite Geodesy, Walter De Gruyter, Berlin, 2nd Edition, 2003

REFERENCES:

1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1983
3. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin,3rdEdition,2016.
4. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 4th Edition, 2015.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	2	2	2	2	3	2
PO3	Design/Development of Solutions	2	3	2	3	3	3
PO4	Conduct Investigations of Complex Problems	2	2	2	3	3	2
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society	2	3	2	3	3	3

PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work	1	1	1	1	2	1
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning	2	2	2	2	2	2
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY **L T P C**
2 0 0 2

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1 To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

CO2 To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3 To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5 To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXTBOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

COs- PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	2	3	-	-	-	-	2	-	-	-
2	3	2	-	-	-	3	3	-	-	-	-	2	-	-	-
3	3	-	1	-	-	2	2	-	-	-	-	2	-	-	-
4	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
5	3	2	1	-	-	2	2	-	-	-	-	1	-	-	-
Avg.	**2.8**	**1.8**	**1**	**1**	**-**	**2.2**	**2.4**	**-**	**-**	**-**	**-**	**1.8**	-	-	-

1-low, 2-medium, 3-high, '-"- no correlation

NCC Credit Course Level 2*

NX3451 (ARMY WING) NCC Credit Course Level - II **L T P C 3 0 0 3**

PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3
LEADERSHIP		**7**
L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7
DISASTER MANAGEMENT		**13**
DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1
ENVIRONMENTAL AWARENESS & CONSERVATION		**3**
EA 1	Environmental Awareness and Conservation	3
GENERAL AWARENESS		**4**
GA 1	General Knowledge	4
ARMED FORCES		**6**
AF 1	Armed Forces, Army, CAPF, Police	6
ADVENTURE		**1**
AD 1	Introduction to Adventure Activities	1
BORDER & COASTAL AREAS		**2**
BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

NCC Credit Course Level 2*

NX3452 (NAVAL WING) NCC Credit Course Level - II **L T P C 3 0 0 3**

PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3
LEADERSHIP		**7**
L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7

DISASTER MANAGEMENT		**13**
DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1
ENVIRONMENTAL AWARENESS & CONSERVATION		**3**
EA 1	Environmental Awareness and Conservation	3
GENERAL AWARENESS		**4**
GA 1	General Knowledge	4
NAVAL ORIENTATION		**6**
AF 1	Armed Forces and Navy Capsule	3
EEZ 1	EEZ Maritime Security and ICG	3
ADVENTURE		**1**
AD 1	Introduction to Adventure Activities	1
BORDER & COASTAL AREAS		**2**
BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

NCC Credit Course Level 2*

NX3453	**(AIR FORCE WING) NCC Credit Course Level - II**	**L T P C** **3 0 0 3**

PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3
LEADERSHIP		**7**
L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7
DISASTER MANAGEMENT		**13**
DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1
ENVIRONMENTAL AWARENESS & CONSERVATION		**3**
EA 1	Environmental Awareness and Conservation	3
GENERAL AWARENESS		**4**
GA 1	General Knowledge	4

GENERAL SERVICE KNOWLEDGE		**6**
GSK 1	Armed Forces & IAF Capsule	2
GSK 2	Modes of Entry in IAF, Civil Aviation	2
GSK 3	Aircrafts - Types, Capabilities & Role	2
ADVENTURE		**1**
AD 1	Introduction to Adventure Activities	1
BORDER & COASTAL AREAS		**2**
BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

GI3411 TOTAL STATION AND GPS SURVEYING LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:
- To train the students to acquire skill in making precise measurements and obtaining accurate results with Total Station and GPS.

EXCERCISES:
1. Temporary adjustment of Total station and Angle, Distance and Coordinate measurement
2. Establishment of Horizontal control point by Traversing
3. To determine the instrument station coordinate by Resection method (Angles only and Distances only)
4. Application COGO function: Area, MLM / Inverse function, REM and offsets
5. Planimetric mapping using Total Station
6. Preparation of Contour map using Total Station
7. Setting out: by Coordinates, by Distance and angle, Points at equal length
8. Navigation and Feature collection using handheld GPS
9. GNSS Planning
10. Accuracy evaluation of baseline with different common observation times
11. Establishment of Ground Control Point using Static / Rapid Static differential GNSS survey by Lee Frog Method
12. Establishment of Ground Control Point using Static / Rapid Static differential GNSS survey by Trilateration method
13. Preparation of Planimetric map using Post Processed Kinematic (PPK) method
14. Network Adjustment of GNSS observation

TOTAL: 60 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Gain the basic idea about Total station and GNSS.
CO2 Acquire knowledge about establishment of horizontal control point using Total station and GNSS.
CO3 Impart Knowledge in preparation of contour map using Total station and GNSS.
CO4 Understand the various coordinate geometry function in Total station and GPS
CO5 Gain knowledge about Total station and GNSS data processing, network adjustment and Mapping.

REFERENCES:
1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th Edition,1996.
2. Satheesh Gopi, rasathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2nd Edition,2017. isbn: 978-81317 00679.
3. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 2003

4. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
5. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1983
6. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin,3rd Edition,2016.
7. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 4th Edition, 2015.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	2	2	2	2	3	2
PO3	Design/Development of Solutions	2	3	2	3	3	3
PO4	Conduct Investigations of Complex Problems	2	2	2	3	3	2
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society	2	2	2	2	2	2
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work	2	2	2	2	2	2
PO10	Communication						
PO11	Project Management and Finance						
PO12	Life-long Learning	2	2	2	2	2	2
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

GI3412 CARTOGRAPHY AND GIS LABORATORY L T P C
0 0 2 1

COURSE OBJECTIVES:

- Hands on experience of basics of cartography and GIS.
- Designing the map
- Development of GIS database and populating attribute data

EXCERCISES:

1. Simple conical,cylindrical and planar projection for the reduced earth having 2to4 cm radius – aspect and secant demo.
2. Graded symbolization and isopleth/choropleth map
3. Map compilation and Design
4. Data Input –Onscreen Digitization –Creation of Point, Line and Polygon layers
5. Projection, Reprojection and Coordinate Transformation of Maps
6. Attribute data input and Measurement of Distance, Area
7. Linking External Database and Tabular Data Analysis using SQL commands
8. Generating Graphs,Charts and Diagrams from Tabular data
9. Data Conversion –Vector to Raster and Raster to Vector

10. Map Joining, Edge Matching and Layout Design

TOTAL:30 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Design and produce thematic maps with suitable projection, symbols and color codes
CO2 Compile and develop digital maps
CO3 Create spatial database and non-spatial databases in GIS environment
CO4 Analyze spatial database and generate reports, maps
CO5 Represent spatial data in a professional format

REFERENCES:

1. Arthur,H.Robinson,Elements of Cartography, Seventh Edition, John Wiley and Sons, 2002.
2. C.P.Lo Albert K.W.Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, Second Edition, 2016.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	3	2	1	2	2	2
PO3	Design/Development of Solutions	3	2	1	2	1	2
PO4	Conduct Investigations of Complex Problems	2	1	1	1	2	1
PO5	Modern Tool Usage	3	2	2	2	2	2
PO6	The Engineer and Society		1			1	1
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work	3	2	2	3	2	2
PO 10	Communication	3	2	2	3	3	3
PO 11	Project Management and Finance	2	2	2	2	2	2
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	2	2	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	1	1	2	2	1

GI3413 **DIGITAL IMAGE PROCESSING LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To familiarize the undergraduate level students in the regular Image Processing Software.

EXCERCISES:

1. Image reading and writing
2. Pre-processing techniques: radiometric correction
3. Random and Periodic Noise removal
4. Pre-processing techniques: Ground control and rectification
5. Enhancements – histogram, filters
6. Band ratioing and normalization – NDVI, SAVI & NDWI
7. PCA
8. Image fusion

9. Classification –supervised &unsupervised
10. Sub pixel classification
11. Classification using Neural Network and Fuzzy Logic
12. Accuracy assessment – correlation, RMSE & kappa
13. Crop conditioning assessment/ inundation damage assessment/ forest fire/ change dynamic analysis

TOTAL: 60 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Enhance satellite imagery through filtering, band ratioing , PCA etc
CO2 Georeference and project the satellite imagery
CO3 Classify and assess accuracy of classification.
CO4 Perform advanced classifier
CO5 Carry out mini project in any of the application

TEXT BOOK

1. Richards, Remote sensing digital Image Analysis –An Introduction Springer-Verlag1993.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	**CO2**	**CO3**	**CO4**	**CO5**	
PO1	Engineering Knowledge	2	3	3	3	3	3
PO2	Problem Analysis		2	3	3	3	3
PO3	Design/Development of Solutions		1	3	3	3	3
PO4	Conduct Investigations of Complex Problems		2	3	2	3	3
PO5	Modern Tool Usage	2	1	3	3	3	3
PO6	The Engineer and Society			2	2	2	2
PO 7	Environment and Sustainability		2		2	3	2
PO 8	Ethics	2	3			2	2
PO 9	Individual and Team Work	2		1	2	3	2
PO 10	Communication		1		2	2	2
PO 11	Project Management and Finance				2	3	3
PO 12	Life-long Learning	3	3	3	3	3	3
PSO 1	Knowledge of Geoinformatics discipline	2	2	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	1	1		2	3	2
PSO 3	Conceptualization and evaluation of Design solutions			1	2	3	2

GI3501 SPATIAL ANALYSIS AND APPLICATIONS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To provide exposure to Raster, Vector, Network and Geo-statistical Analysis Capabilities of GIS.

UNIT I RASTER ANALYSIS 9

Raster Data Exploration: Query Analysis – Local Operations: Map Algebra, Reclassification, Logical and Arithmetic Overlay Operations – Neighborhood Operations: Aggregation, Filtering – Extended Neighborhood Operations – Zonal Operations – Statistical Analysis – Cost – Distance Analysis – Least Cost Path.

UNIT II VECTOR ANALYSIS 9

Non-Topological Analysis: Attribute Database Query, Structured Query Language, Coordinate Transformation, Summary Statistics, Calculation of Area, Perimeter and Distance – Topological Analysis: Reclassification, Aggregation, Overlay Analysis: Point-in-Polygon, Line-in-Polygon, Polygon-on-Polygon: Clip, Erase, Identity, Union, Intersection – Proximity Analysis: Buffering.

UNIT III NETWORK ANALYSIS 9

Network – Introduction – Network Data Model – Elements of Network – Building a Network Database – Geocoding – Address Matching – Shortest Path in a Network –Time and Distance Based Shortest Path Analysis – Driving Directions – Closest Facility Analysis – Catchment / Service Area Analysis – Location – Allocation Analysis.

UNIT IV SURFACE AND GEOSTATISTICAL ANALYSIS 9

Surface Data – Sources of X, Y, Z data – DEM, TIN – Terrain Analysis - Slope, Aspect, View shed, Watershed Analysis: Watershed boundary, Flow Direction, Flow Accumulation, Drainage Network, Spatial Interpolation: IDW, Spline, Kriging, Variogram.

UNIT V CUSTOMISATION, WEBGIS, MOBILE MAPPING 9

Customization of GIS: Need, Uses, Scripting Languages–Embedded scripts–Use of Python script - WebGIS: WebGIS Architecture, Advantages of WebGIS, Web applications – Location Based Services: emergency and business solutions – Big data analytics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Aware of different tools available in GIS for Raster and Vector data analysis
CO2 Understand GIS functionalities to analyse network and surface dataset
CO3 Know the possibilities of customization of GIS
CO4 Understand the architecture of Web GIS and its applications
CO5 Aware of concept of recent techniques like mobile mapping and LBS

TEXTBOOKS:

1. Kang-tang Chang, "Introduction to Geographic Information Systems", 9th Edition, July 2020. ISBN: 978-9390185559.
2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016.

REFERENCES:

1. Michael N. De Mers, Fundamentals of geographic information systems, 4th Edition, Wiley, 2008
2. John Peter Wilson, The hand book of geographic information science, Blackwell Pub., 2008

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge			2	2	1	2
PO2	Problem Analysis	3	3				3
PO3	Design/Development of Solutions				2		2
PO4	Conduct Investigations of Complex Problems	3	3				3
PO5	Modern Tool Usage	3		2		2	2
PO6	The Engineer and Society						

PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication		1			2	1
PO 11	Project Management and Finance						
PO 12	Life-long Learning			2		3	2
PSO 1	Knowledge of Geoinformatics discipline	2	2	2	3	2	2
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	1	2	1	2
PSO 3	Conceptualization and evaluation of Design solutions	2	2	3	1	1	2

GI3502 MAPPING TOOLBOXES FOR GEOMATICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To familiarize the available mapping toolboxes for geomatics applications.

UNIT I INTRODUCTION TO MATLAB PROGRAMMING 9

The MATLAB Environment - MATLAB Basics – Variables - Numbers - Operators - Expressions - Input and output - vector and Matrices operation - Creation - dot product - work with vectors - Working with files: Scripts and Functions - Loops and execution control

UNIT II GRAPHICS AND MATHEMATICAL COMPUTING WITH MATLAB 9

Graph elements; color - theme - type - title and label - drawing multiple functions - generating subplots - drawing bar chart - 3D plots - work with plotting: regression analysis and presentation - Algebraic equations - Basic Symbolic Calculus and Differential equations - Transforms

UNIT III TOOLBOXES FOR GEOSPATIAL DATA 9

Functions: To read and write geospatial data: geotiffwrite - read geotable - shaperead - Interface gateway to link external language programs: C-MEX or F-MEX - shapelib functions - poly(i).handles(k) function – make_map function - Spatial Econometrics and Spatial Statistics toolbox - arc moran plot function - Arc Mat Toolbox functions – Topo Toolbox: DEM Analysis

UNIT IV IMAGE PRE PROCESSING 9

Graphics - Creating Graphs - Customizing Graphs - lattice library- Visualization - Box plot - Histogram - Pareto charts - Pie graph - Line chart - Scatter plot - Developing graphs - Probability Distributions: Normal - Binomial - Poisson and Other Distributions.

UNIT V STATISTICAL DATA ANALYSIS 9

Image processing tool box – reading and writing of image– file format conversion – image display and fusion – image Enhancement - Image smoothening - histogram: Univariate and Multivariate statistical analysis

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Enable the student to understand basic MATLAB/Scilab functions
CO2 Enable to understand graphics and mathematics using MATLAB/Scilab functions
CO3 Enable to understand files and scripts using MATLAB/Scilab functions
CO4 Enable the student to understand geospatial toolbox using MATLAB/Scilab functions
CO5 Enable the student to understand Image processing with MATLAB functions

TEXTBOOKS:

1. Holly Moore, “ MATLAB for Engineers” Third Edition – Pearson Publications,2012.

2. Stephen J. Chapman, “MATLAB Programming for Engineers” Fourth Edition –Thomson learning,2008.

REFERENCES:

1. Fausett L.V.(2007) Applied Numerical Analysis Using MATLAB, 2^{nd} Ed.,Pearson Education.
2. MATLAB: An Introduction with Applications, by Amos Gilat, 2nd edition, Wiley, 2004
3. Hahn B., and D. Valentine, 2013. Essential Matlab for Engineers and Scientists: 5th Edition, Academic Press.
4. Getting Started with MATLAB 7: A Quick Introduction for Scientists and Engineers, by Rudra Pratap, OUP USA,2005.
5. Programming and Engineering Computing with MATLAB 2018 by Huei-Huang Lee , SDC Publications, 2018.

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	1	1	3	3	3	3
PO2	Problem Analysis	2	2	2	2	2	2
PO3	Design/Development of Solutions	2	2	2	2	2	2
PO4	Conduct Investigations of Complex Problems	3	3	3	3	3	3
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society	3	3	3	3	3	3
PO 7	Environment and Sustainability	1	1	1	1	1	1
PO 8	Ethics	1	1	1	1	1	1
PO 9	Individual and Team Work	3	3	3	3	3	3
PO10	Communication	2	2	2	2	2	2
PO11	Project Management and Finance	2	2	2	2	2	2
PO12	Life-long Learning	3	3	3	3	3	3
PSO1	Knowledge of Geoinformatics discipline	1	1	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	1	1	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions						

GI3511 MAPPING TOOLBOXES LABORATORY **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To inculcate the experimental skills to use mapping tool boxes for geomatics applications.

EXCERCISES:

1. Introduction to MATLAB functions
2. Loops in MATLAB
3. Arithmetic operations in matrix
4. Files and scripts
5. 2D and 3D plotting using MATLAB
6. MATLAB for transforms

7. Image reading and writing using matlab/Scilab
8. Enhancements–histogram, filters using matlab/Scilab
9. Band ratioing and normalization– NDVI,SAVI&NDWI using matlab/Scilab
10. PCA and Image fusion using matlab/Scilab
11. Supervised and unsupervised classification using matlab/Scilab
12. Classification using Neural Network and Fuzzy Logic using matlab/Scilab

TOTAL: 30 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Enable the student to understand basic MATLAB/Scilab functions familiar with the MATLAB GUI and basic toolboxes

CO2 Enable to understand graphics and mathematics using MATLAB/Scilab functions exposed to vector and matrix operations

CO3 Enable to understand files and scripts using MATLAB/Scilab functions familiar with arithmetic, logical and relational operations on matrix

CO4 Enable the student to understand geospatial toolbox using MATLAB/Scilab functions

CO5 Enable the student to understand Image processing with MATLAB functions problems and Use built-in toolboxes

REFERENCES:

1.Holly Moore, “ MATLAB for Engineers” Third Edition – Pearson Publications,2012.

2.Stephen J. Chapman, “MATLAB Programming for Engineers” Fourth Edition –Thomson learning,2008.

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	1	1	1	1	1	1
PO2	Problem Analysis	3	3	3	3	3	3
PO3	Design/Development of Solutions	2	2	3	3	3	3
PO4	Conduct Investigations of Complex Problems	1	1	3	3	3	3
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society	1	1	2	2	2	2
PO7	Environment and Sustainability	1	1	1	1	1	1
PO8	Ethics	1	1	1	1	1	1
PO9	Individual and Team Work	2	2	3	3	3	3
PO 10	Communication	1	1	1	1	1	1
PO11	Project Management and Finance	1	1	2	2	2	2
PO12	Life-long Learning	1	1	3	3	3	3
PSO1	Knowledge of Geoinformatics discipline	2	2	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	1	1	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions	2	2	2	2	2	2

GI3601 GEOSPATIAL ANALYSIS WITH R PROGRAMMING **L T P C**
2 0 2 3

COURSE OBJECTIVES:

- To expose the variables, expressions, control stations of R
- To use R Programming for Analysis of data and visualize outcome inform of graphs, charts
- To analysis data using various statistical tools like correlation and regression

UNIT I INTRODUCTION TO R 6+3

Introduction - History and overview - elements and data structures - Sessions and Functions - Variables - DataTypes - Vectors - Scalars - Conclusion - DataFrames - Lists - Matrices - Arrays - Classes - Data input/output - Data storage formats - Sub setting objects - Vectorization

UNIT II PROGRAMMING IN R 6+3

R Programming - Arithmetic and Boolean Operators and values - Structures - Control Statements - Loops - Pointers - Recursion - Scoping Rules - Loop functions - Array and Matrices

UNIT III DATA MANIPULATION 6+3

Math and Simulation - Functions - Math Function - Probability Calculation - Cumulative Sums and Products-Minima and Maxima Data sorting - Linear Algebra Operation on Vectors and Matrices - Set Operation.

UNIT IV DATA VISUALISATION AND PROBABILITY DISTRIBUTION 6+3

Graphics - Creating Graphs - Customizing Graphs - lattice library- Visualization - Box plot - Histogram - Pareto charts - Pie graph - Line chart - Scatter plot - Developing graphs - Probability Distributions: Normal - Binomial - Poisson and Other Distributions.

UNIT V STATISTICAL DATA ANALYSIS 6+3

Basic Statistics - Outlier - regression Analysis: Linear - Multiple - Logistic - Poisson - Survival Analysis and Nonlinear Models: Splines - Decision Tree - Random Forests - Support Vector Machine - Clustering - Correlation - Covariance - Statistical simulation - T-Tests.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 State the capabilities of R and its data, variable types.
CO2 Describe the various operators, control statements and scoping rules in R.
CO3 Apply R programming for manipulation of datasets.
CO4 Produce various graphs and distribution plots using R.
CO5 Analyze dataset using Statistical Tools available in R.

REFERENCES:

1. Mark Gardener, Beginning R -The Statistical Programming Language, John Wiley and Sons, Inc., ISBN: 9781118164303, 2012.
2. Chris Brunsdon, Lex Comber, An Introduction to R for Spatial Analysis and Mapping, 2nd Revised Edition, Sage Publications Ltd (UK), ISBN: 9781446272954, 2019.
3. Jared P. Lander, R for Everyone Advanced Analytics and Graphics, 2nd Edition, Addison-Wesley Professional PTG, ISBN: 9780134546926, 2017
4. Hamid Reza Pourghasemi, Spatial Modeling in GIS and R for Earth and Environmental Sciences, Elsevier (S&T), ISBN: 9780128152263, 2019
5. Michael J. Crawley, The R Book, 2nd Edition, Wiley-Blackwell, ISBN: 9780470973929, 2012.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	2				2
PO2	Problem Analysis			3	2	3	3
PO3	Design/Development of Solutions					2	2
PO4	Conduct Investigations of Complex Problems		1			2	2
PO5	Modern Tool Usage						
PO6	The Engineer and Society					1	1
PO7	Environment and Sustainability						
PO8	Ethics						
PO9	Individual and Team Work						
PO10	Communication				2		2
PO11	Project Management and Finance			1		1	1
PO12	Life-long Learning		2				2
PSO1	Knowledge of Geoinformatics discipline	1				1	1
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations			2		2	2
PSO3	Conceptualization and evaluation of Design solutions		2			1	1

GI3691 AIRBORNE AND TERRESTRIAL LASER MAPPING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concepts of Space Borne, Air Borne, Terrestrial and Bathymetric LASER Scanners for Topographic and Bathymetric Mapping

UNIT I SPACE BORNE RADAR AND LIDAR ALTIMETER 9

Principle and Properties of LASER- Production of Laser – Components of LASER – LiDAR – Types of LiDAR:Range Finder, DIAL and Doppler LiDAR - Platforms: Terrestrial, Airborne and Space borne LiDAR – Space Borne LiDAR Missions – Space Borne Radar Altimeter for mapping Sea Surface Topography , Moon Topography - Merits of ALS in comparison to Levelling, echo sounding, GPS leveling, Photogrammetry and Interferometry

UNIT II AIRBORNE LASER SCANNERS 9

Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser –First Return and Last Return – Ellipsoidal and Geoidal Height - Typical parameters of Airborne Laser Scanner (ALS) – Specifications of Commercial ALS –- Components of ALS - GPS, IMU, LASER Scanner, Imaging Device, Hardware and Software - Various Scanning Mechanisms: Oscillating Mirror, Rotating Polygon, Nutating Mirror, Fibre Optic

UNIT III DATA ACQUISITION AND PRE-PROCESSING 9

Laser Classification – Class I to Class IV Laser – Eye Safety - Synchronization of GPS, IMU and ALS Data -Reflectivity of terrain objects –- Flight Planning – Determination of various data acquisition parameters – Swath Width, Point Density, No. of Strips, Area Covered, Point Spacing - Data Processing – Determination of optimal flight trajectory- Quality Assurance

UNIT IV POST PROCESSING of LiDAR Data 9

Post Processing – Geo location of Laser Foot Prints – Various Co-ordinate Transformations involved Filtering - Ground Point filtering – Digital Surface Model and Digital Elevation Model - LIDAR data file formats – LAS File format and other proprietary file formats – Post Processing Software: Open Source and COTS Software – Quality Control Measures – Error Budget - Overview of LIDAR Applications in various domains - 3D city models – Corridor Mapping Applications – Forestry Applications.

UNIT V TERRESTRIAL LASER SCANNERS 9

Terrestrial Laser Scanners (TLS) – Working Principle – Static TLS – Dynamic TLS –-– Commercial TLS Specifications – Mobile Mapping Lasers :Vehicle Mounted TLS, Back Pack Wearable Laser Scanners – Asset Management Studies – Highways and Railway Asset Management – Indoor Mapping : Laser Scanning of interior of buildings/monuments – Immersive Applications - BIM Model – Applications in Tunnel Surveying, Forest Inventory, Open Cast Mine Surveying

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the components of laser and various platforms of laser scanning
CO2 Summarize the components of Airborne Laser Scanner and concept of ranging principles
CO3 Analyse the flight planning parameters and pre-processing of acquired data
CO4 Post process the data to derive DSM and DEM and its applications
CO5 Understand the components of TLS and its applications

TEXTBOOKS:

1. Jie Shan, Charles K. Toth, “Topographic Laser Ranging and Scanning – Principles and Processing”, 2nd Edition, CRC Press Publication, March 2018. ISBN: 9781498772273.

REFERENCES:

1. George Vosselman and Hans-Gerd Maas, Airborne and Terrestrial Laser Scanning, WhittlesPublishing, 2010
2. Matti Maltamo, Erik Næsset, JariVauhkonen, Forestry Applications of Airborne Laser Scanning-Concepts and Case Studies, Springer, Dordrecht , 2016,Reprint Edition. ISBN 978-94-017-8662-1
3. Michael Renslow, Manual of Airborne Topographic LiDAR, The American Society for Photogrammetry and Remote Sensing, 2013

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis			3	3		3
PO3	Design/Development of Solutions			3	2	2	3
PO4	Conduct Investigations of Complex Problems			3	3		3
PO5	Modern Tool Usage				3	3	3
PO6	The Engineer and Society					3	3
PO7	Environment and Sustainability						
PO8	Ethics						
PO9	Individual and Team Work						
PO10	Communication						
PO11	Project Management and Finance					3	3
PO12	Life-long Learning			3		3	3
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations			3	3		3
PSO3	Conceptualization and evaluation of Design solutions			3		3	3

NCC Credit Course Level 3*

NX3651	(ARMY WING) NCC Credit Course - III	L T P C 3 0 0 3

PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Team Work	2
PD 4	Career Counselling, SSB Procedure & Interview Skills	3
PD 5	Public Speaking	4
BORDER & COASTAL AREAS		**4**
BCA 2	Security Setup and Border/Coastal management in the area	2
BCA 3	Security Challenges & Role of cadets in Border management	2
ARMED FORCES		**3**
AF 2	Modes of Entry to Army, CAPF, Police	3
COMMUNICATION		**3**
C 1	Introduction to Communication & Latest Trends	3
INFANTRY		**3**
INF 1	Organisation of Infantry Battalion & its weapons	3
MILITARY HISTORY		**23**
MH 1	Biographies of Renowned Generals	4
MH 2	War Heroes - PVC Awardees	4
MH 3	Study of Battles - Indo Pak War 1965, 1971 & Kargil	9
MH 4	War Movies	6

TOTAL: 45 PERIODS

NCC Credit Course Level 3*

NX3652	(NAVAL WING) NCC Credit Course - III	L T P C 3 0 0 3

PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Team Work	2
PD 4	Career Counselling, SSB Procedure & Interview Skills	3
PD 5	Public Speaking	4
BORDER & COASTAL AREAS		**4**
BCA 2	Security Setup and Border/Coastal management in the area	2
BCA 3	Security Challenges & Role of cadets in Border management	2
NAVAL ORIENTATION		**6**
NO 3	Modes of Entry - IN, ICG, Merchant Navy	3
AF 2	Naval Expeditions & Campaigns	3

NAVAL COMMUNICATION		**2**
NC 1	Introduction to Naval Communications	1
NC 2	Semaphore	1
NAVIGATION		**2**
N 1	Navigation of Ship - Basic Requirements	1
N 2	Chart Work	1
SEAMANSHIP		**15**
MH 1	Introduction to Anchor Work	2
MH 2	Rigging Capsule	6
MH 3	Boatwork - Parts of Boat	2
MH 4	Boat Pulling Instructions	2
MH 5	Whaler Sailing Instructions	3
FIRE FIGHTING FLOODING & DAMAGE CONTROL		**4**
FFDC 1	Fire Fighting	2
FFDC 2	Damage Control	2
SHIP MODELLING		**3**
SM	Ship Modelling Capsule	3

TOTAL : 45 PERIODS

NCC Credit Course Level 3*

NX3653	**(AIR FORCE WING) NCC Credit Course Level - III**	**L T P C** **3 0 0 3**

PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Team Work	2
PD 4	Career Counselling, SSB Procedure & Interview Skills	3
PD 5	Public Speaking	4
BORDER & COASTAL AREAS		**4**
BCA 2	Security Setup and Border/Coastal management in the area	2
BCA 3	Security Challenges & Role of cadets in Border management	2
AIRMANSHIP		**1**
A 1	Airmanship	1
BASIC FLIGHT INSTRUMENTS		**3**
FI 1	Basic Flight Instruments	3
AERO MODELLING		**3**
AM 1	Aero Modelling Capsule	3
GENERAL SERVICE KNOWLEDGE		**2**
GSK 4	Latest Trends & Acquisitions	2

AIR CAMPAIGNS		**6**
AC 1	Air Campaigns	6
PRINCIPLES OF FLIGHT		**6**
PF 1	Principles of Flight	3
PF 2	Forces acting on Aircraft	3
NAVIGATION		**5**
NM 1	Navigation	2
NM 2	Introduction to Met and Atmosphere	3
AERO ENGINES		**6**
E 1	Introduction and types of Aero Engine	3
E 2	Aircraft Controls	3

TOTAL : 45 PERIODS

GI3611 SPATIAL ANALYSIS AND APPLICATIONS LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To experience the students in various Spatial and Network analysis of Spatial Data and develop problem-solving skills using GIS

EXCERCISES:

A. Raster Analysis
   a. Data exploration – statistics and query analysis
   b. Map algebra, Reclassification, arithmetic and logical overlay.
   c. Focal and zonal operations.
   d. Distance and shortest path analysis.

B. Vector Analysis
   a. Attribute analysis and Data extraction.
   b. Overlay and Cost weighted overlay.
   c. Proximity–Buffer analysis.

C. Network Analysis
   a. Network Conflation, Geocoding.
   b. Short route analysis.
   c. Service area, closest facility analysis.

D. Surface Analysis
   a. Slope and Aspect calculation.
   b. Interpolation techniques.
   c. View shed analysis and Watershed Delineation.

E. Customization
   a. Scripting/embedded scripts.
   b. Batch Processing and Web GIS demo.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Analyze the raster and vector data using various tools available in GIS.
CO2 Customize the GIS environment and writing simple scripts.
CO3 Appreciate the use of Web GIS in dissemination of spatial datasets.

CO4 Understand the concepts of surface Analysis
CO5 Do GIS Customization

REFERENCES:

1. Michael N. DeMers, Fundamentals of geographic information systems, 4th Edition, Wiley, 2008

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	**CO2**	**CO3**	**CO4**	**CO5**	
PO1	Engineering Knowledge	1	1		1		1
PO2	Problem Analysis	3					3
PO3	Design/Development of Solutions	3	3	3		2	3
PO4	Conduct Investigations of Complex Problems		1				1
PO5	Modern Tool Usage	3	3		2	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability			1			1
PO 8	Ethics						
PO 9	Individual and Team Work	1	1				1
PO10	Communication				3	1	1
PO11	Project Management and Finance					2	2
PO12	Life-long Learning					3	3
PSO1	Knowledge of Geoinformatics discipline	3	3	2	2	1	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	2	2	1	1
PSO3	Conceptualization and evaluation of Design solutions	3	3	3	2	1	3

GI3612 **SURVEY CAMP (2 WEEKS)** **L T P C**
0 0 0 1

COURSE OBJECTIVES:

- To provide practical knowledge for implementation of different survey works.

Two weeks Survey Camp will be conducted during summer vacation in the following activities:

1. Traverse– using Theodolite / Total station
2. Contouring
   (i). Radial tachometric contouring -Radial Linear Every 45 Degree and Length not less than 60 Meter on each Radial Line
   (ii). L.S & C.S – Road and canal alignment for a Length of not less than1 Kilometer
3. Offset of Buildings and Plotting the Location
4. Sun observation to determine azimuth (guidelines to be given to the students)
5. Use of GPS to determine latitude and longitude and locate the survey camp location
6. Traversing using GPS
7. Curve setting by deflection angle

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Handle the modern surveying instruments like Total station and GPS
CO2 Apply modern surveying techniques in field to establish horizontal control.
CO3 Understand the surveying techniques in field to establish vertical control
CO4 Apply different survey adjustment techniques.
CO5 Carry out different setting outworks in the field

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	3	3	3	3	3	3
PO3	Design/Development of Solutions			2	2	2	2
PO4	Conduct Investigations of Complex Problems	3	3	3			3
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society	3	3	2	2	2	2
PO 7	Environment and Sustainability	2	2	2	2	2	2
PO 8	Ethics	2	2	2		2	2
PO 9	Individual and Team Work	2	2	3	2	2	2
PO10	Communication	2	2	2	2	2	2
PO11	Project Management and Finance	2	2	2	2	2	2
PO12	Life-long Learning	3	3	3	3	3	3
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

GI3701 SPATIAL DATA ADJUSTMENT **L T P C**
3 0 0 3

OBJECTIVES:

- To impart skills in computational adjustment for Geomatics problems

UNIT I MEASUREMENT AND ERROR 9

Concepts of measurement and Error - Types of errors - Elementary concepts in probability - Reliability of measurement - significant figures - Error Propagation - linearization – Multi-variate distribution-Error ellipse-Weights of an observation- Stochastic model and Functional model.

UNIT II LEAST SQUARES ADJUSTMENT 9

Introduction - simple adjustment methods - Least squares method - Examples of least squares Problems – Techniques of least squares- concept of weight - least squares adjustment of indirect Observations –least square adjustment of observations only.

UNIT III VARIANCE COVARIANCE PROPAGATION 9

Random events and probability - Random variables - continuous probability distributions – normal distribution - Expectation - measures of precision and accuracy - covariance and correlation - covariance, cofactor and weight matrices - Introduction to sampling - Derivation of the propagation laws-Examples-step wise propagation.

UNIT IV PRE-ANALYSIS OF SURVEY MEASUREMENTS 9

Pre analysis procedure- Horizontal angle measurement, Distance measurement and elevation difference–Survey tolerances–Database creation using GIS: Modeling-Map layout.

UNIT V GEODETIC COMPUTATIONS 9

Rectangular, Polar and Spherical Co -ordinates-First and Second geodetic problem- methods of point determinations: intersection, resection, arc section and also with over determinations – Two Dimensional and Three-Dimensional Transformation adjustments.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Imparts concepts of error, error distribution and error adjustment procedures.

CO2 Understand the procedure involved in error adjustment using least square adjustment

CO3 Convey an idea about the quality of infinite size data by Variance and Covariance

CO4 Choose the suitable accuracy of instruments for their projects by pre-analysis, Technique and to create database by collecting quality datasets

CO5 Computation of coordinate using adjusted measurements and its transformation

TEXTBOOKS:

1.Mikhail, E.M. and Gracie G., Analysis and adjustment of Survey measurements, Van Nostrand Reinhold, New York, 2005

2.Paul.R.Wolf and Charles. D.Ghilani, Adjustment Computations -Statistics and least squares in surveying and GIS, John Wiley and sons inc.,6th Edition,2017.

REFERENCES:

1. P.J.G.Teunissen, Adjustment theory an introduction, VSSD. 2006
2. OSCAR S. ADAMS, GEODESY: Application of the Theory of Least Squares to The Adjustment of Triangulation, Japanese Edition, Nabu Press, 2012.
3. Brinker Russell C Minnick Roy, The Surveying Hand Book, Volume-II, Springer,2nd Edition,1995.
4. Edward L. Ingram, Geodetic Surveying and the adjustment of observations (Method of Least Squares),Forgotten Books,2018.
5. Dr. B.C. Punmia, Ashok K.Jain and Arun K.Jain, Surveying Vol-III, Laxmi Publications Pvt Ltd.,17th Revised Edition,2005.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	1	1	1	1	1	1
PO2	Problem Analysis	2	1	1	1	1	1
PO3	Design/Development of Solutions	2	1	1	1	2	1
PO4	Conduct Investigations of Complex Problems	2	1	1	1	2	1
PO5	Modern Tool Usage	3	1	1	1	1	1
PO6	The Engineer and Society	2	2	2	2	2	2
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work	2	2	2	3	2	2

PO10	Communication	3	3	3	3	3	3
PO11	Project Management and Finance						
PO12	Life-long Learning	3	2	1	1	2	2
PSO1	Knowledge of Geoinformatics discipline	1	1	1	1	1	1
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	1	1	1	1	1	1
PSO3	Conceptualization and evaluation of Design solutions	2	2	1	1	2	2

GI3702 WEB GIS L T P C
3 0 0 3

COURSE OBJECTIVES:

- This course provides skills in learning a set of scripts and their applications for providing web based services using GIS technology

UNIT I INTRODUCTION TO WEBGIS AND MARKUP LANGUAGE 9

Internet and GIS – Web GIS Architecture and Components – OGC standards: Web Services WMS, WFS, WCS, WPS – Open Server Standards - Protocols: HTTP, FTP, SMTP- Frontend & Backend programming –- Basic file formats (vector, raster) – JSON, GeoJSON- Real time applications

UNIT II HTML AND CSS 9

HTML: Introduction –HTML, XML, MHTML - HTML Elements - Formatting and Fonts – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – Frames - HTML Forms – CSS: Introduction to CSS – Basic syntax and styles - Inline Styles – Embedding Style Sheets - Linking External Style Sheets – Margins and Padding - Positioning using CSS.

UNIT III JAVA SCRIPT 9

Data types and Variables - Operators, Expressions, and Statements -Functions - Objects - Array, Date and Math related Objects - Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Form handling and validations.

UNIT IV PHP 9

Introduction - Programming basics - Print/echo - Variables and constants – Strings and Arrays – Operators, Control structures and looping structures – Functions – Reading Data in Web Pages - Embedding PHP within HTML – Establishing connectivity with database.

UNIT V GEOSERVER 9

Introduction – Web Administration – Geo server data directory –loading and working with data – shape file – Post GIS file – other web format data - styling the layers – services: WMS, WFS, WCS – security – demos and case studies on Geo server.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to
CO1 Understand the concept web GIS and language
CO2 Understand the concept HTML
CO3 Understand the concept JAVA
CO4 Understand the concept PHP
CO5 Understand the concept Geoserver

REFERENCES:

1. Harvey M. Deitel, Deitel & Associates, Inc., Abbey Deitel, Deitel & Associates, Inc., “Internet and World Wide Web: How to Program”, 5th Edition, Pearson Publication, July 2021. ISBN: 9780137618279.
2. Thomas Powell, "HTML & CSS: The Complete Reference" Fifth Edition, McGraw-Hill, 2010 ISBN-13: 978-0071496292
3. Thomas Powell, Fritz Schneider "JavaScript The Complete Reference" 3rd Edition, TATA McGraw Hill, 2013 ISBN-13: 9781259064685
4. Steven Holzner, "PHP: The Complete Reference" 1st Edition TATA McGraw Hill, 2008 ISBN: 9780070223622
5. Stefano Iacovella, Brian Youngblood " GeoServer Beginner’s Guide" Packt Publishing 2013, ISBN-13: 978-1849516686, 2nd Revised Edition (2017).

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	2	3	3	3
PO2	Problem Analysis	2	2	2	2	3	2
PO3	Design/Development of Solutions	2	2	3	2	3	2
PO4	Conduct Investigations of Complex Problems	2				3	3
PO5	Modern Tool Usage						
PO6	The Engineer and Society						
PO7	Environment and Sustainability						
PO8	Ethics						
PO9	Individual and Team Work						
PO10	Communication						
PO11	Project Management and Finance						
PO12	Life-long Learning					3	3
PSO1	Knowledge of Geoinformatics discipline	3	1	1	1	2	2
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	3	1	1	1	3	2
PSO3	Conceptualization and evaluation of Design solutions	3	2	2	2	3	2

GE3791 HUMAN VALUES AND ETHICS **L T P C**
2 0 0 2

COURSE DESCRIPTION

This course aims to provide a broad understanding about the modern values and ethical principles that have evolved and are enshrined in the Constitution of India with regard to the democratic, secular and scientific aspects. The course is designed for undergraduate students so that they could study, understand and apply these values in their day to day life.

COURSE OBJECTIVES:

- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To instill the scientific temper in the students’ minds and develop their critical thinking.
- To promote sense of responsibility and understanding of the duties of citizen.

UNIT I DEMOCRATIC VALUES 6

Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement.
Reading Text: Excerpts from John Stuart Mills' *On Liberty*

UNIT II SECULAR VALUES 6

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.

Reading Text: Excerpt from *Secularism in India: Concept and Practice* by Ram Puniyani

UNIT III SCIENTIFIC VALUES 6

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.

Reading Text: Excerpt from *The Scientific Temper* by Antony Michaelis R

UNIT IV SOCIAL ETHICS 6

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

Reading Text: Excerpt from *21 Lessons for the 21st Century* by Yuval Noah Harari

UNIT V SCIENTIFIC ETHICS 6

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

Reading Text: Excerpt from *American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer* by Kai Bird and Martin J. Sherwin.

TOTAL: 30 PERIODS

REFERENCES:

1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

COURSE OUTCOMES

Students will be able to

CO1 : Identify the importance of democratic, secular and scientific values in harmonious functioning of social life

CO2 : Practice democratic and scientific values in both their personal and professional life.

CO3 : Find rational solutions to social problems.

CO4 : Behave in an ethical manner in society

CO5 : Practice critical thinking and the pursuit of truth.

GE3752 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Spe cific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. 1Joel.E. Ross, “Total Quality Management – Text and Cases”, Routledge.,2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.
4. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006 .

CO’s, PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3										3	2		3
2						3						3		2	
3					3				3					2	3
4		2			3	2	3	2				3	3	2	
5			3			3	3	2							
AVg.		2.5	3		3	2.6	3	2	3			3	2.5	2	3

GI3711 CUSTOMIZATION LABORATORY

L T P C
0 0 2 1

COURSE OBJECTIVES:

- To facilitate the students with hands on experience on GIS customization using programming concepts, testing and troubleshooting in the developmental frameworks.

EXCERCISES:

1. Basics of scripting Python, Open layers
   i. File Handling (reading/writing)
   ii. GUI based application development
2. Spatial Data handling using the scripts
   i. Reading of shape file (Point, Line and Poly)
   ii. Displaying shape file
   iii. Reading of Post GIS data
3. Displaying of Post GIS data
4. Changing layer symbology
5. Attribute handling
6. Simple Query and spatial Query builder
7. Simple Geo processing (Buffer and Overlay)
8. Reading WMS WFS data
9. Displaying WMS WFS data with symbology
10. Building small application having the above facilities
11. Statistical software interface using the scripts
    i. Linking to R-Stat to get statistical results

TOTAL: 30 PERIODS

COURSE OUTCOMES:

• On completion of the course, the student is expected to

CO1 Learning scripting Languages
CO2 Understanding GIS Data Structure
CO3 Reading and Displaying data through Scripting
CO4 Developing Geo Processing Skills
CO5 Learning Web Services and Statistics.

REFERENCES:

1. https://pro.arcgis.com/en/pro-app/arcpy/get-started/what-is-arcpy-.html
2. http://duspviz.mit.edu/tutorials/intro-postgis
3. https://www.rstudio.com/online-learning/#r-programming
4. https://pro.arcgis.com/en/pro-app/

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge		3		2	3	3
PO2	Problem Analysis				3		3
PO3	Design/Development of Solutions		2	2	3	3	3
PO4	Conduct Investigations of Complex Problems					3	3
PO5	Modern Tool Usage				2	3	3
PO6	The Engineer and Society			2	2	3	3
PO7	Environment and Sustainability	1	2	2		3	2
PO8	Ethics						
PO9	Individual and Team Work	2	2	2	2	2	2
PO10	Communication				2	3	3
PO 11	Project Management and Finance						
PO 12	Life-long Learning	3	3	3	3	3	3
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	2	2	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations			3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3			3

GI3811 PROJECT WORK/INTERNSHIP **L T C**
0 0 20 10

COURSE OBJECTIVE:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

STRATEGY:

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

- On Completion of the project works students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

CO1 Identify Geoinfomatics engineering problems reviewing available literature.
CO2 Identify appropriate techniques to analyze complex Geoinfomatics engineering problems.
CO3 Apply engineering and management principles through efficient handling of Project have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way.

CO's, PO's & PSO's MAPPING

PO/PSO		Course Outcome			Overall Correlation of Cos to POs
		CO1	CO2	CO3	
PO1	Knowledge of Engineering Sciences	3	3	2	3
PO2	Problem analysis	1	3	2	2
PO3	Design/development of solutions	1	1	2	1
PO4	Investigation	3	3		3
PO5	Modern Tool Usage				
PO6	Individual and Teamwork	3	3	2	3
PO7	Communication	2		2	2
PO8	Engineer and Society	2		2	2
PO9	Ethics	2		2	2
PO10	Environment and Sustainability	1	1	1	1
PO11	Project Management and Finance	1	1	1	1
PO12	Life Long Learning	3	3	3	3
PSO1	Knowledge of Geoinfomatics Engineering discipline	3	3	1	3
PSO2	Critical analysis of Geoinfomatics Engineering problems and innovation	3	3	1	3
PSO3	Conceptualization and evaluation of engineering solutions to Geoinfomatics Engineering Issues	3	3	1	3

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL I: SURVEYING & MAPPING

GI3001 TERRESTIAL AND CLOSE RANGE PHOTOGRAMMETRY **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn the working principle and applications of terrestrial and close range photogrammetric system.

UNIT I FUNDAMENTALS OF TERRESTRIAL AND CLOSE-RANGE PHOTOGRAMMETRY9

Terrestrial cameras –metric and non-metric cameras – photo theodolites -stereometric cameras – Photogrammetric process, systems, products - aspects-image forming model-coordinate systems-transformations-adjustment techniques-geometric elements-horizontal and vertical angles from terrestrial photographs - Camera azimuth

UNIT II IMAGING SYSTEMS 9

Imaging concepts-geometric fundamentals-imaging systems-targeting and illumination-Image preprocessing-geometric image transformation-digital processing of single images-image matching and 3D object reconstruction

UNIT III ANALYTICAL METHODS 9

Orientation methods –bundle triangulation-object reconstruction-line photogrammetry-multimedia photogrammetry-panoramic photogrammetry-Analytical self-calibration – statistics - Matrix equations for analytical self-calibration-Initial approximations for least square adjustments –solution approach for self-calibration adjustment-control for terrestrial photogrammetry- analytical determination of horizontal position of a point from Photographic measurement - graphical method

UNIT IV PHOTOGRAMMETRIC MEASURING SYSTEM 9

Comparators-single camera systems-stereoscopic processing systems-multi image measuring systems-systems of surface measurement-project planning-camera calibration-dynamic photogrammetry-close range aerial imagery

UNIT V APPLICATION OF TERRESTRIAL AND CLOSE RANGE PHOTOGRAMMETRY 9

Architecture and cultural heritage-engineering surveying and civil engineering-industrial applications-forensic application-medicine-criminology-structural studies

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Describe fundamental concepts in terrestrial and close-range photogrammetry

CO2 Describe the imaging systems

CO3 Use analytical methods in parameter estimation

CO4 Use photogrammetric concepts in measurement

CO5 Application of terrestrial and close-range photogrammetry in problem domain

TEXTBOOKS:

1. Paul. R Wolf., Bon A.DeWitt, Benjamin E. Wilkinson, Elements of Photogrammetry with Application in GIS, McGrawHill International Book Co., 4th Edition, 2014
2. Thomas Luhmann, Stuart Robson, Stephen Kyle, Ian Harley, Close range photogrammetry Principles, techniques and applications, Whittles Publishing ISBN 978-184995-057-2 Print edition 978-1870325-50-9, 2011
3. Alex Alvarez, Reg Downing , “Image Based Modelling : Advanced 3D Modelling from Panoramas, 2005
4. Wilfried Linder, “Digital Photogrammetry, A Practical Course” 4th edition, 2016.
5. Atkinson, Development in Close Range Photogrammetry - I, Development series, 1988

REFERENCES:

1. Gollfried Konecny, “Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems”, CRC Press, 2nd Edition, 2014. ISBN: 9781420068566.
2. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, Walter de Gruyter GmbH & Co. 2nd Edition, 2007
3. 3.E.M.Mikhail, J.S.Bethel, J.C.McGlone, Introduction to Modern Photogrammetry, Wiley Publisher, 2001
4. E.M.Mikhail, J.S.Bethel, J.C.McGlone, “Introduction to Modern Photogrammetry”, Wiley Publisher, 2012. ISBN: 978-8126539987.
5. Karara, H.M., Non topographic Photogrammetry, 2 nd Edition American Society for Photogrammetry and Remote Sensing, 1989
6. American Society of Photogrammetry and Remote Sensing, 4th Edition, 2013

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis			3		3	3
PO3	Design/Development of Solutions			3		3	3
PO4	Conduct Investigations of Complex Problems			3		3	3
PO5	Modern Tool Usage	2	2			3	2
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						

PO8	Ethics						
PO9	Individual and Team Work						
PO10	Communication						
PO11	Project Management and Finance					3	3
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations				3	3	3
PSO 3	Conceptualization and evaluation of Design solutions				3	3	3

GI3002 GPS SURVEYING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the working principles of satellite geodesy and its applications to solve the surveying problems.

UNIT I INTRODUCTION TO GPS 9

Overview-segments-satellite generations-current GPS satellite constellation-control sites-positioning service-signal structure-receivers-modernization-time systems-Pseudo range and carrier phase measurements-cycle slips-linear combinations

UNIT II GPS POSITIONING MODELS AND ERRORS 9

Point and relative positioning-static surveying- stop and go surveying-RTK GPS-real time differential-real time versus post processing-communication links-GPS ephemeris errors-selective availability, multipath, Antenna-phase-center variation, receiver measurement noise, satellite and receiver clock errors, ionospheric and tropospheric delay, satellite geometry measures, GPS mission planning, user equivalent range error

UNIT III GPS DATA AND CORRECTION SERVICES 9

Datum-geodetic co-ordinate system-datum transformations-map projections-marine nautical charts-local arbitrary mapping systems-height systems-antenna swap method-on the fly ambiguity resolution-data service-DGPS radio beacon systems-wide area DGPS systems-multisite RTK system

UNIT IV GPS FORMATS AND INTEGRATION 9

RINEX and NGS-SP3 format-RTCM SC104 standards for DGPS services-NMEA 0183-Integration-GPS/GIS, GPS/LRF, GPS/dead reckoning-GPS/INS, GPS / pseudolite, GPS/cellular-GLONASS satellite system-Chinese regional satellite navigation-regional augmentations-future European global satellite navigation system

UNIT V APPLICATIONS 9

Utilities and industry-forestry and natural resources-precision farming-land seismic surveying-marine-airborne mapping-seafloor mapping-vehicle navigation-transit systems-cadastral surveying-navigation

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the basic concepts of GPS.
CO2 Imparts knowledge in GPS models and errors
CO3 Develop the required skills in GPS data and correction services.
CO4 Understand the procedure of GPS formats and integration
CO5 Imparts knowledge in GPS applications

REFERENCES:
1. Ahmed El-Rabbany, “Introduction to GPS”, 2nd Edition, 2006, ISBN: 9781596930162.
2. Alfred Leick, Lev Rapoport, Dmitry Tatarnikov, “GPS Satellite Sureying”, 4th Edition, 2015, ISBN: 978-1-119-01826-1.
3. Laurila, S.H.Electronic Surveyingin Practice,John Wiley and SonsInc, 1993.
4. Guochang Xu, Yan Xu, “GPS – Theory, Algorithms and Applications”, 3rd Edition, Springer Berlin, Heidelberg Publications, 2016. ISBN: 978-3-662-50365-2.

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	3	3	3	3	3
PO2	Problem Analysis	2	3	3	3	2	3
PO3	Design/Development of Solutions	2	3	3	2	3	3
PO4	Conduct Investigations of Complex Problems	1	2	2	3	3	2
PO5	Modern Tool Usage	1	3	3	2	3	3
PO6	The Engineer and Society	2	2	2	2	2	2
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning	1	2	2	2	3	2
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	2	3	3	3	2	3

GI3003 TERRESTRIAL AND BATHYMETRIC LASER SCANNING **L T P C**
3 0 0 3

COURSE OBJECTIVES:
- To introduce the concepts and applications of Terrestrial and Bathymetric LASER Scanners for Topographic and Bathymetric Mapping

UNIT I TERRESTRIAL LASER SCANNING 9

Terrestrial Laser Scanner (TLS) – Measurement Techniques: Pulse and Phase based – Components of TLS – Scanning Mechanism in TLS – Scanning Geometry – Working Principle of TLS – Factors affecting 3D Point Cloud Quality – Commercially available Terrestrial Laser Scanners: Salient Features- Selection of Scanners – Vehicle Mounted and Back Pack Mobile Laser Scanner

UNIT II TLS – PROJECT PLANNING AND DATA ACQUISITION 9

TLS Project Planning – Eye Safety – Reconnaissance: Visibility – Number of Instrument Stations and positioning to ensure full coverage – Control Point Requirements – Indoor Mapping: Number of Instrument Stations and its position – Data Acquisition Procedures – Georeferencing – Processing Software – Data Quality

UNIT III TLS APPLICATIONS 9

Overview of TLS Applications – Topographic Mapping – Asset Management Studies – Tunnel Deformation and Maintenance Studies – Mine: Volume Calculation Studies – Accident/Crime Scene Investigation – Cultural Heritage Preservation Studies – Digital 3D City Model development studies

UNIT IV BATHYMETRIC LASER SCANNING 9

Bathymetric Laser Scanners (BLS) – Types of Laser used in BLS – Working Principle of BLS Waveform Analysis – Secchi Depth – Factors affecting Depth of Penetration of BLS – Project Planning: Flying Height, Scanning Speed, Swath Width, and Point Spacing – Data Acquisition – Processing Software

UNIT V BLS APPLICATIONS 9

Overview of BLS Applications – Preparation of Nautical Charts – Maintenance Dredging in Ports and Harbours – Submerged archaeological sites in shallow water – Shallow Water Bathymetry studies – Coastal Engineering Applications

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the working principle of Terrestrial Laser Scanner
CO2 Summarize the Project Planning and Data Acquisition Procedures
CO3 Understands the applications of TLS in various domains/industry
CO4 Understands the working principle of BLS
CO5 Understands the applications of BLS in various domains/industry

TEXT BOOKS:

1. Yuriy Reshetyuk "Terrestrial laser scanning: Error sources, self-calibration and direct georeferencing", ISBN-13: 978-3639175509, VDM Verlag (July 9, 2009) Berlin Heidelberg -2011.
2. George Vosselman, Hans – Gerd Mass, "Airborne and Terrestial Laser Scanning", Whittles Publishing, 2010. ISBN: 978-1904445-87-6.
3. Airborne Laser Hydrography – II, Blue Book II, William Philpot, editor,2019, Available from: https://ecommons.cornell.edu/handle/1813/66666

REFERENCES:

1. Bahadır Ergün (2011). Terrestrial Laser Scanning Data Integration in Surveying Engineering, Laser Scanning, Theory and Applications, Prof. Chau-Chang Wang (Ed.), ISBN: 978-953-307-205-0, InTech, DOI: 10.5772/14728. Available from: http://www.intechopen.com/books/laser-scanning-theory-and-applications/terrestrial-laser-scanning-data-integration-in-surveying-engineering

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2					2
PO2	Problem Analysis					2	2
PO3	Design/Development of Solutions		3	3	3	3	3
PO4	Conduct Investigations of Complex Problems		3	3		3	3
PO5	Modern Tool Usage	3		3		3	3
PO6	The Engineer and Society						
PO7	Environment and Sustainability						
PO8	Ethics						
PO9	Individual and Team Work						
PO10	Communication						
PO11	Project Management and Finance		2			2	2
PO12	Life-long Learning			3		3	3

PSO1	Knowledge of Geoinformatics discipline	3	3	3	2	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations		3		3		3
PSO3	Conceptualization and evaluation of Design solutions			3		3	3

GI3004 UNMANNED AERIAL VECHICLE (UAV) FOR LARGE SCALE MAPPING **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge and skill for preparation of large scale maps from UAV imagery.

UNIT I INTRODUCTION TO UAV/UAS/Drones/RPAS 9

History of UAV -classification - Introduction to Unmanned Aircraft Systems - Application based UAVs for photogrammetry and others- Advantages and types for aerial production; planning for photogrammetry - filming and other applications introduction. Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-Introduction to Design and Selection of the System for applications- Category of UAVs- Fixed wing - VTOL - Quadcopters - Water landing - Nano - Mini - Micro (<2 kg) - (RPAS)-VLOS Small (MOW<25 kg) Medium (<150kg) Large (MTOW>150kg) - launching-hand - catapult - water surface - VTOL - civilian and military category classes.

UNIT II UAV HARDWARE AND CONTROL SYSTEMS 9

Parts of UAV-Body - wings - propellers - sensors - pitot tubes - Autopilot or manual operating system - IMU - UAV IP datalink - UAV tracking (antenna) - Mimo tracking antenna - Ground control systems - UAV gimbal - propeller and accessories - ground detecting sensors - wing types and systems - source of energy (fuel) - Telemetry-tracking-Aerial photography-controls-PIO feedback-radio control frequency range -modems-memory system-simulation-ground test-analysis-trouble shooting. Anti-drone systems

UNIT III PAYLOADS FOR UAV SYSTEM 9

Sensors: Payloads Dispensable Payloads (deliverable payloads to the consumer) - Non-Dispensable Payloads - Active Payloads (surveillance:active throughout the mission) - Passive Payloads- special sensors for UAV systems - payloads - RGB - MSS - TIR - Lidar - magnetometer.

UNIT IV OPERATIONAL AND DATA PROCESSING SOFTWARE 9

Flight planning – features of mission planning - intuitive workflow - polygon of AOI - automatic 3D flight planning - photogrammetry based flight simulation (flight altitude - resolution overlap etc) - oblique and ortho imagery coverage - waypoints - directional take-off - realtime flight status - after flight raw image development Processing of data- work flow of UAV photogrammetry - configure image properties - selecting image coordinate system - camera model - purpose of GCPS - point cloud and mesh - raycloud DSM - Orthomosoaic DTM and other products -

UNIT V APPLICATIONS 9

VALUE ADDITION TO UAV DATA: Topographic maps - volume estimate from point cloud - Mapping - Surveillance - Wildlife Monitoring - Forestry - Agriculture - Water resources - urban planning - archeology - energy sector (solar - windmill - high tension electrical) - medical applications - mountain applications etc

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understanding the different types of UAV and their characteristics
CO2 Synthesize the function of various components
CO3 Know various payload available for mapping
CO4 Plan and process UAV based mapping missions
CO5 Assimilate possible UAV applications

TEXT BOOKS:

1. Vahram Dilbaryan "Investigations about the use of UAV photogrammetry and Laser Scanning: Investigation about UAV Photogrammetry and Laser Scan for control of construction works by comparison with CAD model"October 4, 2017, AV Akademikerverlag Publisher. ISBN: 978-3639871098.
2. Lauren Newman , "Drones (21st Century Skills Innovation Library: Emerging Tech)", Cherry Lake Publishing, 2017.
3. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010. ISBN: 978-0-470-05819-0.
4. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", 4th Edition, John Wiley & Sons, Ltd, 2012. ISBN: 9781119978664.

REFERENCES:

1. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
2. Kirnon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
3. Robert Nelson, "FLIGHT STABILITY AND AUTOMATIC CONTROL", 2nd Edition, McGraw Hill Education, 2017, ISBN: 978-0070661103.
4. https://www.pix4d.com/education-course-material

CO's, PO's & PSO's MAPPING

PO	**Graduate Attribute**	**Course Outcome**					**Average**
		CO1	**CO2**	**CO3**	**CO4**	**CO5**	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	1	1	1	2	2	1
PO3	Design/Development of Solutions	1	2	2	3	2	2
PO4	Conduct Investigations of Complex Problems	1	2	2	2	2	2
PO5	Modern Tool Usage	3	3	3	3	2	3
PO6	The Engineer and Society	2	1	2	1	3	2
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO10	Communication						
PO11	Project Management and Finance	2	2	2	2	2	2
PO12	Life-long Learning						
PSO1	Knowledge of Geoinformatics discipline	2	2	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	1	1	2	3	3	2
PSO3	Conceptualization and evaluation of Design solutions	1	2	2	3	3	2

GI3005 SUBSURFACE SURVEY METHODS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart skills in subsurface surveying for Geomatic applications

UNIT I HYDROGRAPHIC SURVEYING 9

Introduction - Shore Line Survey - Soundings - Making the Soundings - Methods of Locating Soundings - Reduction of Soundings - Plotting of Soundings - The Tides - Prediction of Tides - Tide Gauges - Mean Sea Level as datum - River Surveys - Measurement of Current and Discharge - Bathymetric Measurements

UNIT II MINE SURVEYING 9

Measuring the depth of shaft and other working - underground benchmark - Datum - determining throw of fault - gradient of underground road. - Measuring subsidence. Determining the true and apparent dip and strike from bore hole data - Determining the deviation in the borehole drilling - Determining the throw of fault and length of drift to cross the fault - Finding out the bearings and dip of various mine working.

UNIT III UNDERGROUND SURVEYING 9

Introduction - purpose - advantages of correlation surveys - Description of methods used in correlation survey - underground traversing and setting of new road ways - Stope surveying-purpose and advantages - Classification of stope surveying-Methods and instruments used.

UNIT IV GROUND PENETRATING RADAR SURVEY 9

Electromagnetic principles of GPR – Electrical and magnetixc properties of rocks - soil and fluids – GPR systems; types of GPR - Measurement Configuration - Bands and Polarizations - Manual and Vehicle Mounted GPR – Salient Technical Features of Commercially Available GPR – Ground Penetrating radar surveys: Reflection Survey - Multisource – Multi receiver - Data Processing: Dewow - Time - Gain - Deconvolution - Migration - Topographic Correction - Modeling and Analysis – Processing Software.

UNIT V APPLICATIONS 9

Applications in Ground Water Resources: Depth to water from the land surface - Archeological Science: Identification and Mapping Buried Structures - Mapping of Underground utilities like power cables - Pipelines and other buried utilities - Containment Mapping.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Plan the subsurface survey for a given project also capable of extending consultancy service for real time Hydrographic and Mining operations

CO2 Apply the knowledge of different methods of survey to map the investigating real field condition.

CO3 Apply the knowledge of survey to measure stope and traverse underground

CO4 Plan the subsurface investigation program for a given project also capable of extending consultancy service for real time Soil Mechanics and Foundation Engineering problems

CO5 Apply the knowledge of different methods of exploration to select appropriate method of boring for investigating real field condition.

REFERENCES:

1. Harry M. Jol, “GROUND PENETRATING RADAR: Theory and Applications”, 1st Edition, Elsevier Science, 2008. ISBN: 9780444533487.
2. Raffaele Persico, “Introduction to ground penetrating radar: Inverse Scattering and Data Processing”, Y John Wiley & Sons, Inc., Hoboken, New Jersey, 2014.

3. Annan A. P, “GPR Methods for Hydrogeological Studies: in Hydrogeophysics”, edited by Y. Rubin and S. S. Hubbard, Springer, The Netherlands,2005. pp. 185-213.
4. Annan A. P, “Ground Penetrating RADAR: Near Surface Geophysics”, Dwain K. Butler, Society of Exploration Geophysicists, 2005. ISBN: 9781560801306
5. Dr. B. C. Punmia , Er. Ashok Kr. Jain , Dr.Arun Kumar Jain, “SURVEYING VOL. II”, 16th Edition, Laxmi Publications, 2019. ISBN: 9788170088837.

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	2	3	2	3	2	2
PO3	Design/Development of Solutions	2	3	3	2	3	3
PO4	Conduct Investigations of Complex Problems	3	3	3	3	2	3
PO5	Modern Tool Usage	2	2	3	3	3	3
PO6	The Engineer and Society	2	2	2	2	3	2
PO7	Environment and Sustainability						
PO8	Ethics						
PO9	Individual and Team Work						
PO10	Communication						
PO11	Project Management and Finance						
PO12	Life-long Learning	2	2	2	2	2	2
PSO1	Knowledge of Geoinformatics discipline	3	3	2	2	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	1	2	2	3	3	2
PSO3	Conceptualization and evaluation of Design solutions	2	3	3	2	3	3

GI3006 CADASTRAL SURVEYING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To inform the students about the raster data model and the way to handle raster database.
- To educate the student about various statistical and numerical tools with techniques to handle image.
- To make the student capable of handling images from various sources to extract basic information for application.

UNIT I CADASTRE- INTRIDUCTION 9

History of cadastral survey – Types of survey – Tax – Real Property – Legal cadastre -Graphical and Numerical Cadastre, Legal Characteristics of Records- Torrens System

UNIT II METHODS OF SURVEYING 9

Cadastral Survey Methods – survey of villages – Instruments used for cadastral survey – Orthogonal, Polar survey methods – Boundary survey – Rectangulation – town survey - Calculation of area - GPS and Total Station in Cadastral survey

UNIT III MAINTAINENCE AND MEASUREMENT **9**

Cadastral survey maintenance – FMS: manual and digital – Resurveys – Measurement of sub-division – Measurement of obstructed lines – Survey of urban areas – Control requirement for Urban survey use of Satellite Imagery in boundary fixing- maintenance of accounts

UNIT IV LAND INFORAMTION SYSTEM **9**

land records in India – digital conversions of records – NLRMP – DILRMP – smart cities – current systems – international and nationals – digital solutions for land records – examples- Indian initiatives – Tamil nilam

UNIT V MODERN TECHNOLGY **9**

Current developments –- UAV- UAS –tools and techniques- Laser terrain mapping – documentation - data maintenance – data bases – block chain technology – web technology

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the principles Cadastral system, records and taxation

CO2 Apply various methods used for surveying, mapping and maintenance of cadastral records

CO3 Know the procedure of maintenance and documentation of land records and the current national developments in this regard

CO4 Update with modern surveying technology and geospatial solutions for creation, maintenance and documentation of land records

CO5 Frame the methodology to create and maintain digital cadastre, LIS, etc.

TEXT BOOKS:

1. Land Information Management: An Introduction with Special Reference to Cadastral Problems in Third World Countries by Peter F.Dale, John D. McLaughlin,1988.
2. Land Tenure, Boundary Surveys, and Cadastral Systems by George M.Cole &Donald A Wilson,2016.
3. Multipurpose Land Information Systems The Guidebook by The FederalGeodetic Control Committee,US,1989.

REFERENCES:

1. The (TAMIL NADU) survey and boundaries act, 1923, Tamil Nadu Act No.VIII.
2. Cadastral Survey Methodologies and Techniques in Developing Countries, Pertti ONKALO, 2006.
3. NLRMP - Guidelines, Technical Manuals and MIS,2009.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	1	2	3	3	2
PO2	Problem Analysis	1	3	3	2	3	2
PO3	Design/Development of Solutions	1	2	3	2	3	2
PO4	Conduct Investigations of Complex Problems	2	2	3	3	2	3
PO5	Modern Tool Usage	1	1	3	3	3	2
PO6	The Engineer and Society	2	2	2	3	3	2
PO 7	Environment and Sustainability	1	3	3	2	3	2
PO 8	Ethics	3	3	3	2	2	3
PO 9	Individual and Team Work	3	1	3	2	3	2
PO 10	Communication	1	2	3	3	2	2
PO 11	Project Management and Finance	2	3	3	3	3	3

PO 12	Life-long Learning	3	3	2	3	2	3
PSO 1	Knowledge of Geoinformatics discipline	2	3	3	3	2	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	2	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	2	3	3

GI3007 ADVANCED SURVEYING TECHNIQUES (MINING, HYDROLOGY, ROUTE, ASTRONOMY) **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn the various methods and adjustments principles of plane and geodetic surveying to solve the real world problems

UNIT I SURVEY ADJUSTMENTS AND THEORY OF ERRORS 9

Introduction : Kinds of Errors – The Law of Accidental Errors – General Principle of Least Squares – Law of Weights – Determination of Probable Error – Distribution of Error of the Field Measurements – Normal Equations – Determination of the Most Probable Values – Method of Correlates – Triangulation Adjustments – Figure Adjustment – Adjustment of a Geodetic Triangle – Adjustment of Chain of Triangles – Adjustment of two connected Triangles – Adjustment of a Geodetic Quadrilateral – Adjustment of a Quadrilateral with a central Station by Method of Least Squares – Adjustments of Geodetic Triangles with Central Station by Method of Least Squares

UNIT II FIELD ASTRONOMY 9

Definition of Astronomical Terms – Co-ordinate Systems – The Terrestrial Latitude and Longitude – Spherical Trigonometry and Spherical Triangle – The Astronomical Triangle Relationship Between Co-ordinates – The Earth and the Sun – Unites of Time – Interconversion of Time – Instrumental and Astronomical Corrections to the observed Altitude and Azimuth – Determination of Azimuth – The Determination of Latitude – Determination of Longitude

UNIT III TOPOGRAPHIC AND ROUTE SURVEYING 9

Topographic Surveying: Planimetric map, concept of map scale, Mapping software's, Methods of Representing Relief – Contours and Contour Interval – Characteristics of Contours– Methods of Locating Contours – Interpolation of Contours – Procedure in Topographic Surveying Route Surveying for Highways, Railways, Power line and Canal – Reconnaissance survey, Preliminary survey and Location survey by Conventional method and Geomatics techniques - Setting Out Simple curves, Compound curves, Reverse Curve, Transition and Vertical curves – Sight distance.

UNIT IV MINE SURVEYING 9

Equipment for Mine Surveys: The Transit – The stations and Station Markers – Measurement of Distance and difference in Elevation – Tunnel Alignment and Setting Out – Suspension Mining Compass – Brunton's Universal Pocket Transit – Mountain Compass Transit. Azimuth transfer methods: Single Wire, The Weisbach Triangle, The Weiss Quadrilateral, Azimuth by Gyroscope - Shafts and Adits - Vertical control transfer by shaft plumbing.

UNIT V HYDROGRAPHIC SURVEYING 9

Tides and Datums: Overview of hydrographic surveying concepts - bathymetric and nautical chart - Basic tidal theory - tidal observations and prediction - common types of recording tide gauges - Different vertical datums - Soundings: Overview of depth data types - Working principle of echo sounder - characteristics of underwater acoustic signals – transducers - Error sources and calibration - Advanced instrumentation - Navigation and Position Fixing: Horizontal positioning methods and requirements - Concept of line and surface of position - Positioning and navigation using satellite positioning systems.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the rudiments of various surveying measurement and its adjustment.
CO2 Imparts knowledge in computation of positions and azimuth using astronomical observation
CO3 Develop the required skills in route surveying fundamentals necessary to provide geomatic solutions.
CO4 Understand the procedure of conducting the mine surveying.
CO5 Imparts knowledge in computation of positions and levels waterbodies.

TEXT BOOKS:

1. J. Uren and W.F. Price, Surveying for Engineers, Palgrave macmillan, Fifth Edition, 2010.
2. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2019.

REFERENCES:

1. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.
4. S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India2004.
5. K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013.
6. C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011
7. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008.
8. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	3	3	2	2	3	3
PO3	Design/Development of Solutions	3	2	3	2	2	2
PO4	Conduct Investigations of Complex Problems	3	3	3	3	2	3
PO5	Modern Tool Usage	3	2	3	3	3	3
PO6	The Engineer and Society	2	3	2	2	3	2
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work	2	2	2	2	2	2
PO10	Communication						
PO11	Project Management and Finance						
PO12	Life-long Learning	3	2	2	2	2	2
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

VERTICAL II: GEOSPATIAL DATA ANALYTICS

GI3008 GIS CUSTOMIZATION AND SCRIPTING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- This course enables the student to understand the fundamentals of GIS customization using the programming concepts, testing and troubleshooting in the developmental frameworks.

UNIT I INTRODUCTION TO GIS CUSTOMIZATION FUNDAMENTALS 6+3

Need for Customization in GIS, Introduction to customization environments and platforms, Introducing Python, Introducing Model Builder, Programming Basics – Objects, Classes, Methods, Functions, Attributes and Variables. Introduction to Data types and Arguments

UNIT II PROGRAMMING IN GIS AND BASICS 6+3

Objects in GIS -maps, tables, layers, symbols and features, Programming with Objects, Concept of Lists, Loops, Decision structures, Strings, Inheritance, Polymorphism, encapsulation, and abstraction

UNIT III GIS DATA ACCESS AND MANIPULATIONS 6+3

Reading Attribute Data, accessing data fields, reading through records. Retrieving records using attribute and spatial queries, working with cursors, Working with raster data, Events and Triggers, Reading and Parsing text files, Writing Geometries, Working with Map Documents

UNIT IV TESTING AND TROUBLESHOOTING 6+3

Testing concepts – Unit testing, Integration testing, recursive testing and performance testing. Trouble shooting and identifying problems, Diagnosis, Using the spyder debugger, Printing messages from the geoprocessor, Code standardization and Optimization technique

UNIT V GIS DEVELOPMENTAL FRAMEWORKS 6+3

Introduction to Desktop Development Frameworks (Python, .net, Java), Web Development frameworks (JS, Angular, React, Leaflets), Mobile Development Frameworks (Android, IOS, Xamarin), Database Customization frameworks (PL/SQL, Post GIS/Postgres)

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Employ different programming languages commonly used in GIS customization and describe how to use these technologies to expand upon existing GIS software functionality.

CO2 Perform object-oriented programming tasks using various programming languages, such as Python.

CO3 Analyze procedures and interactions for workflows within GIS.

CO4 Program small-scale GIS-based models in Python, integrated within a GIS software.

CO5 Recognize and employ general software engineering concepts and good programming methods and practices.

TEXT BOOKS:

1. Headfirst Python, 2nd Edition, Paul Berry,2010.

REFERENCES:

1.QGIS Python Programming Cookbook, Joel Lawhead,2015.

2.Python Scripting for ArcGIS Pro, Paul A. Zandbergen,2020.
3.Learn Python the Hard Way, Second Edition, Zed Shaw,2012.
4.Modeling our World, Second Edition. Esri Press, Michel Zeiler,2010.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	3	2	2	2	2
PO2	Problem Analysis	2	3	2	3	2	2
PO3	Design/Development of Solutions	3	3	2	3	1	3
PO4	Conduct Investigations of Complex Problems	2	2	3	2	1	2
PO5	Modern Tool Usage	3	3	3	3	2	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics	1	1	1	1	1	1
PO 9	Individual and Team Work	2	2	2	2	2	2
PO 10	Communication	1	1	1	1	1	1
PO 11	Project Management and Finance	1	1	1	1	1	1
PO 12	Life-long Learning	3	2	2	2	2	2
PSO 1	Knowledge of Geoinformatics discipline	2	2	2	2	2	2
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	2	2	2	2	1	2

GI3009 OPEN SOURCE GIS L T P C
3 0 0 3

COURSE OBJECTIVES:

- This course supports students ability to act autonomously and think creatively when implementing geoinformatics projects and also provide total freedom to change the programme as necessary.

UNIT I BASICS 9

Open Source software and Freeware, Open Source Licensing Models, W3C, WWW and Protocols–Software standards and opensource GIS-OGC, GDALand OSGeo,FOSS4G-Opensource software for Desktop GIS and WEB Mapping- Proprietary vs Opensource- OGC Standards.

UNIT II DEVELOPMENT ENVIRONMENT 9

Linux and Windows–PostgreSQL and Database Engines-C,C++,OOP and Java streams-GNU, Mosix–WAP and Android stack–Scripts and Macros

UNIT III DATA MODELS FOR GIS 9

View Graphics–Data exchanges-portability and interoperability–Raster handling and Image analysis–vector data management–Raster and vector analysis-2D/3Dvectors with topology,3D Voxel,2D Raster

UNIT IV DATABASE MANAGEMENT AND USER INTERFACE 9

Files vs Database-Distributed operations and Architecture–ODBC-Open source Database management tools- Database: Spatial and Attribute queries Spatial functions and Analysis–Map Server, Application Server and Database server concepts.

UNIT V OPEN SOFTWARE AND WEB MAPPING 9

Open Source Software: GRASS, QGIS, OSSIM, PostgreSQL and R Environment–WEB Mapping Architecture and components–WEB mapping servers-Thin clients in WEB mapping-WMS,WFS,WCS,WPS and Restful web services- Open API.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the concepts and protocols used in Opensource GIS.

CO2 Know the functionalities of Opensource GIS software in Desktop and Web based environments.

CO3 Understand the GIS data models

CO4 Understand the concepts of DBMS and user interface

CO5 Acquire the knowledge of open-source software in web mapping

TEXT BOOKS:

1. MitchellT(2005) Web mapping illustratedˆ,OˆReilly Media Inc.,Sebastopol, Canada
2. HelenaM(2008) Open source GIS:A GRASS GIS approachˆ,3rd edn, Springer, NewYork
3. Bill Kropla (2005) Beginning Map Server: Open Source GIS Development, A press (Springer Verlog) New york.

REFERENCES:

1. Peng, Z.R. and Tsou, M.H. Internet GIS : distributed geographic information services for the Internet and wireless networks. New York: John Wiley and Sons, New york, 2003

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	1	3	2	2	1	2
PO2	Problem Analysis	1	3	2	2	1	2
PO3	Design/Development of Solutions	1	3	3	3	2	2
PO4	Conduct Investigations of Complex Problems	1	2	2	2	1	2
PO5	Modern Tool Usage	2	3	3	3	3	3
PO6	The Engineer and Society	1	1	1	1	1	1
PO 7	Environment and Sustainability			1	1	1	1
PO 8	Ethics	1	2	2	2	2	2
PO 9	Individual and Team Work	2	2	1	2	2	2
PO 10	Communication	2	1	1	2	2	2
PO 11	Project Management and Finance		2	1	2	1	
PO 12	Life-long Learning	3	3	3	3	3	3
PSO1	Knowledge of Geoinformatics discipline	2	2	3	3	2	2
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	3	3	2	2
PSO3	Conceptualization and evaluation of Design solutions	2	2	3	3	3	3

GI3010 LOCATION BASED SERVICES

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge to design and develop next generation location based information systems involving mobile devices.

UNIT I INTRODUCTION 9

Introduction - Evolution of Location Based Services - Application Areas of Location Based Services (LBS) - Application Taxonomy – LBS Privacy – LBS Markets and Customer Segments

UNIT II PLATFORM AND ARCHITECTURE 9

LBS Components - Data Capture and Collection – LBS Middleware Standards (Open GML,KML) – Mobile Platform Technologies for LBS

UNIT III DATA AND VISUALIZATION TOOLS 9

LBS Data – Crowd Sourcing and Open street Maps ,Google Earth, Google Maps, Bing Maps – Content Distribution formats – GeoJSON, GeoRSS, KML - Generating KML‟s Dynamically – Location determination: Indoor GPS, Network based positioning techniques, short range positioning, Hybrid Positioning

UNIT IV LBS APPLICATIONS 9

Vehicle Tracking: Tracking concepts, components of vehicle tracking, online and offline tracking. Alarms used in vehicle tracking, Fleet Management – Vehicle Navigation: Navigation concepts for Road, Waterways and Airways – components of vehicle navigation, file formats used for navigation – Distress call management

UNIT V COMMUNICATION & BUSINESS IN LBS 9

Communication in LBS: maps – issues –multi model and context aware modes – emerging sectors – emerging products – standard digitization – legal and social issues

TOTAL :45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the evolution and application of Location Based Services
CO2 The concepts of Location Based Services and architecture
CO3 Summarize the tools available for data and visualization of LBS
CO4 Identify the various feasible LBS applications
CO5 Identify the communication modes and business in LBS

TEXT BOOKS:

1. Location-Based Services and Geo-Information Engineering by Allan Brimicombe, Chao Li, ISBN: 978-0-470-85737-3 August 2009
2. Jochen Schiller & Agnes Voisard“ Location - Based Services” Morgan Kaufmann Publishers, 2004
3. Richard Ferraro & Murat Aktihanoglu “Location-Aware Applications” Manning Publications Company, 2011
4. Syed A. Ahson& Mohammad Ilyas “Location-Based Services Handbook: Applications, Technologies, and Security – CRC Press, 2010

REFERENCES:

1. Next Generation Location Based Services for Mobile - Sidney Shek CSC – http://assets1.csc.com/lef/downloads/CSC_Grant_2010_Next_Generation_Location_Based_Services_for Mobile_Devices.pdf

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	2	3	3
PO2	Problem Analysis	2	2	2	2	2	2

PO3	Design/Development of Solutions	1	2	2	1	2	2
PO4	Conduct Investigations of Complex Problems	1	1	2	2	2	2
PO5	Modern Tool Usage	3	3	3	1	2	3
PO6	The Engineer and Society	1	1	1	2	2	2
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO10	Communication						
PO11	Project Management and Finance						
PO12	Life-long Learning						
PSO1	Knowledge of Geoinformatics discipline	3	3	3	2	2	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	3	3	2	2
PSO3	Conceptualization and evaluation of Design solutions	1	2	3	3	2	2

GI3011 ENTERPRISE GIS (API, REST SOAP SOA, SAS, OGC, WEB SERVICES) L T P C
3 0 0 3

COURSE OBJECTIVES:

- To expose students on technical requirements for establishment of an enterprise GIS.

UNIT I ENTERPRISE GEOGRAPHICAL INFORMATION SYSTEM 9

Introduction – Information sources – Enterprise Architecture& Roles in Enterprise Architecture- Organizational context– Applied GIS – Definitions– The beginning of enterprise system.

UNIT II ENTERPRISE ARCHITECTURE 9

Enterprise architecture – Capabilities – Flexible Architecture – Designing an enterprise architecture – Establishing goals – Introduction to GIS Web services – WCS, WMS, WFS, WMTS, WPS. Web Service Communication protocols – REST Vs SOAP

UNIT III DATA ARCHITECTURE 9

Data architecture – Data Vs information – Enterprise data – Metadata – System hierarchies - Data Standards – Data Formatting - Geodatabase domains. Data Security and Access Controls, Data Sharing – Service Oriented Architecture, Daas (Data as a service) Vs Saas (Software as a Service), Data Exchange formats – CSV, XML, GML, Json, YAML, HTTP content

UNIT IV DESIGNING AN ENTERPRISE GIS SYSTEM 9

Designing a Conceptual reference architecture, Design Considerations – Automation, Collaboration, Integration considerations, High Availability Scenarios, Deployment considerations, Data Governance, Load Balancing, Security and Workload Separation considerations, Designing the enterprise GIS for different Scenarios

UNIT V GIS VISUALISATION 9

Web administration, Connecting to Enterprise Geo database, Publishing the GIS data services, Styling, Tiling and Caching considerations, Performance Considerations, Using the web services, Hosting the Enterprise GIS application.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the concept and working principle of Enterprise GIS
CO2 Summarize the architecture of Enterprise GIS
CO3 Understand how data standards security adopted in Enterprise GIS
CO4 Design an Enterprise GIS system for different scenarios
CO5 Publish and view the data across platform by tuning different publishing parameters

TEXT BOOKS:

1. Enterprise GIS: Concepts and Applications, John Woodard,2019.
2. Building a GIS : system architecture design strategies for managers, Dave Peters,2012.
3. Web GIS: Principles and Applications, Pinde Fu, Jiulin Sun,2011.

REFERENCES:

1. https://enterprise.arcgis.com/en/server/latest/publish-services/windows/services-in-arcgis-enterprise.html

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	2	2	3	2	2
PO2	Problem Analysis	1	2	2	3	3	2
PO3	Design/Development of Solutions	1	1	1	3	2	2
PO4	Conduct Investigations of Complex Problems	1	1	2	2	2	2
PO5	Modern Tool Usage	2	3	3	3	3	3
PO6	The Engineer and Society	2	1	1	2	3	2
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance	1	1	1	3	1	1
PO 12	Life-long Learning	1	3	2	1	3	2
PSO 1	Knowledge of Geoinformatics discipline	3	2	3	2	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	1	2	2	3	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	2	3	3	3	3

GI3012 GIS BASED UTILITY AND ASSET MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To inculcate the implementational GIS concepts for the Utility sectors and asset management.

UNIT I INTRODUCTION 9

History of AM/FM Systems, Moving from CAD to GIS, Introducing Key components of Utility GIS, Unique Utility GIS requirements, Introduce various products available in the market towards utility GIS.

UNIT II DATAMODELS 9

Importance and uniqueness of Data model for Utility GIS, Introduction to Electric Data model, Introduction to Telco Data model, Introduction to Gas Data model, Introduction to Water Data model, Introduction to Multi Utility Data model,

UNIT III DATA COLLECTION METHODOLOGIES 9

Identify various data to be collected (Primary, Secondary and Tertiary datasources), Introduction to Mobile Mapping data collection, Drone based survey, Door-to-Door Survey (for consumer index) etc. Introduction to Quality Control framework, Implementation of Data Governance within Organization

UNIT IV BUSINESS PROCESS IMPLEMENTATION 9

Identifying Business process, Integration with external systems (ERP, EAM, SCADA etc.) , Introduction to typical electric utility business process, Introduction to typical Telco utility business process, Introduction to typical Gas utility business process, Introduction to typical Water utility business process

UNIT V MODERN SYSTEM FOR SMART UTILITIES 9

Introduction Smart Grid Initiatives for Electric Utility, Fiber Planning and 5G rollout for Telcos , Vegetation Management using Lidar/Drone imagery via AI/ML systems , Advanced Asset Identification and Management using AI/ML , Building of Organizational dashboards using big data and analytics software.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Know What constitutes a Utility GIS and why they are different from a typical GIS implementation

CO2 Know organization of the utility sector (electric, gas, telco, water) can benefit

CO3 Understand Importance of System (various software/hardware), Data (to be modelled and collected), Business process (to make GIS work for the organization) and People (to train, mentor the end users

CO4 Get Introduced to designing, developing and Implementing a Utility GIS

CO5 Explore modern GIS systems that various utilities are currently embarking on

TEXT BOOKS:

1. Delivering Water and Power: GIS for Utilities: 1 (Applying GIS) ,by Pat Hohl (Editor), Keith Mann (Editor)ISBN-13 : 978-1589486751,2021.
2. GIS for Enhanced Electric Utility Performance (Artech House Power Engineering) Bill Meehan (Author)ISBN-13 : .1608075591,2013-978
3. Modeling Electric Distribution with GISBillMeehan (Author)ISBN-13 : .1589482418,2013-978
4. Empowering Electric and Gas Utilities with GIS (Case Studies in GIS)Bill Meehan (Author) ISBN-13 : 1589480254-978

REFERENCES:

1. https://www.ge.com/digital/applications/smallworld-gis-geospatial-asset-management
2. https://www.esri.com/en-us/arcgis/products/arcgis-utility-network/overview
3. https://www.hexagonsafetyinfrastructure.com/products/utilities-and-communications-products/advanced-utility-gis/intergraph-gtechnology

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3		3	3	3	3
PO2	Problem Analysis	3			3	3	3
PO3	Design/Development of Solutions				3	3	3
PO4	Conduct Investigations of Complex Problems				3	3	3
PO5	Modern Tool Usage			3	3	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						

PO 11	Project Management and Finance					3	3
PO 12	Life-long Learning	3				3	3
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations					3	3
PSO 3	Conceptualization and evaluation of Design solutions					3	3

GI3013 GEO COMPUTING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn about the computational aspects and its implementation with raster and vector data formats using python scripting.

UNIT I INTRODUCTION AND PYTHON FUNDAMENTALS 9

Understanding geospatial data formats and file organization - Programming basics & Python core concepts – Functions - Flow control.

UNIT II PYTHON ADVANCED CONCEPTS 9

Introduction to numpy, Containers - Copies, Reading and Writing files& Python system access - Classes and objects - Plotting with Python.

UNIT III PYTHON FOR GIS 9

Raster Processing with GDAL - Vector Processing with OGR - Geoprocessing with ArcPy - Interactive Mapping and Geoprocessing on Jupyter Notebook.

UNIT IV ADVANCED GIS ALGORITHMS 9

Vector Data Algorithms (Spatial data clustering) - Raster Data Algorithms (classification, change detection) - Network Data Algorithms (shortest path, centrality) - Geospatial Big Data Visualization Methods and Tools - Spatiotemporal Data Analytics

UNIT V OPEN-SOURCE GEOSPATIAL BIG DATA ANALYSIS AND APPLICATIONS 9

Machine learning and deep Learning for remote sensing imagery analytics – Tensor flow - LiDAR Point Cloud analytics - GPS Trajectory Data analytics - Textual Documents analytics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Be familiar with major geospatial vector and raster file formats and specifications for spatial reference coordinate systems.

CO2 Have used and be comfortable with online resources that support geocomputing and programming in the GIS profession.

CO3 Learn newly developed GIS computation tools/libraries and platforms.

CO4 Understand the concepts of raster, vector and data analytics

CO5 Do ML/DL data analytics for imagery, LiDAR and GPS

TEXT BOOKS:

1. Think Python: How to Think Like a Computer Scientist by Allen Downey et al., 2014, O'Reilly.
2. Introduction to GIS Programming and Fundamentals with Python and ArcGIS, Chaowei Yang et al., 2017, CRC Press

REFERENCES:

1. Yang, Chaowei, and Qunying Huang. Spatial cloud computing: a practical approach. CRC Press, 2013.
2. Géron, Aurélien. Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems. O'Reilly Media, Inc., 2017.
3. Richert, Willi. Building machine learning systems with Python. Packt Publishing Ltd, 2013.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	2	2	3	3	3
PO2	Problem Analysis	3			3	3	3
PO3	Design/Development of Solutions	3	2	2	3	3	3
PO4	Conduct Investigations of Complex Problems		3		3	3	3
PO5	Modern Tool Usage				3	3	3
PO6	The Engineer and Society				3	3	3
PO7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO10	Communication						
PO11	Project Management and Finance						
PO12	Life-long Learning	3			3	3	3
PSO1	Knowledge of Geoinformatics discipline	3			3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	3			3	3	3
PSO3	Conceptualization and evaluation of Design solutions	3			3	3	3

GI3014 GEOSPATIAL MODELLING AND SIMULATION **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To expose students on capabilities of spatial tools for modelling and simulation of physical and biological systems.

UNIT I CONCEPTS OF MATHEMATICAL MODEL 9

Concepts – types of model – examples of mathematical model – classification of mathematical model – black and white box model - Modelling assumptions – choice of equation – phenomena and model geometry – choice of variables and parameters – data and knowledge acquisition – model building – calibration and verification – results presentation - Advantages – steps to be followed in the development of model - problem associated with modelling.

UNIT II ATMOSPHERIC MODELLING 9

Study on Atmosphere – Greenhouse effect - aerosol – Natural and manmade – ozone depletion – acid rain – classification on of atmosphere – modelling of atmosphere – governing equations weather and climate modelling – numerical weather prediction model global and regional climate models – Air quality model – Gaussian dispersion model.

UNIT III HYDROLOGICAL MODELLING 9

Hydrological cycle – definition – various components – rainfall – runoff model – Groundwater model – different types; lumped and distributed – Areal extent of the model – boundary conditions – compilation of Geological & Hydrological information – model stresses – model size & discritingation - finite difference & finite element – interfacing GIS with groundwater model – modelling the effect of climate change on water resources.

UNIT IV BIOLOGICAL / ECOLOGICAL SYSTEM MODELLING 9

Environmental modelling – need for Environmental modelling – physical process – integrating forest growth model with GIS – ecological modelling, GIS & expert system – Regional fish species richness model – introduction to quantitative methods – Landscape ecology.

UNIT V SIMULATION MODEL FOR FOREST MANAGEMENT 9

Types of fires - Empirical approaches to modelling wild land fire – simulating forest fire regimes – simulation of broad – scale fire – natural forest landscape disturbance – forest fire – timber harvesting – forest management using decision support system – developing forest management strategies based on fire regimes.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Gain knowledge on concepts for building mathematical models
CO2 Apply mathematical models in hydrology, Atmosphere; Biological / Ecological Domains
CO3 Develop mathematical models for modelling hydrological phenomena
CO4 Apply Modelling techniques for ecological system
CO5 Develop simulations for sufficient management of forests.

REFERENCES:

1. George F. Pinder, Groundwater modelling using GIS, John Wiley & Sons, New York, 2002. 20
2. Michale N. Demers, GIS modelling in Raster, John Wiley & Sons, inc, 2002.
3. Keith C. Clarke/. Bradley O.Parks. Michale P.Crane, GIS & Environmental modelling, Prentice Hall, Inc. New Jersey, 2002.
4. Meyer, Walter J. : Concepts of Mathematical Modeling (ISBN 10: 0070417474 / ISBN 13: 9780070417472) 1984
5. Edward A. Bender An Introduction to Mathematical Modeling, ISBN 10: 048641180X / 0-486-41180-X , ISBN 13: 9780486411804, Dover Publication 2000

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	2	2	2
PO2	Problem Analysis	2	3	3	3	3	3
PO3	Design/Development of Solutions	2	3	3	3	3	3
PO4	Conduct Investigations of Complex Problems	2	3	3	3	3	3
PO5	Modern Tool Usage	3	2	2	2	2	2
PO6	The Engineer and Society	1	3	3	3	3	3
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						

PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	2	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	1	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	2	3	3	3	3	3

VERTICAL III: IMAGE PROCESSING AND ANALYSIS

GI3015 SOFT COMPUTING TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- The objective of the course is to make the students to understand the concepts of Artificial Neural Network, Fuzzy logic and Genetic algorithms and also their application in Geomatics.

UNIT I SOFT COMPUTING AND ARTIFICIAL NEURAL NETWORKS 9

Soft Computing: Introduction – soft computing vs. hard computing – soft computing techniques – applications of soft computing – ANN: Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm, Linear separability, Widrow & Hebbian learning rule/Delta rule, ADALINE, MADALINE and BPN.

UNIT II FUZZY SYSTEMS 9

Fuzzy Logic: Fuzzy set theory, Fuzzy set versus crisp set, Crisp and fuzzy relations – introduction and features of membership functions, Fuzzy rule base system: fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making.

UNIT III NEURO-FUZZY MODELLING 9

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum

UNIT IV GENETIC ALGORITHM 9

Genetic algorithm : Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method

UNIT V APPLICATIONS OF SOFT COMPUTING IN GEOMATICS 9

Image registration – Object recognition – Automated feature extraction – navigation – Integration of soft computing and GIS for flood forecasting and monitoring, Landslide susceptibility, Highway alignment, smart city planning, agriculture, solid waste disposal

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the necessity of soft computing techniques and fundamentals of Artificial Neural Networks

CO2 Imparts the concepts of uncertainty and its impacts on artificial intelligence

CO3 Helps to realize the merits of hybrid computing techniques
CO4 Introduces the concepts of heuristic search methods and optimization of solutions
CO5 Gain knowledge on utility of soft computing on multidisciplinary problems

TEXTBOOKS:

1. Freeman J.A. and Skapura B.M., "Neural Networks, Algorithms Applications and Programming Techniques", Pearson, 2002.
2. Jang J.S.R.,Sun C.T and Mizutami E - Neuro Fuzzy and Soft computing ,Prentice hall New Jersey, Pearson, 2015.

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1. Introduction to Artificial Neural Systems by Jacek.M Zurada, Jaico Publishing House,1992.
2. Timothy J.Ross: Fuzzy Logic Engineering Applications, 4th Edition, 2016, McGraw Hill,NewYork,1997.
3. Laurene Fauseett: Fundamentals of Neural Networks, Pearson 2004, Prentice Hall India, New Delhi,1994.
4. George J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall Inc., New Jersey,1995
5. Nih.J. Ndssen Artificial Intelligence, Harcourt

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	2	3	3	3
PO2	Problem Analysis	2	3	2	2	3	2
PO3	Design/Development of Solutions	1	2	2	1	3	2
PO4	Conduct Investigations of Complex Problems	2	3	3	2	3	2
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society	2	3	2	3	3	3
PO 7	Environment and Sustainability	1	1	2	3	3	2
PO 8	Ethics	1	2	2	3	3	2
PO 9	Individual and Team Work	1	2	3	2	3	2
PO 10	Communication	1	2	2	2	2	2
PO 11	Project Management and Finance	2	2	3	2	3	2
PO 12	Life-long Learning	3	2	3	3	3	3
PSO1	Knowledge of Geoinformatics discipline	2	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	2	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	2	3	2	3	3	3

GI3016 THERMAL, HYPERSPECTRAL AND PLANETARY REMOTE SENSING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- This course provides opportunity to explore diverse remote sensing sensors for a wide range of applications.

UNIT I THERMAL REMOTE SENSING 9

History - Thermal Infrared radiation principles – Thermal Radiation Laws – Thermal Properties of Terrain – Data collection-methods – Environmental Consideration - Thermal sensors and characteristics – thermal image characters–image degradation sources & correction.

UNIT II THERMAL DATA ANALYSIS 9

Interpretation of thermal images, Emissivity conservation, Thermal inertia considerations, Factors effecting analysis of thermal images- Application: Estimation of land surface temperature, geological studies, evapotranspiration, Emissivity mapping, Sea Surface Temperature mapping, ET distribution, Urban heat island study.

UNIT III HYPERSPECTRAL REMOTE SENSING 9

Diffraction principles - field spectrum – BDRF and spectral reflectance & imaging spectrometry-sensors - virtual dimensionality-Viewing – Hughe's phenomenon - Data reduction, Calibration and normalization

UNIT IV HYPERSPECTRAL DATA ANALYSIS 9

Spectral library – response functions – MNF transformation – library matching, spectral angle mapper, BBMLC-spectral mixture analysis – end member extraction – spectral unmixing- MIA analysis concepts - PCF, PCA, WPCA spectral transformation – band detection,reductionandselectionprinciples-datacompression-Applications:vegetation,soil and mineral

UNIT V PLANETARY EXPLORATION 9

Universe and Solar system - Terrestrial planets – Planetary interior, atmosphere, planetary surface – simple and complex craters -Planetary exploration and missions: Mars Global Surveyor, Mars Express and MRO – Indian missions - payloads-Moon Minerology Mapper, Thermal emission spectrometer, HySI– age dating of craters – spectral signature of minerals –mineral identification.

TOTAL :45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the concepts of Thermal Remote Sensing
CO2 Understand the thermal data analysis and applications
CO3 Understand the Principles of Hyperspectral Remote sensing
CO4 Workout Hyperspectral data analysis and Applications
CO5 Acquire Knowledge at terrestrial planet and applicability of thermal and hyperspectral remote sensing

TEXTBOOKS:

1. Richards, Remote sensing digital Image Analysis-An Introduction Springer -Verlag, 5th edition 2013.
2. John R. Jenson: Remote Sensing of the environment, Pearson, 2011, 2nd edition
3. Thomas M. Lillesand, Ralph W.Kiefer and Jonathan W.Chipman, Remote Sensing and Image interpretation, JohnWiley and Sons, Inc, New York,2015.
4. Planetary exploration in Thermal and Hyperspectral data Analysis Bo Wu, Kaichang Di, Jürgen Oberst, Irina Karachevtseva, Planetary Remote Sensing and Mapping 1st Edition, CRC Press, 2018

REFERENCES

1. Janza,F.Z.,Blue H.M.andJohnson,J.E.Manual of Remote Sensing. Vol.I, American Society of Photogrametry, Virginia,USA,2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources.CRCPress,1995
3. Paul Curran P.J. PrinciplesofRemoteSensing.Longman,RLBS,1988.
4. Thermal Infrared Remote Sensing Sensors, Methods, Applications Springer Publication 2013

5. Hyperspectral Remote Sensing – Fundamentals & Practices by Ruiliang Pu, CRC Press 2017
6. Remote Sensing Applications for Planetary Surfaces by Deepak Kumar, Lambert Academic Publishing, 2014

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	2	3	2	2	2
PO2	Problem Analysis	3	3	3	3	2	3
PO3	Design/Development of Solutions	1	2	1	2	2	2
PO4	Conduct Investigations of Complex Problems	1	2	1	2	2	2
PO5	Modern Tool Usage	1	1	3	3	2	2
PO6	The Engineer and Society	1	1	1	1	1	1
PO 7	Environment and Sustainability	3	3	3	3	3	3
PO 8	Ethics						
PO 9	Individual and Team Work	1	2	1	2	2	2
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning	3	2	3	2	2	2
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	1	3	1	2	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	2	1	2	2	2

GI3017 POLARIMETRY AND INTERFEROMETRY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To familiarize the students with the concepts of polarimetric and Interferometric observation and its applicability.

UNIT I BASICS OF SAR POLARIMETRY 9

Electromagnetic Waves - Plane Waves – Coherence – Polarization Ellipse - Polarization types: Circular, Elliptical and Linear Horizontal and Linear vertical polarization – Polarimetric Channels: single, dual ,Alternative (ASAR), polarized waves - quadrature or polarimetric waves – Polarimetric representation :Stokes vector and degree of polarization, Scattering matrix – covariance and coherence matrices, stokes and muller matrics – polarimetry parameters : Total power, co-pol correlation coefficient, co-pol phase difference and coefficient of variation.

UNIT II PROCESSING OF SAR POLARIMETRY DATA 9

Polarization Signature: single bounce, double bounce,multi-bounce scatterers and Bragg scatterer – Coherent polarimetric decomposition methods: Pauli,Krogager, Cameron decompositions and Touzi criterion – Incoherent polarimetric decomposition methods: Freeman,Huynen-Barnes,Eigen vector-Eigen value decomposition – Polarimetric classifications :Unsupervised H/A/α, Supervised Bayes maximum likelihood classifications-Overview of Data formats and software (Both free and commercial) availability for SAR and polarimetric- Limitation of polarimetry for practical use and future technological and processing trends.

UNIT III BASICS OF SAR INTERFEROMETRY 9

Basics principle – Interference pattern : Point source, Constructive and Destructive interference - Interferogram - Interference fringe : intensity and visibility of fringes – localization of fringes –

Complex SAR image - Interferometric data structure/Single Look Complex data – Classes of SAR Interferometry- Single Pass/across track, repeat pass/along track and differential SAR Interferometry – INSAR viewing geometry – Sensitivities and errors .

UNIT IV PROCESSING OF SAR DATA FOR INTERFEROMETRY 9

Terrain altitude measurement using INSAR: Baseline estimation, interferogram generation, Orbital flattening, phase unwrapping: branch cuts, fringe detection and absolute phase determination, phase to height conversion, Geocoding of DEM - Differential INSAR: – Multipass geometry – Multi-interferogram techniques : PSINSAR ,SBAS and SqueeSAR – 2D-displacement estimation – precision assessment and validation: atmospheric contribution, phase noise sources: look angle and temporal decorrelation effect, volume scattering effect. Data availability, software availability, limitations and future trends.

UNIT V MISSIONS AND APPLICATIONS 9

Missions:TerraSAR X,ERS 1and2,ENVISAT,RADARSAT,ALOS,RISAT,Sentinel 1 and GRACE satellite. Polarimetric Applications : Soil tillage,crop productivity - snow mapping-sea-ice structure and type- forest type mapping – Soil moisture mapping- Flood/Wetland mapping – Marine winds – oil slick detection – ship detection. Interferometric Applications Vegetation height estimation – Tectonic deformations : pre,co-and post-seismic deformations – Ground Subsidence: Oil and Ground water extraction, Mine subsidence – Landslide detection - Reclaimed Land monitoring - Glacier monitoring: regular ice stream movement and tidal flexing of glaciers –volcanic inflation and deflation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the basic concepts of Polarimetry and Interferomtery
CO2 Gain knowledge about polarimetric processing concepts
CO3 Acquire the knowledge about the fundamentals of SAR Interferometry
CO4 Learn about the grammetric concepts of Interferometric techniques
CO5 Familiarize about the applicability of SAR Polarimetry and Interferometry

TEXTBOOKS:

1. Jhon R.Schott, Fundamentals of Polarimetric Remote Sensing, SPIE press, 2010.
2. P.Hariharan,"Basics of SAR Interferometry",Elsevier, 2007.

REFERENCES

1. Alessandro Ferretti,"Satellite InSAR data: Reservoir monitoring from Space", EAGE Publications, 2014.
2. Alessandro Ferretti, Andrea Monti-Guarnieri,Claudio Prati,Fabio Rocca, "INSAR principles: Guidelines for SAR Interferometry processing and interpretation",ESA Publicaions,2007.
3. Woodhouse Iain. H, "Introduction to Microwave Remote Sensing" Taylor & Francis, 1st edition, 2006.
4. V. B. H. (Gini) Ketelaar,"Satellite Radar Interferometry- Subsidence Monitoring Techniques, Sprringer,2009.
5. Jong-sen Lee,Eric Pottier," Polarimetric Radar Imaging :From Basics to Applications, Taylor & Francis Inc,2009.
6 Ramon F. Hanssen,"Radar Interferometry: Data Interpretation and Error Analysis: 2 (Remote Sensing and Digital Image Processing), Springer; 2001

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	2	3
PO2	Problem Analysis	2	3	2	3	3	3
PO3	Design/Development of Solutions	2	3	2	3	3	3

PO4	Conduct Investigations of Complex Problems	3	3		3	3	3
PO5	Modern Tool Usage	3	3		3	3	3
PO6	The Engineer and Society	2	2		3	3	3
PO 7	Environment and Sustainability		2	2	3	3	3
PO 8	Ethics					3	3
PO 9	Individual and Team Work		3	3	3	3	3
PO 10	Communication		3		3	3	3
PO 11	Project Management and Finance	2	3	2	3	3	3
PO 12	Life-long Learning		3	3	3	2	3
PSO 1	Knowledge of Geoinformatics discipline		3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations		3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

GI3018 AI / DL FOR IMAGE PROCESSING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To familiarize the undergraduate level students to understand the concepts of AI/DL and their applications.

UNIT I EXPLORATORY DATA ANALYSIS 9

Inferential statistics - hypothesis testing – spectral divergence- spectral angle mapper – spectral correlation analysis – support vector machines- tree models – unsupervised learning – clusters –k-means- fuzzy concepts – possibilistic k means - training date sets- random forest classifier - measures of accuracy: RMS, correlation co efficient, ROC

UNIT II ARTIFICIAL INTELLIGENCE 9

Foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation – AI problems

UNIT III LEARNING BASED CLASSIFIERS 9

Kernel concepts – Linear regression – logistics regression - ANN – variants of ANN – back propagation- weight update- CNN- supervised machine learning concepts- recurrent neural network – Hybrid learning network – prediction algorithms - exercise: building foot print extraction, wetland map generation

UNIT IV DEEP LEARNING CONCEPTS AND METHODS 9

Cloud essentials -Git hub - Concepts- convolution- pooling – activation functions – tensors-normalisation- sampling- training – loss function- optimizer – inference – ensemble techniques - models with multiple sources- patch based mode vs. fully convolutional mode- Introduction to CNNs-Back Propagation Algorithm, Vanishing and Exploding Gradients Overfitting Evolution of CNN Architectures: AlexNet, ZFNet, VGG Net, InceptionNets, ResNets, DenseNets.

UNIT V APPLICATIONS OF CNN 9

CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO. CNNs for Segmentation: Types of Segmentation: Instance vs semantic segmentation. FCN, Seg-Net, U-Net, Mask-RCNN.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected

CO1 To provide Knowledge about exploratory data analysis

CO2 To understand concept of Artificial Intelligence

CO3 To understand about learning based classifiers

CO4 To learn concepts and various methods of deep learning

CO5 To learn about various applications of CNN

TEXTBOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2010.
2. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017. 2.
3. Francois Chollet, "Deep Learning with Python", Manning Publications, 2021, 2nd edition.

REFERENCES

1. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison Wesley Educational Publishers Inc., 2011.
2. M. Tim Jones, "Artificial Intelligence: A Systems Approach(Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008
3. Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017.
4. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2017.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	2	3	3	3	3	3
PO3	Design/Development of Solutions			2	3	3	3
PO4	Conduct Investigations of Complex Problems			2	2	3	2
PO5	Modern Tool Usage	2	3	3	3	3	3
PO6	The Engineer and Society	1	1		2		2
PO7	Environment and Sustainability						
PO8	Ethics						
PO9	Individual and Team Work		2		2		2
PO10	Communication				2		2
PO11	Project Management and Finance		2				2
PO12	Life-long Learning	3	3	3	3	3	3
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions			2	2	3	2

GI3019 PATTERN RECOGNITION (SATELLITE, AERIAL, UAV) L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the undergraduate level students to understand the concepts of pattern recognition, feature extraction and other advanced methods..

UNIT I PATTERN CLASSIFIER 9

Overview of Pattern Recognition, Types of Pattern recognition – Discriminant Functions – Supervised Learning – Parametric Estimation – Maximum Likelihood Estimation – Bayes Theorem – Bayesian Belief Network, Naive Bayesian Classifier, non-parametric density estimation, histograms, kernels, window estimators.

UNIT II CLUSTERING 9

Unsupervised learning - Clustering Concept – Hierarchical Clustering Procedures – Partitional Clustering – Clustering of Large Data Sets – EM Algorithm – Grid Based Clustering – Density Based Clustering.

UNIT III FEATURE EXTRACTION AND SELECTION 9

Entropy Minimization – Karhunen Loeve Transformation – Feature Selection Through Functions Approximation – Binary Feature Selection – K-NN.

UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINES 9

State Machines – Hidden Markov Models: Maximum Likelihood for the HMM, The Forward and Backward Algorithm, Sum-Product Algorithm for the HMM, Scaling Factors, The Viterbi Algorithm, Extensions Of The Hidden Markov Model – Support Vector Machines: Maximum Margin Classifiers, Relevance Vector Machines.

UNIT V RECENT ADVANCES 9

Fuzzy Classification: Fuzzy Set Theory, Fuzzy And Crisp Classification, Fuzzy Clustering, Fuzzy Pattern Recognition – Introduction to Neural Networks: Elementary Neural Network For Pattern Recognition, Hebbnet, Perceptron, ADALINE, Back Propagation.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Provide basic knowledge about the fundamentals of pattern recognition and its applications.

CO2 Understand about unsupervised algorithms suitable for pattern classification.

CO3 Familiarize with the feature selection algorithms and methods of implementing them in applications.

CO4 Learn about the basis of algorithms used for training and testing the dataset.

CO5 Learn basic fuzzy system and neural network architectures, for applications in pattern recognition, image processing, and computer vision.

TEXTBOOKS:

1. Andrew Webb, “Statistical Pattern Recognition”, Arnold publishers, London, Second edition, 2002.

REFERENCES

1. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, Second Edition, 2011.
2. R. O. Duda, P. E. Hart, D. G. Stork, “Pattern Classification”, John Wiley, 2001.
3. Narasimha Murthy, V. Susheela Devi, “Pattern Recognition”, Springer 2011.
4. Menahem Friedman, Abraham Kandel, “Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches”, World Scientific publishing Co. Ltd, 2020.
5. Robert J. Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., 1992.
6. S. Theodoridis, K. Koutroumbas, “Pattern Recognition”, Fourth Edition, Academic Press, 2009.

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome	Average

		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	2	3	2	3	3	3
PO3	Design/Development of Solutions	1	1	2	3	3	2
PO4	Conduct Investigations of Complex Problems			3	2	3	3
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society		2			2	2
PO 7	Environment and Sustainability		1			2	2
PO 8	Ethics				2		2
PO 9	Individual and Team Work		2	2		3	2
PO 10	Communication		1			2	2
PO 11	Project Management and Finance					2	2
PO 12	Life-long Learning	2	2	3	3	3	3
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	3	3	3	3
PSO3	Conceptualization and evaluation of Design solutions	2	2	2	2	3	2

GI3020 RASTER DATA MODELLING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To inform the student of raster data model and the way to handle raster database.
- To educate the student about various statistical and numerical tools and techniques to handle image.
- To make student capable of handling images from various sources to extract basic information for application.

UNIT I POINT BASED FUNCTION 9

Image – properties – reading – color contrast – histogram – zooming and display –pan operations – pyramids – enhancements – transformation.

UNIT II NEIGHBORHOOD AND PROXIMITY ANALYSIS 9

8,4 D neighborhood – texture computation – GLCM – distance measurement – buffers (point,line,area).

UNIT III AREA DESCRIPTORS / BOUNDARIES 9

Area computation - shape numbers – perimeter – aspect ratio – point in polygon – line in polygon – overlay analysis.

UNIT IV MULTILAYER MODELING 9

Image ratio – indices – normalization – segmentation – similarity measures – maximum likelihood classification.

UNIT V STATISTICAL METRICS 9

Mean – mode – standard deviation – correlation –regression –covariance – kappa statistics – random sample selection.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Acquaint with the raster data structure and its relevance in from pint based, neighbourhood based and region based geospatial .data analysis

CO2 Understand the various raster based data modeling applied on the earth observation data for resource management

CO3 Evaluate the procedures of spatial data handling using raster data model for solving resource management problems

CO4 Acquire knowledge on the current development, issues methods and solutions in raster data analysis using earth observation data.

CO5 Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of geospatial data modeling

TEXTBOOKS:

1. Geoprocessing with python, Chris Garrad, First edition, 2016
2. Python Data Analysis Cookbook, 2016.
3. Learning Geospatial Analysis with Python, Joel Lawhead, Third edition, 2019.
4. Digital Image Processing using MATLAB, Rafael C. Gonzalez, Third edition, 2020.

REFERENCES

1. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods , Pearson , Fourth edition, 2022.
2. Concepts and Techniques in Geographic Information System, C.P Lo., Second Edition, 2016.
3. Deep Learning with Python, Manning, Second Edition, 2021.
4. Geocomputation with R, Jakub Nowosad, JannesMuenchow, and Robin Lovelace, First Edition, 2020.
5. Advance Custom Raster Processing using Python, Jie Zhang, Hao. Available from: Hu.https://www.esri.com/content/dam/esrisites/en-us/events/conferences/2020/developer-summit/advance-raster-processing-using-python.pdf

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	1	3
PO2	Problem Analysis	1	3	3	2	3	2
PO3	Design/Development of Solutions	3	3	3	1	3	3
PO4	Conduct Investigations of Complex Problems	1	2	3	3	3	2
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society	1	3	2	3	3	2
PO 7	Environment and Sustainability	2	2	3	3	3	3
PO 8	Ethics	1	2	2	3	3	2
PO 9	Individual and Team Work	2	3	3	3	2	3
PO 10	Communication	1	1	3	3	2	2
PO 11	Project Management and Finance	2	2	3	2	3	2
PO 12	Life-long Learning	3	2	1	3	2	
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	3	2	3	3
PSO3	Conceptualization and evaluation of Design solutions	3	3	2	3	3	3

GI3021 **SDG AND GEOMATICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To inform students about the importance of sustainable development and the responsiveness to that.
- To educate the students about the SDG goals and India s initiative to address them.
- To make the student aware of geospatial technology as a central idea in achieving the SDGs.

UNIT I SDG EVOLUTION 9

UNDP- Rio Earth summit 1992 - Agenda 21 - millennium summit- MDGs – world summit on sustainable development – R + 20, Rio – open working group – post-2015 development agenda - 2030 agenda - 2015 agreements and international policy shaping – SDG formulation

UNIT II 17 SDGs 9

SDGs – 17 goals – targets and indicators global sustainable development report 2019 and 2023 - yearly SDG reports (2016 to 2022) – capacity development – international scenario - geospatial capacity in India - Niti Ayog – cooperative federalism, sub groups and task force- -key initiatives- verticals - reports – model agreements-SDG scope in Tamil Nadu - TNAPCC 2

UNIT III SDG-WORLD EXPERIENCE 9

UNDP – integrated solutions – SDG acceleration tool kits- global initiative - Covid -19 experience; UN – GGIM – genesis – objectives – IAEG-SDGS – regional committees- working groups - build the bridge phases - collaboration , corroboration and collation

UNIT IV GEOMATIC TOOLS FOR GIS 9

Geospatial technology – earth observation – historical and current sensors and technology – open and costed data products - geo portals – application areas - SDG focus indicators – national datasets – data portals - GIS - data assimilation – modeling capabilities- statistical dis-aggregation

UNIT V SDG – GEOSPATIAL ROAD MAP 9

Data availability — focus indicators- geospatial Indian story maps – geo-viable SDG indicators – water availability- primary productivity- building index – land capability maps- Health indices – Land temperature maps – watershed characteristics- climate products from satellites – assessment of SDG matrix

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Appreciate the importance of sustainable development and the understand history of worlds unified effort to achieve through SDG s and the participation of the partner countries including India to achieve the same

CO2 Understand the relevance of SDG s , the role of the geospatial technology as central idea to realize the SDG s and the status of this technology worldwide

CO3 Acquire the knowledge about the standard geospatial focus indicators to achieve SDGs and evaluate the methodology to formulate them

CO4 Acquire knowledge on the current development, issues, methods and solutions in application of geospatial technology in comprehending the SDGs for a better world future

CO5 Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation efforts and capacity building of geospatial technology to achieve SDGs

TEXTBOOKS:

1. The sustainable Development Goals - by United Nations: Department of Public Information , 2018, ISBN - 978-9211013696.
2. Dilip Kumar, R.B. Singh, Ranjeet Kaur “Spatial Information Technology for sustainable

Development Goals (sustainable Development Goals series), ISBN-13, 978-3319580388, Springer, 1st edition, 2019.
3. Rajabifard, Abbas (Editor), Sustainable Development Goals Connectivity Dilemma, ISBN9780429290626,Taylor & Francis, 2022 Open access http:// library.oapen.org/ handle/20.500.12657/24929
4. SDGs Geospatial roadmap-UNGGIM, https://ggim.un.org/meetings/GGIMcommittee/11thSession/documents/The_Geospatial_SDGs_Roadmap_WGGI_IAEG_SDGs_20210804.pdf

REFERENCES

1. UNDP, INEGI, The SGD s Geospatial Roadmap, 2019 – OPEN ACCESS
2. UNDP, UNHABITAT, GLOBAL TASK FORCE, "Road map for localizing the SDG: implementation and monitoring at sub national level
3. WWW.NITIAYOG.IN
4. UNDP, "global consultation draft: strategies pathways" 2020

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	3	3	3	1	3
PO2	Problem Analysis	1	1	3	2	3	2
PO3	Design/Development of Solutions	1	1	3	3	3	2
PO4	Conduct Investigations of Complex Problems	1	3	2	3	3	2
PO5	Modern Tool Usage	1	2	3	3	3	3
PO6	The Engineer and Society	3	3	3	2	3	3
PO 7	Environment and Sustainability	2	2	3	3	3	3
PO 8	Ethics	1	3	2	1	3	2
PO 9	Individual and Team Work	1	1	3	3	2	2
PO 10	Communication	2	3	2	3	3	2
PO 11	Project Management and Finance	1	2	3	3	2	2
PO 12	Life-long Learning	2	2	2	3	3	2
PSO 1	Knowledge of Geoinformatics discipline	2	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	2	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	2	3	3	2	3	3

VERTICAL IV: GEO SPATIAL APPLICATIONS

GI3022 ENVIRONMENTAL GEOINFORMATICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- The objective of this course is to expose the students to the applications of Remote Sensing and GIS for water quality assessment, soil degradation assessment and monitoring pollution.

UNIT I WATER AND THE ENVIRONMENT 9

Sources and demands of water – Characteristics of water – Point and non-point sources of water pollution – Spectral responses of clear and contaminated water – chlorophyll – Remote Sensing of

Water quality assessment - Classification of water quality for various purposes , Sampling procedure, quality analysis, Database creation and quality modeling using GIS. Database Creation and designing water supply network, sewerage network using GIS. Runoff estimation – flood prediction modeling – aquifer vulnerability modeling.

UNIT II SOIL CONSERVATION AND MANAGEMENT 9

Formation of Soils – classification – landforms – soil erosion – factors influencing soil erosion, soil contamination – distribution and accumulation of contaminants such as toxic metals, synthetic chemicals in soil – mining pollution – methods of conservation – afforestation – EMR responses with contaminated soil – modeling soil characteristics using satellite data-soil degradation assessment using Remote Sensing and GIS- Land reclamation.

UNIT III SOLID WASTE MANAGEMENT 9

Definition – sources – identification of storage and collection location - Analysis of collection route Site selection: Transfer station, Disposal site – Waste allocation –contamination transport model - case studies.

UNIT IV AIR POLLUTION 9

Geo demographic Analysis – Land Value Analysis – Optimisation of Facility Locations – Site suitability Analysis for Infrastructure – Optimal Route Analysis – Accident Analysis – Road Alignment Planning – Traffic and Parking Studies – case studies.

UNIT V GLOBAL PROSPECTIVE AND CLIMATE CHANGE 9

Prevention and Control measures – Carbon footprints and sinks, carbon trading, carbon credits and marketing, Indian and international status - case studies - Definitions- Climate, Climate system, climate change – Drivers of Climate change – Characteristics of climate system components - Green house effect – Carbon cycle - case studies.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the possible applications of remote sensing and GIS in water quality analysis and network design

CO2 Understand the possible applications of remote sensing and for soil conservation

CO3 Understand the possible applications of remote sensing and for solid waste management

CO4 Understand the possible applications of remote sensing and for air pollution mapping and modelling

CO5 Understand the possible applications of remote sensing and for climate change perspectives

TEXTBOOKS:

1. Andrew N. Rencz, Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring, John Wiley& Sons Inc, April 2004.
2. Baretl,E.C.and CulisI. F.Introduction to Environmental Remote Sensing, Second edition, Chapman and Hall, NewYork, 1993

REFERENCES

1. Lintz, J. and Simonent,D.S. Remote sensing of environment Addision Wesley, Radingmars, 2010.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	3	3	3	3	2	3
PO3	Design/Development of Solutions	3	2	3	3	2	3

PO4	Conduct Investigations of Complex Problems	3	3	3	3	3	3
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	The Engineer and Society	3	3	3	3	3	3
PO 7	Environment and Sustainability	3	3	3	3	3	3
PO 8	Ethics	1	1	1	1	1	1
PO 9	Individual and Team Work	2	2	2	2	2	2
PO 10	Communication	2	2	2	2	2	2
PO 11	Project Management and Finance	3	2	3	3	2	3
PO 12	Life-long Learning	3	3	3	3	3	3
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	2	2	2	2	2	2

GI3023 GEOMATICS FOR URBAN INFRASTRUCTURE L T P C
3 0 0 3

COURSE OBJECTIVES:

- To expose students the relevance of Geoinformatics to Urban Planning and Management
- To introduce the latest developments in Remote Sensing methods useful for Urban Planning and Management
- To impart knowledge on possible applications of Geoinformatics for Urban planning and Management

UNIT I INTRODUCTION 9

Remote Sensing – Developments – Relevance in Urban Planning – Scope and Limitations – Scale and Resolution requirements – Spectral characteristics of Urban Features – High Resolution, Thermal, Hyperspectral and Microwave Remote Sensing for Urban Analysis – Stereo Data Products – Aerial and Ground based Sensors – UAVs – Laser Scanners

UNIT II REMOTE SENSING FOR URBAN MAPPING 9

Urban Area Definition and Characterization – Base Map Preparation – Urban Landuse Classification – Visual and Digital Techniques for Landuse Mapping – Urban Structure and Patterns – Urban Land Cover Classification – Feature Extraction techniques – Change Detection – Sprawl Detection and Characterization – Mapping of Urban Morphology – Urban Heat Island – Building Typology

UNIT III GEOINFORMATICS FOR URBAN PLANNING 9

Steps in planning process- Objectives, types and Contents of Plans – Master and Detailed Development Plans – Role of Geoinformatics in Plan Formulation and Review - Urban Information System – Population Estimation – Property Tax Assessment and Management – Urban Solid Waste Management Planning – Urban Renewal Planning – Utility Network Planning and Management– case studies.

UNIT IV GEOINFORMATICS FOR URBAN ANALYSIS 9

Geo demographic Analysis – Land Value Analysis – Optimisation of Facility Locations – Site suitability Analysis for Infrastructure – Optimal Route Analysis – Accident Analysis – Road Alignment Planning – Traffic and Parking Studies – case studies.

UNIT V VISUALIZATION, SIMULATION AND MODELING OF URBAN AREAS 9

Urban Growth Modelling – Air quality indexing and mapping – Noise pollution modeling - 3D City Modelling – Flood Modeling in Urban Areas – Geoinformatics for Smart Cities–IOT integeration-BIM-Recent Advancements – Case Studies

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 The basics of Urban mapping and Plan preparation.
CO2 The application of remote sensing in urban mapping.
CO3 The role of remote sensing in preparation of urban plans.
CO4 The modeling techniques for modeling and prediction of future land use scenarios
CO5 Understanding the Visualization, simulation and modelling of urban area.

TEXTBOOKS:

1. Netzband,Maik;Stefanov,WilliamL.;Redman,Charles(Eds.)¸Applied Remote Sensing for Urban Planning, Governance and Sustainability,Springer,1st Edition, 2007
2. Rashed,Tarek; Jürgens,Carsten(Eds.),Remote Sensing of Urban and Sub urban Areas, Springer, 1st Edition. 2010

REFERENCES

1. Jean-Paul Donnay,Michael John Barnsley, Remote sensing and urban analysis,1st Edition, Taylor &Francise-Library,2005
2. Qihao Weng, Dale A.Quattrochi(Eds), Urban Remote Sensing,1st edition, CRC Press, 2006
3. Maik Netzband, William L. Stefanov, Charles Redman Applied Remote Sensing for Urban Planning, Governance and Sustainability, Springer berlin Heidelberg, 2007
4. Xiaojun Yang,Urban Remote Sensing: Monitoring, Synthesis and Modeling in the Urban

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	2	2	3	3	3
PO2	Problem Analysis	1	1	2	2	3	2
PO3	Design/Development of Solutions			2	3	3	3
PO4	Conduct Investigations of Complex Problems			2	2	3	2
PO5	Modern Tool Usage	2	2	3	3	3	3
PO6	The Engineer and Society		1	2	3	3	3
PO7	Environment and Sustainability		2	2	3	3	3
PO8	Ethics	1				1	1
PO 9	Individual and Team Work			2	2		2
PO10	Communication			2			2
PO11	Project Management and Finance		2		2	3	2
PO12	Life-long Learning	1	2	3	3	3	3
PSO1	Knowledge of Geoinformatics discipline	2	2	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations	1	2	3	3	3	2
PSO3	Conceptualization and evaluation of Design solutions		1	2	2	3	2

GI3024 GEOMATICS FOR HYDROLOGY AND WATER RESOURCES **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge in various applications of hydrology and water resources using Geomatic technology.

UNIT I HYDROLOGIC COMPONENTS **9**

Hydrologic cycle-estimation of various components – clouds: Types of Clouds – rainfall: Types of Rainfall – runoff – evaporation –transpiration – evapo-transpiration–interception–depression storage-Spectral properties of water.

UNIT II SURFACE WATER MODELLING **9**

Drainage basin – Delineation and codification of watershed - Morphometric analysis – Hydrological Modelling – Rainfall – runoff modelling – USDA-SCS-CN Method – Urban Hydrology – LiDAR Mapping for Urban area – Impact of Climate change on Hydrological modeling - Water quality mapping and monitoring – Correlation model for pollution detection.

UNIT III RISK AND DAMAGE ASSESSMENT **9**

Mapping of snow covered area– Snow melt runoff– glacier runoff modelling– flood forecasting – Flood Risk Zoning - Flood damage assessment– Flood Modelling- Early warning system for Flood mitigation–drought–types–assessment of droughts and mitigation-water harvesting structures

UNIT IV GROUND WATER MODELLING **9**

Origin–classification and properties of aquifer–ground water potential identification – surface indicators – aquifer parameters – hydrologic budgeting – different types of ground water models–mathematical modelling of groundwater system- sea water intrusion–interfacing GIS with ground water model - artificial recharge of ground water.

UNIT V IRRIGATION AND WATERSHED MANAGEMENT **9**

Crop water requirements - Visible and Near Infrared – Crop Stress: Thermal Infra Red and Biophysical Indices – Reservoir Sedimentation Studies – capacity curve generation - modelling of reservoir siltation – impact of climate and land use change on drainage basin – Erosion Estimation using Remote sensing - prioritization of watersheds – watershed modelling for sustainable development.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand various components of Hydrologic Cycle
CO2 Apply remote sensing & GIS concepts for surface water resources applications
CO3 Apply remote sensing & GIS concepts for risk and damage assessment
CO4 Apply remote sensing & GIS concepts for ground water modelling
CO5 Estimate water requirement and to apply best practices for watershed management.

TEXTBOOKS:

1. Gert A. Schultz, Edwin T. Engman, Remote Sensing in Hydrology and Water Management, Springer Berlin Heidelberg -2011
2. S. K. Gupta, Modern Hydrology and Sustainable Water Development, John Wiley & Sons – 2010.
3. K. Ramamohan Reddy, B. Venkateswara Rao, C. Sarala, HYDROLOGY AND WATERSHED MANAGEMENT, Allied Publishers – 2014.

REFERENCES

1. Andrew Skidmore, Environmental Modelling with GIS and Remote Sensing, CRC Press– 2017
2. Dorota Swiatek, Stefan Ignar, Modelling of Hydrological Processes in the Narew Catchment, Springer Berlin Heidelberg - 2013

3. Tim Davie, FUNDAMENTALS OF HYDROLOGY Second edition, Taylor & Francis -2018

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis		3	3	3	3	3
PO3	Design/Development of Solutions		3		3	3	3
PO4	Conduct Investigations of Complex Problems			3		3	3
PO5	Modern Tool Usage	3	3	3	2	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						
PSO1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO2	Critical analysis of Geoinformatics Engineering problems and innovations		3	3	2	2	3
PSO3	Conceptualization and evaluation of Design solutions				3	3	3

GI3025 SATELLITE METEOROLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic concepts of atmospheric science and meteorology.
- To impart the knowledge on surface, upper air and space based meteorological observation and its applicability.

UNIT I STANDARD ATMOSPHERIC CHARCTERISTICS AND OBSERVATION 9

Meteorology: Definition and types – Origin and Composition of atmosphere – Structure of Standard atmosphere – Distribution of Temperature, Pressure and Density –Distribution of winds :Global wind circulation pattern, Local and Monsoon winds– Aerosols- Conventional measurement of Temperature, Humidity, Wind, pressure and precipitation – Modern meteorological instruments – Surface and Upper air observation network – Doppler weather radar.

UNIT II WEATHER AND CLIMATE SYSTEM 9

Cloud types and formation processes– Precipitation development – Bergeron and Findeison mechanism, –Air masses and fronts :Warm, Cold, Stationary and Occluded fronts - Weather charts and symbols – Tropical Cyclones: Influencing factors, Formation, Structure, Life cycle, movement and climatology – Life cycle –Thunderstorms– ElNino – Southern Oscillation – Climatic scales and classification– genetic and empirical approaches.

UNIT III METEOROLOGICAL SATELLITES AND SENSING SYSTEM 9

Polar and Geostationary orbits – Payloads: imaging and non-imaging – Evolution of polar and geostationary satellites : TIROS, NIMBUS, GOES, Meteosat and Metop series –Indian meteorological missions– current operational satellites: INSAT-3D and INSAT-3DR –Imaging channels: visible,IR, water vapour and shortwave IR - meteorological image properties – visual image interpretation

UNIT IV ATMOSPHERIC SOUNDING 9

Atmopsheric absorption and emission – absorption bands of CO2,water vapour and ozone –Vertical sounding – Radiosonde –Radiative Transfer Modelling–transmittance and weighting function –IR and Microwave sounders –vertical profile retrieval for temperature –aerosol retrieval – Ozone sounding:in-situ measurement, satellite techniques-BUV, occultation, Limb scattering and emission.

UNIT V APPLICATIONS 9

Weather forecasting : Tools and methods – Low pressure system monitoring – DVORAK Cyclone intensity estimation – Cyclone Warning System – Flood and storm surge warning system –Global warming and sea level change – Agrometeorology – Urban meteorology –aviation meteorology – Wild Fires and Volcanic Ash.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the fundamental concepts on atmospheric science.

CO2 Gain knowledge on various weather and climate features and system.

CO3 Familiarize about the historical and current operational meteorological sensing system.

CO4 Acquire knowledge about the principle of atmospheric sounding and vertical profile retrieval methods

CO5 Be able to analyze the critical weather and climatic issues and to develop the solutions.

TEXTBOOKS:

1. Chandrasekar.A, “Basics of atmospheric science”,PHI Learning Pvt Ltd, 2010.
2. Stojce Dimov Ilcev,”Global Satellite Meteorological Observation (GSMO) Applications”,Volume 2,Springer,2019.
3. S.R.Kalsi, ―Use of Satellite Image in Tropical Cyclone Intensity Analysis and Forecasting‖, India Meteorological Department, New Delhi, Meteorological Monograph, Cyclone warning Division No.1/2002.

REFERENCES

1. Asnani, G.C ―Tropical Meteorology‖, Vol.I and II, 3rd Edition, 2016
2. Doviak and Zrnic, ― Doppler Radar and Weather observations‖, Academic press, London,2014.
3. Su-Yin Tan,”Meteorological Satellite Systems”,International Space University, Springer,2014.
4. Kelkar R.R. Satellite Meteorology, B S Publications, Hyderabad,2007.
5. A.Henderson-Sellers and P.J.Robinson,”Contemporary Climatology”, Longman Scientific &Technical,Longman group UK Ltd.1986..
6. Adarsh Deepak,”Remote Sensing of Atmospheres and Oceans”,Academic Press Inc,1980.
7. Inversion methods in Atmospheric Remote Sensing”,Adarsh Deepak,Academic Press Inc,1977.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3		3	2	3
PO2	Problem Analysis			2	3	3	3
PO3	Design/Development of Solutions	2	2		3	3	3
PO4	Conduct Investigations of Complex Problems		2	3	3	3	3
PO5	Modern Tool Usage	2		3	3	3	3
PO6	The Engineer and Society		3		2	3	3
PO 7	Environment and Sustainability	2	3	3		3	3
PO 8	Ethics	3		3		3	3
PO 9	Individual and Team Work	3		3	2	3	3
PO 10	Communication	2	3	3	2	3	3
PO 11	Project Management and Finance	3		3		3	3
PO 12	Life-long Learning	2		3	2	3	3
PSO 1	Knowledge of Geoinformatics discipline		2	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations		3	2	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

GI3026 GEOMATICS FOR DISASTER AND RISK MITIGATION **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand various technological options especially Remote Sensing and GIS in Disaster management.

UNIT I INTRODUCTION TO DISASTERS 9

Disaster: Definition and Classification - Hydrological and geological disasters, characteristics crisis and consequences-Role of Government administration, University research organization and NGO's-International disaster assistance-Sharing technology and technical expertise.

UNIT II LONG TERM MITIGATION MEASURES 9

Needs and approach towards prevention-Principles and components of mitigation Disaster legislation and policy - Insurance - Cost effective analysis - Utilization of resources -Training - Education-Public awareness-Roles of media.

UNIT III SAFETY RATING OF STRUCTURES 9

Slope stability of Ghat roads -Structural safety of Dams, Bridges, Hospitals, Industrial structures, - Disaster resistant structures-Low cost housing for disaster prone areas-Cyclones helter projects and their implications-Reconstruction after disasters: Issues of practices.

UNIT IV SPACE SCIENCE INPUT IN DISASTER MANAGEMENT 9

Remote sensing in Hazard evaluation- zonation – Risk assessment - Damage assessment- Land use planning and regulation for sustainable development–Communication satellite application- Network-Use of Internet – Warning system-Post disaster review-Case studies

UNIT V EMERGENCY PLANNING USING SPATIAL AND NON-SPATIAL DATA 9

Information systems management-Spatial and non-spatial data bank creation– Operational emergency management - Vulnerability analysis of infrastructure and settlements – Pre disaster and post disaster planning for relief operations - Potential of GIS application in development planning – Disaster management plan-Case studies

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Gain knowledge on various types of disasters and infrastructural facilities available for managing disasters

CO2 Plan long term disaster mitigation measures

CO3 Evaluate the safety of the various social structures

CO4 Use remote sensing data products for disaster management

CO5 Apply GIS concepts in disaster management

TEXTBOOKS:

1. J. P. Singhal (2010), Disaster Management, Laxmi Publications, ISBN-10:9380386427, ISBN-13:978-9380386423.
2. Tushar Bhattacharya (2012), Disaster Science and Management, McGraw Hill India EducationPvtLtd., ISBN-10:1259007367,ISBN-13:978-1259007361.

REFERENCES

1. Bell, F.G.Geological Hazards: Their assessment, avoidance and mitigation E&F.NSPON Routledge, London.2012.
2. George G.Penelis and Andreas J. Kappos-Earthquake Resistant concrete Structures.E&F.NSPON,London, 2010
3. Mitigating Natural Disasters, Phenomena, Effects and options, A Manual for policy makers and planners, United Nations. New York,1991
4. GuptaAnilK,SreejaS,Nair.2013 Disaster Mangement and Risk reduction: Role of Environmental Knowledge, Narosa Publishing House, NIDM, NewDelhi
5. Kapur Anu,Vulnerable India: A Geographical study of Disasters,IIAS and sage Publishers,NewDelhi,2010

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2		3	3	3	3
PO2	Problem Analysis	2	3	3	3	3	3
PO3	Design/Development of Solutions				3	3	3
PO4	Conduct Investigations of Complex Problems			3	3		3
PO5	Modern Tool Usage				3	3	3
PO6	The Engineer and Society	3	3	3		3	3
PO 7	Environment and Sustainability	3	3	3	3	3	3
PO 8	Ethics	3	3	3			3
PO 9	Individual and Team Work	3	3	3			3
PO 10	Communication	2	2		3	3	3
PO 11	Project Management and Finance		3		3	3	3
PO 12	Life-long Learning	3	3		3	3	3
PSO 1	Knowledge of Geoinformatics discipline				3	3	3

PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	2	2	3	3	3	3

GI3027 GEOMATICS FOR AGRICULTURE AND FORESTRY L T P C
3 0 0 3

COURSE OBJECTIVES:

- Through this course students can learn about remote sensing and GIS techniques to use in a variety of applications related to agriculture,soil, land and forest resources.

UNIT I CROP INVENTORY AND REMOTE SENSING 9

Introduction-leaf optical properties-identification of crops and crop inventorying–crop acreage estimation-vegetation indices-yield estimation-crop production forecasting through digital analysis -microwave and hyper spectral sensing for crop inventory –crop monitoring and condition assessment – case studies.

UNIT II REMOTE SENSING FOR SOIL 9

Introduction-soil survey, types of soil surveys-soil genesis and soil classification –soil taxonomy-soil reflectance properties-soil mapping using remote sensing–problem soils-saline, alkali soil characteristics-mapping of saline alkaline soils-soil erosion and sedimentation-assessment of soil erosion – estimation of reservoir capacity.

UNIT III LAND EVALUATION AND MANAGEMENT 9

Introduction- land use/land cover definition- land use/ land cover classification-concepts and approaches of land evaluation–Change dynamics–Land capability assessments-decision support system for land use planning -optimum land use planning for sustainable agriculture

UNIT IV DAMAGE ASSESSMENT 9

Introduction-damage by pests and diseases-crop loss assessment by floods -flood hazard zone mapping-remote sensing capabilities and contributions for drought management-landdegradationduetowaterloggingandsalinity-cropstress-reflectance properties of stressed crops-identification of crop stress –Agricultural insurance in India –CCIS,ECIS,FIIS and NAIS

UNIT V FOREST MANAGEMENT 9

Introduction-forest taxonomy-inventory of forests-forest type and density mapping-bio mass assessment-timber volume estimation-factors for forest degradation-mapping degraded forests deforestation and afforestation-forest fire mapping and damage assessment–species mapping -sustainable development of forests

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to
CO1 Characterize the crops using Remote Sensing tools
CO2 The concepts of soil mapping through remote sensing
CO3 The evaluation of land capability for better land use planning
CO4 Acquire Knowledge in damage assessment using remote sensing
CO5 Understand the forest management using remote sensing

TEXTBOOKS:

1. Applications of Remote Sensing in Agriculture (2013) United Kingdom Elseiver Science
2. Remote Sensing of Agricultural crops & Vegetation by Mutlu Ozdogan, Yang Yang, Excelic press, 2020
3. Remote Sensing for Sustainable Forest Management, Steve E. Franklin, CRC Press 2001

4. Srinivas,M.G.,Remote Sensing Applications, Narosa Publishing House,NewDelhi,2001.
5. Andrew Rencz ,Manual of Remote Sensing. Vol.3. Edn.3. Remote Sensing for the Earth Sciences, American Society for photogrammetry and Remote Sensing, John Wiley& Sons, New York, 1999

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1. Jensen,J.R.,Remote Sensing of the Environment -An Earth Resource Perspective. Dorling Kindersley (India) Pvt. Ltd., NewDelhi,2001
2. Agarwal,C.S.and P.K.Garg, Textbook on Remote Sensing in Natural Resources Monitoring and Management.WheelerPublishing,NewDelhi,2000
3. Narayan,L.R.A.,Remote Sensing and its Applications. Universities Press (India) Ltd., Hyderabad, 2001

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	2	2	2	2
PO2	Problem Analysis	2	2	2	2	2	2
PO3	Design/Development of Solutions	1	3	2	3	3	3
PO4	Conduct Investigations of Complex Problems	1	2	3	3	2	2
PO5	Modern Tool Usage	1	3	2	3	2	2
PO6	The Engineer and Society	2	2	2	2	2	2
PO 7	Environment and Sustainability	2	2	3	3	2	2
PO 8	Ethics			1	2		2
PO 9	Individual and Team Work	1	1	1	3	2	2
PO 10	Communication	1	1	1	2	1	1
PO 11	Project Management and Finance						
PO 12	Life-long Learning	3	2	2	3	2	2
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	2	2	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	3	1	3	2	2

GI3028 GEOMATICS FOR OCEAN AND COASTAL APPLICATIONS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To familiarize the students about the basics and Geomatics applications in the field of Oceanography and coastal processes

UNIT I FUNDAMENTAL OCEANOGRAPY AND COASTAL PROCESSES 9

Origin and formation of large water bodies – Ocean basins–Oceanic Zones –Ocean Circulations: Global thermohaline, wind driven circulations and currents – Regional Upwelling and eddy development – Waves: structure, characteristics and wave generated currents –Current meters – Tides – Coastal erosional and accretional landforms.

UNIT II SEA WATER CHARACTERISTICS AND MEASUREMENT 9

Heat, Light and sound transmission characteristics –Sea water chemistry – Ocean Biology – Marine food web –sea water sampling and measurement –NISKIN water sampler and DSRT –CTD profiler – CTD rosette – Bathythermograph – XBT –Sediment samplers: Dredge,GRAB and deep sea coring devices

UNIT III COASTAL HYDRODYNAMICS AND SENSING SYSTEMS 9

Sea water intrusion – pollution dispersion – coastal protection structures –platforms and sensing systems – payloads - past and current operational satellites: NOAA, SeaSTAR, Adeos, ERS, Topex/Poseidon, QikSCAT and sentinel 3 – Indian missions: Oceansat1 and 2, SARAL and SCATSAT.

UNIT IV REMOTE SENSING RETRIEVAL AND MAPPING 9

Ocean color remote sensing – bio-optical algorithm and SeaDAS processing – sea surface temperature estimation –sea surface topography mapping: RADAR altimetry and data processing – Sea level Anomaly – Scatterometry:Sea surface wind retrieval and mapping – Bathymetry – Bathymetric LiDAR.

UNIT V APPLICATIONS AND MANAGEMENT 9

Coastal zone management :critical issues, LU/LC and wetland mapping –Coastal Regulation Zones –Potential Fishing Zone Mapping – Shoreline Change Analysis –Sea Level Rise Monitoring –- Cyclone tracking and damage assessment - Tsunami early warning system and damage assessment - Use of SAR images– Ship detection - Oil spill studies.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the basic concepts of Ocean and Coastal processes.
CO2 Gain knowledge on physical, chemical and biological characteristics of sea water.
CO3 Familiarize about coastal hydro dynamism and operational sensing systems
CO4 Acquire knowledge on retrieval through remote sensing methods.
CO5 Analyze the applicability of retrievals for solving critical issues and develop strategic management plan.

TEXTBOOKS:

1. Ian.S.Robinson,"Discovering the Ocean from Space:The unique applications of satellite ocanohraphy",Springer &Praxis Publishing,2010.
2. Seelye Martin,"An Introduction to Ocean Remote Sensing", Cambridge University Press,2004.
3. Ian.S.Robinson,"Measuring the Oceans from Space-The principles and methods of satellite Oceanoghraphy, Springer &Praxis Publishing,2004.

REFERENCES

1. Robert Stewart,"Introduction to Physical Oceanography, Orange Grove Books publisher ,2009.
2. Motoyoshi Okeda and Frederic W.Dobson, "Oceanographic applications of Remote Sensing", CRC Press,2005.
3. Vasilis D. Valavanis, GIS in oceanography & Fisheries, Taylor & Francis London &NewYork, 2002.
4. David Halpem,"Satellites, Oceanography and Society",Elsevier,2000.
5. Alasdair J.Edward, Remote Sensing Handbook for Tropical Coastal Management, UNESCO publishing, 2000.
6. Karsten Mangor, Shoreline Management Guidelines, Publisher: Horsholm, DHI Water & Environment, Denmark, 2004.
7. L.S.Robinson,"Satellite Oceanography: An introduction for Oceanographers and Remote-Sensing Scientists", John Wiley and Praxis Publishing, 1995.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	2	3		3
PO2	Problem Analysis	3	2		3	3	3
PO3	Design/Development of Solutions	3	2	3	2	3	3
PO4	Conduct Investigations of Complex Problems	3	3	2	3	3	3

PO5	Modern Tool Usage		2	3	3	3	3
PO6	The Engineer and Society			3	2	3	3
PO 7	Environment and Sustainability	3		3	3	3	3
PO 8	Ethics		3	3	2	3	3
PO 9	Individual and Team Work		3	2	3	3	3
PO 10	Communication		3	3	3		3
PO 11	Project Management and Finance		2	3	3	3	3
PO 12	Life-long Learning		2	3	2	3	3
PSO 1	Knowledge of Geoinformatics discipline			3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3		3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	2	3		3	3

VERTICAL V:GEODESY

GI3029 ADVANCED GEODESY **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- The objective of this course is to expose the students to the advancement in geodesy and to understand the international perspective of advanced geodesy and be able to cooperate internationally.

UNIT I GEODETIC CONTROL 9

Horizontal control – characteristics – method and standards for triangulation, traversing, trilateration, inertial and space techniques (Doppler GPS, SLR and VLBI) – computation – problems on spherical coordinates. Vertical control - characteristics – method and standards for spirit levelling, trigonometrical levelling and space techniques - computations- national networks.

UNIT II GEODETIC COMPUTATIONS 9

Rectangular and Polar Co - ordinates - First and Second geodetic problem – Similarity, Affine Projective and Polynomial transformation - methods of point determinations – problems on intersection, resection, arc section and also with over determinations, polar method and its extension.

UNIT III ASTRONOMICAL COMPUTATIONS 9

Variation in celestial co - ordinates, Determination of Astronomical Azimuth- stars altitude and hour angle methods, astronomical latitude and longitude determination – sources of errors and its eliminations- problems

UNIT IV HEIGHT SYSTEMS 9

Geo potential number - Orthometric height, Normal height, Dynamic height and their corrections – computation of orthometric height, Ellipsoidal height and its determination with a single and reciprocal observation of vertical angle - geoidal height – methods and computation.

UNIT V MISCELLANEOUS TOPICS 9

Crystal movements and plate motion – methods of determination of horizontal and vertical movements – dam deformation- earth tides – tidal forces, tidal response of the solid earth, tidal loading, analyzing and predicting earth tides, earth tide instrumentation – satellite altimetry – observations, computation and interpretation and application – Gravity Field Missions: satellite-to-satellite tracking – CHAMP and GRACE Satellite gravity gradiometry: GOCE.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Identify and relate various methods available for Horizontal and Vertical Control

CO2 Understand methods available for computation of coordinates of control points

CO3 Understand procedure for computation of azimuth, latitude, longitude by astronomical observations

CO4 Identify various methods to represents height and compute the same

CO5 Summarize various applications of geodetic observations and gravity measurements

TEXTBOOKS:

1. Physical Geodesy by Weikko A. Heiskanen and Helmet Moritz, W.H.Freeman and Company, 1967.
2. The gravity field of the Earth, International Geophysics Series- Vol-10 by Michele Caputo, Academic Press, New York, 1967.

REFERENCES

1. Petr Vanicek and Edward J. Krakiwsky, Geodesy: The concepts, North-Holland, Publications Co., Amsterdam, 1991.
2. James R.Smith, Introduction to Geodesy, John wiley & Sons Inc. 1997
3.Tom Herring, ―Geodesy ‗ Elsevier,2009, ISBN: 0444534601
4. Schwarze, V.S. Geodesy: The challenge of the 3rd millennium, Springer verlag, 2002

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	2	3
PO2	Problem Analysis	3	3	3	2	3	3
PO3	Design/Development of Solutions	2	3	3	2	2	2
PO4	Conduct Investigations of Complex Problems	2	2	2	2	1	2
PO5	Modern Tool Usage	3	1	1	1	2	1
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	3	2	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	2	2	2	1	2

GI3030 **SATELLITE GEODESY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- This subject deals with satellites in space, which are used for the geodetic applications. Several satellites launched will transmit the carrier signal, by receiving the ground position are determined.

UNIT I INTRODUCTION 9

Introduction to satellite geodesy- Overview of GNSS: Introduction to GPS- GLONASS- GALILEO- BIDOU- IRNSS satellite systems etc. Keplerian laws of satellite motion- geometry of ellipse and Keplerian ellipse in space- transformation of coordinates from Keplerian elements to Earth centered Earth fixed (ECEF) coordinate system- perturbed satellite motion- Lagrangian and Gaussian forms of perturbation equations- gravitational and non-gravitational perturbing forces- geodetic applications of satellite missions.

UNIT II DIFFERENT TECHNIQUES 9

Observables and Basic Concepts- Determination of Directions- Ranges and Range Differences (Doppler method)- Satellite Altimetry- Determination of Ranges and Range-Rates (Satellite-to-Satellite Tracking)- Interferometric Measurements- Satellites Used in Geodesy- Navigation Payload- PRARE- Planned Satellites and Missions- Electronic Ranging SECOR- Electronic observation techniques – Doppler Effect – Positioning concept – Development of TRANSIT satellites.

UNIT III SATELLITE SYSTEM 9

GPS – Different segments – space- control and user segments – GPS signal structure and code modulation- pseudo range measurements and navigation solution signal structure – Accuracy of navigation position: UERE and DOP. Intentional degradation of GPS signals: Selective availability (SA) and anti-spoofing (AS). GPS receiver's components. Differential GPS: Space based augmentation systems (e.g.- GAGAN- WAAS- EGNOS) and ground-based augmentation systems (GBAS).

UNIT IV GPS DATA OBSERVATION 9

GPS observables - code and carrier phase observation. Single differencing- double differencing and triple differencing in GPS measurements. ambiguity resolution- multi path and other observational errors- doppler effect on GPS signals- cycle slip detection. GNSS observation- data downloading- processing and discussion of processed data. Relative positioning: Static – Rapid static and pseudo kinematic; kinematic positioning – pure kinematic- semi kinematic and real time kinematic (RTK) methods of observations. Real time network (VRS) services.

UNIT V GPS DATA PROCESSING AND APPLICATIONS OF SATELLITE GEODESY 9

Networking- data post processing; with commercial software and scientific software. CORS - setting up of regional geodetic networks and development of regional geoid models. Geodetic control surveys- Cadastral surveying- Photogrammetry- Remote Sensing- Engineering and Monitoring GIS - Satellite Laser Ranging and Applications.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Recognize the factors affecting satellite motion and laws governing the motion

CO2 Summarize various techniques available for geodetic measurements from space

CO3 Understand the concepts and components of GNSS

CO4 Choose appropriate methods for GNSS surveying
CO5 Summarize various applications of Satellite Geodesy

TEXTBOOKS:

1. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 2nd edition 2008

REFERENCES

1. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 4th Edition, 2015.
2. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer – Verlag, Berlin, 2004

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	3	3	2	2	3	3
PO3	Design/Development of Solutions	2	2	2	2	2	2
PO4	Conduct Investigations of Complex Problems	2	2	1	1	2	2
PO5	Modern Tool Usage	1	3	3	2	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	2	2	3	3	2
PSO 3	Conceptualization and evaluation of Design solutions	2	1	1	2	2	2

GI3031 PHYSICAL GEODESY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of gravimetry, gravity field and their statistics.

UNIT I INTRODUCTION 9

Need to study gravity- historical review- research areas- applications. Potential theory: some vector calculus- attraction and potential- potential of a solid body- Laplace equation – exterior potential field-Poisson equation – interior potential field- spherical harmonics- boundary-value problems.

UNIT II GRAVITY FIELD OF THE EARTH 9

Gravitation- gravity- attraction of a point mass- attraction of a point mass- rigid body- gravity and shape of the Earth- level surfaces and plumb lines- natural coordinates- Normal gravity: Superposition principle- ellipsoid as an approximation of the Earth- the level ellipsoid- series expansion of the normal gravity field.

UNIT III GRAVIMETRY 9

Functional of the gravity field- terrestrial gravimetry – absolute and relative- airborne gravimetry-space borne gravimetry- gradiometry- torsion balance- gravity networks. Gravity field modelling**:** Linear model of physical geodesy- disturbing potential and gravity- anomalous potential and gravity- gravity reductions- Geoid modelling: The Stokes integral- Koch's formula- Vening-Meinesz formula- Molodensky's approach- practical aspects.

UNIT IV GRAVITY FIELD AND HEIGHT SYSTEMS 9

Statistics of the gravity field: The power spectrum- Kaula's rule of thumb- covariance functions-Height systems: Height measurements- physical and geometric heights and their relationship- height systems around the world- Geoid as a vertical reference frame.

UNIT V TEMPORAL VARIATIONS OF THE GRAVITY FIELD 9

Geophysical effects on gravity- loading theory- tides- hydrological loading- atmospheric loading-ocean loading- ice-mass loading- glacial isostatic adjustment.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the physics of gravity and governing equations
CO2 Define gravity and surfaces generated through gravity observations
CO3 Identify methods and techniques for Erath's gravity field determination
CO4 Acquire knowledge of earth's gravity field parameters computations
CO5 Understand the factors affecting gravity field and their influence.

REFERENCES

1. Hofmann-Wellenhof- B and Moritz- H (2006). Physical Geodesy. Springer Vienna. Doi: 10.1007/978-3-211-33545-1.
2. Torge- W (2012). Geodesy. 3rd edn. Walter de Gruyter. Berlin. New York.
3. Vanícek- P and Krakiwsky- E (1986). Geodesy: The Concepts. 2nd edn. Elsevier.

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	3	3	3	2	3
PO2	Problem Analysis	1	2	3	2	2	2
PO3	Design/Development of Solutions	1	2	2	2	1	2
PO4	Conduct Investigations of Complex Problems	1	1	1	1	2	1

PO5	Modern Tool Usage	1	2	3	1	1	1
PO6	The Engineer and Society	1				2	1
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work		2	2	2		2
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	1	2	3	3	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	1	2	2	1	1

GI3032 GEODETIC INTERFEROMETRY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of geodetic interferometry techniques, measurements and very long baseline interferometry

UNIT I INTRODUCTION 9

History- overview - basics of interferometry - interferometric base line - differential interferometry - phase unwrapping - correlation.

UNIT II GEODETIC INTERFEROMETRY TECHNIQUES 9

ScanSAR interferometry - solutions for baseline and source position vectors - Phase Referencing – position – frequency - Precession and Nutation - Measurement of Polar Motion and UTI

UNIT III GEODETIC MEASUREMENTS 9

Geodetic Measurements- Proper Motion and Parallax Measurements- Solar Gravitational Deflection-Imaging Astronomical Masers- Least-Mean-Squares Analysis- Second-order effects in phase referencing

UNIT IV VLBI IN GEODETIC INTERFEROMETRY 9

Introduction- VLBI elements- techniques-space segment- propagation media- ground segment-interferometer and interferometric principle- carrier of interferometer baseline- determination of observables- precision and analysis of group delays

UNIT V DATA ANALYSIS 9

Automated geodetic VLBI- antenna and receiving systems- data acquisition systems- monitoring and control systems- observations- data reduction and analysis

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to
CO1 Apprehend the fundamentals of interferometry
CO2 Identify various interferometric techniques
CO3 Understand different geodetic measurements for Geodetic observations
CO4 Comprehend the components and working principle of VLBI
CO5 Summarize the methods for VLBI data analysis and reduction.

REFERENCES
1. Alef, W., Introduction to Phase-Reference Mapping, in Very Long Baseline Interferometry: Techniques and Applications, Felli, M., and Spencer, R.E., Eds., Kluwer, Dordrecht (1989), pp. 261–274
2. Backer, D.C., and Sramek, R.A., Proper Motion of the Compact, Nonthermal Radio Source in the Galactic Center, Sagittarius A*, Astrophys. J., 524, 805–815 (1999)
3. Bailer-Jones, C.A.L., Estimating Distances from Parallaxes, Publ. Astron. Soc. Pacific, 127, 994– 1009 (2015)
4. Bartel, N., Bietenholz, M.F., Lebach, D.E., Ransom, R.R., Ratner, M.I., and Shapiro, I.I., VLBI for Gravity Probe B: The Guide Star, IM Pegasi, Class. Quantum Grav., 32, 224021 (21pp) (2015)
5. Bartel, N., Ratner, M.I., Shapiro, I.I., Cappallo, R.J., Rogers, A.E.E., and Whitney, A.R., Pulsar Astrometry via VLBI, Astron. J., 90, 318–325 (1985)

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	3	2	3	3	3	3
PO3	Design/Development of Solutions	1	2	2	2	1	2
PO4	Conduct Investigations of Complex Problems	1	2	2	2	2	2
PO5	Modern Tool Usage	2	1	3	3	2	2
PO6	The Engineer and Society						
PO 7	Environment and Sustainability	1		1		1	1
PO 8	Ethics						
PO 9	Individual and Team Work		2		2		2
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning	2	2	2	2	2	2
PSO 1	Knowledge of Geoinformatics discipline	2	3	3	2	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	1	2	2	2	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	2	2	2	3	2

GI3033 ENVIRONMENTAL GEODESY L T P C
3 0 0 3

COURSE OBJECTIVES:
- To introduce concepts of the Earth system and its observation techniques.
- To expose the observables of hydrological, oceanographic, cyrospheric and atmosphere.

UNIT I THE EARTH SYSTEM 9
Systems approach to studying Earth, climate and weather systems, mass distribution, transport and exchange in the Earth system, Impact of physical processes on the geometry and gravity of the Earth, loading theory and the sea level equation.

UNIT II OBSERVATION TECHNIQUES IN GEODESY 9

Geometric techniques – Total Stations, Strain meters, Tide Gauges, Global Navigation Satellite Systems, Satellite Laser Ranging, Very Long Baseline Interferometry, Satellite Altimetry (radar and laser), Interferometric SAR; Gravimetric techniques – absolute gravimetry, relative gravimetry, Satellite gravimetry – CHAMP, GRACE and GOCE.

UNIT III TIDES AND HYDROLOGICAL OBSERVABLES 9

Gravitational interaction of the Sun, Moon and the Earth, ocean tides, atmospheric tides, solid Earth tides, Doodson numbers, Water storage change, soil moisture, river runoff and lake levels, groundwater variability.

UNIT IV OCEANOGRAPHIC AND CRYOSPHERIC OBSERVABLES 9

Sea surface topography and the mean sea level, ocean currents, ocean mass redistribution, ocean bathymetry, Sea ice thickness observations, ice mass balance, glacier thickness and drift.

UNIT V ATMOSPHERIC AND SOLID EARTH OBSERVABLES 9

Total precipitable water, ionospheric total electron content, atmospheric circulation and mass redistribution, Elastic, viscoelastic and episodic deformation and gravity responses to geodynamic processes like plate tectonics, Earthquakes and volcanic activity. Tsunami early warning, atmospheric / ionospheric seismology.

TOTAL:45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Summarize the concept of earth system and processes influencing the system

CO2 Explore various geodetic techniques for observation of earth system

CO3 Identify the observations used for measurement of tides and hydrological parameters

CO4 Identify the observations used for measurement of Ocean and Cryospheric parameters

CO5 Identify the observations used for measurement of Atmospheric and Solid earth parameters

REFERENCES

1. Lambeck, K. (1989). Geophysical Geodesy. Oxford University Press.
2. Lambeck, K. (1980). The Earth’s variable rotation: Geophysical causes and consequences. Cambridge University Press
3. Christopherson, Geosystems 8th edition, Pearson Prentice Hall,2010.
4. Ilk, K.H., Flury, J., Rummel, R., Schwintzer, P., Bosch, W., Haas, C., Schröter, J., Stammer, D., Zahel, W., Miller, H. and Dietrich, R. (2005).
5. Pail, R., Bingham, R., Braitenberg, C., Eicker, A., Horwath, M., Longuevergne, L., Panet, I., Rolstad-Denby, C., Wouters, B., et al. (2015).
6. Stammer, D. and Cazenave, A. (2017). Satelite Altimetry over oceans and land surfaces (2017).

CO’s, PO’s & PSO’s MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	3	3	2	2	2
PO2	Problem Analysis	1	1	2	2	2	2
PO3	Design/Development of Solutions	1	2	1	2	2	2
PO4	Conduct Investigations of Complex Problems	2	3	3	3	3	3
PO5	Modern Tool Usage	1	3	2	2	2	2
PO6	The Engineer and Society	1	1			1	1
PO 7	Environment and Sustainability		1	2	2	1	2
PO 8	Ethics						

PO 9	Individual and Team Work	1	1	1	1	1	1
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	2	3	2	2	2	2
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	1	3	2	2	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	2	2	2	2	2

GI3034 GEODETIC CONTROL SURVEY AND ADJUSTMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the rudiments of control surveying and geodetic principles to Geoinformatics Engineers.
- To learn the various methods of geodetic control surveying to solve the real world problems.
- To introduce the basics of Astronomical Surveying.

UNIT I HORIZONTAL CONTROL SURVEYING 9

Definition – Uses and Establishment of Horizontal control – Methods: Triangulation, Traversing and Trilateration – Classification and accuracy - Instruments: Theodolite, Total Station and GNSS – Field procedure for Triangulation, Traversing and Trilateration: Horizontal angle measurements methods – Base line measurement – Elimination of blunder and systematic errors - Computation of weight of observation for length and angle.

UNIT II ADJUSTMENT OF HORIZONTAL CONTROL 9

Introduction - simple adjustment methods - Error propagation and linearization - Least squares adjustment method for Triangulation, Traversing and Trilateration – least squares adjustment of indirect Observations - least squared adjustment of observations only.

UNIT III VERTICAL CONTROL SURVEYING 9

Definition – Uses and Establishment of Vertical control – Methods: Sprit levelling, Reciprocal levelling, Trigonometric levelling, GNSS Surveying and Precise Levelling – Instruments: Dumpy level, Tilting level, Auto level, Digital level, Total Station and GNSS - Field procedure for different methods - Elimination of blunder and systematic errors - Computation of weight of observation

UNIT IV ADJUSTMENT OF VERTICAL CONTROL 9

Introduction - simple adjustment methods - Error propagation and linearization - Least squares adjustment method for Level Net and Trigonometrical levelling – least squares adjustment of indirect Observations - least squared adjustment of observations only.

UNIT V COORDINATE COMPUTATION 9

Plane and Spherical coordinate system – Computation of plane coordinate for horizontal control point of Triangulation, Traversing and Trilateration stations - Computation of Spherical coordinate for horizontal control point of Triangulation, Traversing and Trilateration stations – Computation of bearing and length from plane coordinates - Computation of forward azimuth, backward azimuth and length from spherical- coordinates

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO 1 Apprise various methods used for horizontal control surveying and the process involved
CO 2 Develop the error identification and adjustment methods for horizontal control
CO 3 Apprise various methods used for vertical control surveying and measurement process
CO 4 Develop methods for identification of error and its adjustment
CO 5 Derive the 3-dimensional coordinates for adjusted observations

TEXT BOOKS:

1. T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008
2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2016

REFERENCES

1. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004
4. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice'Hall of India 2004
5. K.R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013
6. C.Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis	2	3	2	3	3	3
PO3	Design/Development of Solutions	1	3	1	3	3	2
PO4	Conduct Investigations of Complex Problems	2	1	2	1	3	2
PO5	Modern Tool Usage	3	1	3	1	2	2
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work	3	2	3	2	2	2
PO 10	Communication						
PO 11	Project Management and Finance	1		1		1	1
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	3	2	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	2	2	2	2	2	2

GI3035 GEODETIC ASTRONOMY L T P C
3 0 0 3

COURSE OBJECTIVES:

- The overall objective is the development of a set of practical models for the determination of astronomic azimuth, latitude and longitude that utilize observations made to celestial objects.

UNIT I INTRODUCTION 9

Definition and application of geodetic astronomy- Spherical Trigonometry- Spherical excess- Celestial sphere- definition of terms in astronomy- solution of astronomical triangle celestial coordinate systems

UNIT II CELESTIAL COORDINATE SYSTEM 9

Celestial coordinate system: Horizon system- Hour angle system- Right Ascension system- Ecliptic system and their inter-transformations- derivation and problems. Variation in celestial coordinates: precession- nutation and polar motion. Reduction of star position

UNIT III TIME SYSTEMS 9

Sidereal time- universal time- relation between Sidereal time and universal time- irregularities of rotational time systems- Proper motion time systems: solar- sidereal- ephemerides- atomic- time dissemination- the astronomical basis of time keeping and time recording. Rotational time systems: UT0- UT1- UT2 and UTC- polar motion CIO- Earth rotation- leap second

UNIT IV DETERMINATION OF POSITION AND ASTRONOMIC AZIMUTH 9

Determination of astronomic azimuth- latitude and longitude- Azimuth by star hour angle and star altitudes- latitude by meridian zenith distance and Polaris at any hour angle- longitude by meridian transit distance

UNIT V STAR CATALOGUES AND APPLICATION OF GEODETIC ASTRONOMY 9

Historical and Types of Star catalogues- ephemerides - time span- observer location- target body- almanacs. Star almanacs for Land Surveyors – Astrometry: precise positions- angular proper motions and parallaxes of celestial sources. Application of Geodetic Astronomy: Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

•On completion of the course, the student is expected to

CO1 Understand the principles and mathematics involved in Geodetic Astronomy
CO2 Summarize and relate Coordinate Systems used for Astronomical observations
CO3 Understand and relate various time system used in astronomy
CO4 Apply astronomical observations for determination of azimuth, latitude and longitude
CO5 Identify the contents of Star Catalogues, Almanacs and their applications

REFERENCES

1. Torge, W (2001) Geodesy, 3rd edition, Walter de Gruyter.
2. Vanícek, P and Krakiwsky, E (1986). Geodesy: The Concepts 2nd edn, Elsevier.
3. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 2nd edition 2008
4. Kaula, W.M. (2000). Theory of Satellite Geodesy: Applications of Satellites to Geodesy. Dover Publications
5. Montenbruck, O. and Gill, E (2000). Satellite Orbits. Springer – Verlag, Berlin, 2003

CO's, PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	2	3	3	3	3	3
PO2	Problem Analysis	2	2	2	3	3	2
PO3	Design/Development of Solutions	1	2	2	2	2	2
PO4	Conduct Investigations of Complex Problems	1	2	2	3	2	2
PO5	Modern Tool Usage	1	1	2	2	2	2
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						

PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						
PSO 1	Knowledge of Geoinformatics discipline	2	3	2	3	2	2
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	2	1	2	3	2	2
PSO 3	Conceptualization and evaluation of Design solutions	1	3	2	3	2	2

MANDATORY COURSES I

MX3081 INTRODUCTION TO WOMEN AND GENDER STUDIES L T P C
3 0 0 0

COURSE OUTLINE

UNIT I CONCEPTS
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL
Rise of Feminism in Europe and America.
Women's Movement in India.

UNIT IV GENDER AND LANGUAGE
Linguistic Forms and Gender.
Gender and narratives.

UNIT V GENDER AND REPRESENTATION
Advertising and popular visual media.

Gender and Representation in Alternative Media.
Gender and social media.

TOTAL : 45 PERIODS

MX3082 ELEMENTS OF LITERATURE L T P C
3 0 0 0

OBJECTIVE:

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

1. **COURSE CONTENTS**
   Introduction to Elements of Literature

1. **Relevance of literature**
   a) Enhances Reading, thinking, discussing and writing skills.
   b) Develops finer sensibility for better human relationship.
   c) Increases understanding of the problem of humanity without bias.
   d) Providing space to reconcile and get a cathartic effect.
2. **Elements of fiction**
   a) Fiction, fact and literary truth.
   b) Fictional modes and patterns.
   c) Plot character and perspective.
3. **Elements of poetry**
   a) Emotions and imaginations.
   b) Figurative language.
   c) (Simile, metaphor, conceit, symbol, pun and irony).
   d) Personification and animation.
   e) Rhetoric and trend.
4. **Elements of drama**
   a) Drama as representational art.
   b) Content mode and elements.
   c) Theatrical performance.
   d) Drama as narration, mediation and persuasion.
   e) Features of tragedy, comedy and satire.

3. READINGS:

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

3.1 Textbook:

3.2 *Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

4. OTHER SESSION:

4.1*Tutorials:

4.2*Laboratory:

4.3*Project: The students will write a term paper to show their understanding of a particular piece of literature

5.*ASSESSMENT:

5.1HA:

5.2Quizzes-HA:

5.3Periodical Examination: one

5.4Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.

5.5Final Exam:

TOTAL : 45 PERIODS

OUTCOME OF THE COURSE:

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

MX3083 FILM APPRECIATION L T P C
3 0 0 0

In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

Theme - A: The Component of Films
A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language
B-1: Film language, form, movement etc.
B-2: Early cinema… **silent film** (Particularly French)
B-3: The emergence of feature films: **Birth of a Nation**
B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation
C-1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4: Film Criticism / Appreciation

Theme – D: Development of Films
D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films
E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India

READING:
A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

MX3084 DISASTER RISK REDUCTION AND MANAGEMENT L T P C
3 0 0 0

COURSE OBJECTIVE

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, --, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction**,** Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill -

TOTAL : 45 PERIODS

TEXT BOOKS:

1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications

2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications

3 Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423

4 Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]

REFERENCES

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

COURSE OUTCOME:

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)

CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

CO3: To develop disaster response skills by adopting relevant tools and technology

CO4: Enhance awareness of institutional processes for Disaster response in the country and

CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

CO's – PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	-	-	2	2	-	-	2	-	2	-	1
2	3	3	3	3	-	-	2	1	-	-	2	-	2	-	1
3	3	3	3	3	-	-	2	2	-	-	-	-	2	-	1
4	3	3	2	3	-	-	2	1	-	-	2	-	2	-	1
5	3	3	2	3	-	-	2	2	-	-	2	-	3	-	1
AVG	3	3	3	3	-	-	2	2	-	-	2	-	2	-	1

MANDATORY COURSES II

MX3085 WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA

L T P C
3 0 0 0

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 2+4

Health: Definition - Importance of maintaining health - More importance on prevention than treatment

Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET 4+6

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet

Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes

Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / **(**Five Element Theory) 96 fundamental Principles - Uyir Thathukkal **(**Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 3+4

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.
Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2+12

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by
The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. **Simple lifestyle modifications to maintain health** https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. **Read more**: https://www.legit.ng/1163909-classes-food-examples-functions.html
4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
5. **Benefits of healthy eating** https://www.cdc.gov/nutrition/resources-publications/benefits-of-healthy-eating.html
6. **Food additives** https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives
7. **BMI** https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
8. **Yoga** https://www.healthifyme.com/blog/types-of-yoga/
https://yogamedicine.com/guide-types-yoga-styles/
Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
9. **Siddha** : http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp
10. **CAM :** https://www.hindawi.com/journals/ecam/2013/376327/
11. **Preventive** herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:

After completing the course, the students will be able to:

- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health

MX3086 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA L T P C
3 0 0 0

UNIT-I CONCEPTS AND PERSPECTIVES

Meaning of History
Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.
Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT-II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT-III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA

Technology in pre-historic period
Beginning of agriculture and its impact on technology
Science and Technology during Vedic and Later Vedic times
Science and technology from 1st century AD to C-1200.

UNIT-IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA

Legacy of technology in Medieval India, Interactions with Arabs
Development in medical knowledge, interaction between Unani and Ayurveda and alchemy
Astronomy and Mathematics: interaction with Arabic Sciences
Science and Technology on the eve of British conquest

UNIT-V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA

Science and the Empire
Indian response to Western Science
Growth of techno-scientific institutions

UNIT-VI SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA

Science, Technology and Development discourse
Shaping of the Science and Technology Policy
Developments in the field of Science and Technology
Science and technology in globalizing India
Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY L T P C
3 0 0 0

Pre-Requisite**:** None. (Desirable: Universal Human Values 1, Universal Human Values 2)

OBJECTIVES:

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

COURSE TOPICS:
Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems. **(9 lectures, 1 hour each)**

(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. **(5 lectures)**

(Refs: Adam smith, J S Mill)

Fascism and totalitarianism. World war I and II. Cold war. **(2 lectures)**

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.

(Refs: Marx, Lenin, Mao, M N Roy) **(5 lectures)**

Welfare state. Relation with human desires. Empowered human beings, satisfaction. **(3 lectures)**

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature. **(6 lectures)**

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. **(3 lectures)**

(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. **(4 lectures)** (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

Reference Books: Authors mentioned along with topics above. Detailed reading list will be provided.

GRADING:

Mid sems	30
End sem	20
Home Assign	10
Term paper	40

TOTAL : 45 PERIODS

OUTCOME:
- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA L T P C
3 0 0 0

OBJECTIVE:

The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

TOPICS:

Understanding the need and role of State and politics.

Development of Nation-State, sovereignty, sovereignty in a globalized world.

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary,
The idea of India.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.
Goals, objective and philosophy.
Why a federal system?
National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari)
New social movements.
The changing nature of Indian Political System, the future scenario.
What can we do?

TOTAL : 45 PERIODS

OUTCOME OF THE COURSE:

It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

SUGGESTED READING:

i. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
ii. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
iii. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
iv. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
v. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
vi. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
vii. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

MX3089 **INDUSTRIAL SAFETY** **L T P C**
3 0 0 0

OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

Course outcomes on completion of this course the student will be able:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES

1. Frank Lees (2012) ‘Lees’ Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.

4. Alan Waring.(1996).Safety management system: Chapman &Hall,England
5. Society of Safety Engineers, USA

ONLINE RESOURCES

ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html

Indian Standard code of practice on occupational safety and health audit https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf

Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

CO's – PO's & PSO's MAPPING

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	Understand the basic concept of safety.	3	3	3	1	1	3	2	2	3	3	1	3	3	3	3
CO2	Obtain knowledge of Statutory Regulations and standards.	2	3	2	2	1	3	2	3	3	2	1	3	3	3	3
CO3	Know about the safety Activities of the Working Place.	2	2	2	2	1	2	2	2	3	2	1	2	3	3	3
CO4	Analyze on the impact of Occupational Exposures and their Remedies	3	3	3	2	2	3	2	2	3	2	1	3	3	3	3
CO5	Obtain knowledge of Risk Assessment Techniques.	3	2	3	2	2	3	2	2	3	2	2	3	3	3	3
	Industrial safety	3	3	3	2	1	3	2	2	3	2	1	3	3	3	3

OPEN ELECTIVE I AND II

OCS351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS

L T P C
2 0 2 3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand the importance, principles, and search methods of AI
- Provide knowledge on predicate logic and Prolog.
- Introduce machine learning fundamentals
- Study of supervised learning algorithms.
- Study about unsupervised learning algorithms.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - **Intelligent Agents** - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - **Uninformed Search** - Breadth First Search - Dijkstra's algorithm or uniform-cost search - Depth First Search - Depth Limited Search

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - **Game theory** - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - **Constraint Satisfaction Problems (CSP)** - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT III LEARNING 6

Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - **Regression**: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING 6

Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - **Decision Tree:** Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - **Naïve Bayesian classification** - **Support Vector Machines** (SVM)

UNIT V UNSUPERVISED LEARNING 6

Unsupervised Learning – Principle Component Analysis - **Neural Network**: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – **Clustering**: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm

TOTAL : 30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

Programs for Problem solving with Search

1. Implement breadth first search
2. Implement depth first search
3. Analysis of breadth first and depth first search in terms of time and space
4. Implement and compare Greedy and A* algorithms.

Supervised learning

5. Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
6. Write a program to demonstrate the working of the decision tree based algorithm.
7. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
8. Write a program to implement the naïve Bayesian classifier.

Unsupervised learning

9. Implementing neural network using self-organizing maps
10. Implementing k-Means algorithm to cluster a set of data.
11. Implementing hierarchical clustering algorithm.

Note:

- Installation of gnu-prolog, Study of Prolog (gnu-prolog).
- The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface
- Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

TOTAL : 60 PERIODS

COURSE OUTCOMES:
CO1: Understand the foundations of AI and the structure of Intelligent Agents
CO2: Use appropriate search algorithms for any AI problem
CO3: Study of learning methods
CO4: Solving problem using Supervised learning
CO5: Solving problem using Unsupervised learning

TEXT BOOK

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2021
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,

REFERENCES

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. I. Bratko, "Prolog: Programming for Artificial Intelligencell, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

OCS352	**IOT CONCEPTS AND APPLICATIONS**	**L T P C**
		2 0 2 3

COURSE OBJECTIVES:

- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things(IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT I INTRODUCTION TO INTERNET OF THINGS 5

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

UNIT II COMPONENTS IN INTERNET OF THINGS 5

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT 6

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT IV OPEN PLATFORMS AND PROGRAMMING 7

IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V IOT APPLICATIONS 7

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS
1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5 Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10.Design an IOT based system

COURSE OUTCOMES:
CO1: Explain the concept of IoT.
CO2: Understand the communication models and various protocols for IoT.
CO3: Design portable IoT using Arduino/Raspberry Pi /open platform
CO4: Apply data analytics and use cloud offerings related to IoT.
CO5: Analyze applications of IoT in real time scenario.

TOTAL PERIODS:60

TEXTBOOKS

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015

REFERENCES

1. Perry Lea, "Internet of things for architects", Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
6. https://www.arduino.cc/
   https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

OCS353 DATA SCIENCE FUNDAMENTALS L T P C
2 0 2 3

COURSE OBJECTIVES:
- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT I INTRODUCTION 6
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II DATA MANIPULATION 9

Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance

UNIT III MACHINE LEARNING 5

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis

UNIT IV DATA VISUALIZATION 5

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn

UNIT V HANDLING LARGE DATA 5

Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

LAB EXERCISES

1. Download, install and explore the features of Python for data analytics.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Basic plots using Matplotlib
5. Statistical and Probability measures
    a) Frequency distributions
    b) Mean, Mode, Standard Deviation
    c) Variability
    d) Normal curves
    e) Correlation and scatter plots
    f) Correlation coefficient
    g) Regression
6. Use the standard benchmark data set for performing the following:

a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.

b) Bivariate Analysis: Linear and logistic regression modelling.

7. Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8. Apply and explore various plotting functions on any data set.

Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Gain knowledge on data science process.

CO2: Perform data manipulation functions using Numpy and Pandas.

CO3 Understand different types of machine learning approaches.

CO4: Perform data visualization using tools.

CO5: Handle large volumes of data in practical scenarios.

TEXT BOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

REFERENCES

1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.

CCS333	**AUGMENTED REALITY/VIRTUAL REALITY**	**L T P C**
		2 0 2 3

COURSE OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION 7

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I’s of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System**.**

UNIT II VR MODELING 6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III VR PROGRAMMING 6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV APPLICATIONS 6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V AUGMENTED REALITY 5

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices **30 PERIODS**

PRACTICAL EXERCISES: 30 PERIODS

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.

5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

TOTAL:60 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Understand the basic concepts of AR and VR
CO2: Understand the tools and technologies related to AR/VR
CO3: Know the working principle of AR/VR related Sensor devices
CO4: Design of various models using modeling techniques
CO5: Develop AR/VR applications in different domains

TEXTBOOKS:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003’

CO’s – PO’s & PSO’s MAPPING

CO’s	PO’s													PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2	
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2	
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2	
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2	
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3	
AVg.	3.00	2.60	2.40	2.00	3.00	-	-	-	2.80	2.20	1.80	2.60	2.80	1.80	2.20	

OPEN ELCTIVE III

OHS351 ENGLISH FOR COMPETITIVE EXAMINATIONS L T P C
3 0 0 3

Course Description:

Students aspiring to take up competitive exams of which the English language is a vital component will find this course useful. Designed for students in the higher semesters, the course will help students to familiarise themselves with those aspects of English that are tested in these examinations.

COURSE OBJECTIVES:

- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS).
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.
- To improve students' confidence to express their ideas and opinions in formal contexts
- To create awareness of accuracy and precision in communication

UNIT I 9

Orientation on different formats of competitive exams - Vocabulary – Verbal ability – Verbal reasoning - Exploring the world of words – Essential words – Meaning and their usage – Synonyms-antonyms – Word substitution – Word analogy – Idioms and phrases – Commonly confused words – Spellings – Word expansion – New words in use.

UNIT II 9

Grammar – Sentence improvement –Sentence completion – Rearranging phrases into sentences – Error identification –Tenses – Prepositions – Adjectives – Adverbs – Subject-verb agreement – Voice – Reported speech – Articles – Clauses – Speech patterns.

UNIT III 9

Reading - Specific information and detail – Identifying main and supporting ideas – Speed reading techniques – Improving global reading skills – Linking ideas – Summarising – Understanding argument – Identifying opinion/attitude and making inferences - Critical reading.

UNIT IV 9

Writing – Pre-writing techniques – Mindmap - Describing pictures and facts - Paragraph structure – organising points – Rhetoric writing – Improving an answer – Drafting, writing and developing an argument – Focus on cohesion – Using cohesive devices –Analytic writing – Structure and types of essay – Mind maps – Structure of drafts, letters, memos, emails – Statements of Purpose – Structure, Content and Style.

UNIT V 9

Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication – Dysfluency -Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story or a personal anecdote – Talking about oneself - Utterance – Speech acts- Brainstorming ideas – Group discussion.

TOTAL: 45 PERIODS

Learning Outcomes:

At the end of the course, learners will be able

CO1 expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required

CO2 identify errors with precision and write with clarity and coherence

CO3 understand the importance of task fulfilment and the usage of task-appropriate vocabulary

CO4 communicate effectively in group discussions, presentations and interviews

CO5 write topic based essays with precision and accuracy

Teaching Methods:

Instructional methods will involve discussions, taking mock tests on various question papers – Objective, multiple-choice and descriptive. Peer evaluation, self-check on improvement and peer feedback - Practice sessions on speaking assessments, interview and discussion – Using multimedia.

Evaluative Pattern:
Internal Tests – 50%
End Semester Exam - 50%

TEXTBOOKS:

1. R.P.Bhatnagar - *General English for Competitive Examinations.* Macmillan India Limited, 2009.

REFERENCES:

1. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.
3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.

Websites
http://www.examenglish.com/, http://www.ets.org/ , http://www.bankxams.com/
http://civilservicesmentor.com/, http://www.educationobserver.com
http://www.cambridgeenglish.org/in/

CO's – PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	3	1	3	3	3	3	1	3	1	3	-	-	-
2	2	3	3	2	3	3	3	3	1	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
4	2	2	2	2	2	2	2	2	3	3	3	3	-	-	-
5	2	2	2	2	2	2	2	2	2	3	2	3	-	-	-
AVg.	**2**	**2.6**	**2.6**	**2**	**2.6**	**2.6**	**2.6**	**2.6**	**2**	**3**	**2.4**	**3**	**-**	**-**	**-**

1-low, 2-medium, 3-high, '-"- no correlation
Note: The average value of this course to be used for program articulation matrix.

OMG352 NGOS AND SUSTAINABLE DEVELOPMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the importance of sustainable development
- To acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management
- To comprehend the role of NGOs in attaining sustainable development

UNIT I ENVIRONMENTAL CONCERNS 9
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

UNIT II ROLE OF NGOS 9
Role of NGO's in national development, NGO's and participatory management, Challenges and limitations of NGO's, Community Development programmes, Role of NGO's in Community Development programmes, Participation of NGO's in environment management, Corporate Social responsibility, NGO's and corporate social responsibility

UNIT III SUSTAINABLE DEVELOPMENT 9
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-

renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators

UNIT IV NGO'S FOR SUSTAINABILITY 9

Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies

UNIT V LEGAL FRAMEWORKS 9

Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO's in implementing environmental laws, Challenges in the implementation of environmental legislation

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the student will :

CO1 Have a thorough grounding on the issues and challenges being faced in attaining sustainable development

CO2 have a knowledge on the role of NGOs towards sustainable developemnt

CO3 present strategies for NGOs in attaining sustainable development

CO4 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment

CO5 understand the environmental legislations

REFERENCES

1. Kulsange, S and Kamble, R. (2019). Environmental NGO's: Sustainability Stewardship, Lap Lambert Academic Publishing, India, ISBN-13: .6200442444-978
2. Dodds, F. (2007). NGO diplomacy: The influence of nongovernmental organizations in international environmental negotiations. Mit Press, Cambridge, ISBN-13: .0262524766-978
3. Ghosh, S. (Ed.). (2019). Indian environmental law: Key concepts and principles. Orient BlackSwan, India, ISBN-13: .9352875795-978
4. Alan Fowler and Chiku Malunga (2010) NGO Management: The Earthscan Companion, Routledge, ISBN-13 : .1849711197-978

OMG353 DEMOCRACY AND GOOD GOVERNANCE L T P C
3 0 0 3

UNIT I (9)

Structure and Process of Governance: Indian Model of Democracy, Parliament, Party Politics and Electoral Behaviour, Federalism, the Supreme Court and Judicial Activism, Units of Local Governance

UNIT II (9)

Regulatory Institutions – SEBI, TRAI, Competition Commission of India,

UNIT III (9)

Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.

UNIT IV (9)

Contemporary Political Economy of Development in India: Policy Debates over Models of Development in India, Recent trends of Liberalisation of Indian Economy in different sectors, E-governance

UNIT V **(9)**

Dynamics of Civil Society: New Social Movements, Role of NGO's, Understanding the political significance of Media and Popular Culture.

TOTAL : 45 PERIODS

REFERENCES:

1. Atul Kohli (ed.): The Success of India's Democracy, Cambridge University Press, 2001.
2. Corbridge, Stuart and John Harris: Reinventing India: Liberalisation, Hindu Nationalism and Popular Democracy, Oxford University Press, 2000.
3. J.Dreze and A.Sen, India: Economic Development and Social Opportunity, Clarendon, 1995.
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India,2013
5. Himat Singh: Green Revolution Reconsidered: The Rural World of Punjab, OUP, 2001.
6. Jagdish Bhagwati: India in Transition: Freeing The Economy, 1993.
7. Smitu Kothari: Social Movements and the Redefinition of Democracy, Boulder, Westview, 1993.

CME365 **RENEWABLE ENERGY TECHNOLOGIES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To know the Indian and global energy scenario
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT I **ENERGY SCENARIO** **9**

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT I **SOLAR ENERGY** **9**

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT III **WIND ENERGY** **9**

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT IV **BIO-ENERGY** **9**

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT V **OCEAN AND GEOTHERMAL ENERGY** **9**

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1 Discuss the Indian and global energy scenario.

CO2 Describe the various solar energy technologies and its applications.

CO3 Explain the various wind energy technologies.

CO4 Explore the various bio-energy technologies.

CO5 Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India : 10-Learning Private Limited; 2nd edition (1 January 2011), ISBN 8120344707

REFERENCES:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.
2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.

CO’s – PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	2	3	2	2	1	1	3	2	1	2
2	3	2	2	1	1	1	3	1	1	1	2	3	2	1	2
3	3	2	3	1	2	1	3	1	1	1	1	3	1	1	2
4	2	2	2	1	2	1	3	1	1	1	2	3	2	2	2
5	2	1	2	1	2	1	3	1	1	1	1	3	2	1	2
Low (1) ; Medium (2) ; High (3)															

OME354 APPLIED DESIGN THINKING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The course aims to

- Introduce tools & techniques of design thinking for innovative product
- development Illustrate customer-centric product innovation using on simple
- use cases Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems

UNIT I DESIGN THINKING PRINCIPLES 9

Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies

UNIT II ENDUSER-CENTRIC INNOVATION 9

Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit

UNIT III APPLIED DESIGN THINKING TOOLS 9

Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design

UNIT IV CONCEPT GENERATION 9

Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts

UNIT V SYSTEM THINKING 9

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able to:

CO1 Define & test various hypotheses to mitigate the inherent risks in product innovations.

CO2 Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.

CO3 Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching

CO4 Apply system thinking in a real-world scenario

Text Books

1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
3. Proposition Design: How to Create Products and Services Customers Want, Wiley
4. Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute.
5. Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

REFERENCES

1. https://www.ideou.com/pages/design-thinking#process
2. https://blog.forgefor ward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253ca86 24
3. https://blog.forgefor ward.in/product-innovation-rubric-adf5ebdfd356
4. https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e
5. https://blog.forgefor ward.in/user-guide-for-product-innovation-rubric-857181b253dd
6. https://blog.forgefor ward.in/star tup-failure-is-like-true-lie-7812cdfe9b85

MF3003 REVERSE ENGINEERING LT P C
3 0 0 3

COURSE OBJECTIVES:

- The main learning objective of this course is to prepare students for:
- Applying the fundamental concepts and principles of reverse engineering in product design and development.
- Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Analysing the various legal aspect and applications of reverse engineering in product design and development.
- Understand about 3D scanning hardware & software operations and procedure to generate 3D model

UNIT I INTRODUCTION & GEOMETRIC FORM **9**

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION **9**

.Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

UNIT III DATA PROCESSING **9**

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT IV 3D SCANNING AND MODELLING **9**

Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.

UNIT V INDUSTRIAL APPLICATIONS **9**

Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry. Case studies and Solving Industrial projects in Reverse Engineering.Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 Apply the fundamental concepts and principles of reverse engineering in product design and development.

CO2 Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.

CO3 Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.

CO4 Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.

CO5 Analyze the various legal aspect

CO6 Applications of reverse engineering in product design and development.

TEXT BOOKS:

1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1st Edition, McGraw-Hill Education, 2014
2. Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011

REFERENCES:

1. Scott J. Lawrence , Principles of Reverse Engineering, Kindle Edition, 2022
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001
3. Kathryn, A. Ingle, “Reverse Engineering”, McGraw-Hill, 1994.
4. Linda Wills, “Reverse Engineering”, Kluver Academic Publishers, 1996
5. Vinesh Raj and Kiran Fernandes, “Reverse Engineering: An Industrial Perspective”, Springer-Verlag London Limited 2008.

OPR351 **SUSTAINABLE MANUFACTURING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:
- To be acquainted with sustainability in manufacturing and its evaluation.
- To provide knowledge in environment and social sustainability.
- To provide the student with the knowledge of strategy to achieve sustainability.
- To familiarize with trends in sustainable operations.
- To create awareness in current sustainable practices in manufacturing industry.

UNIT I ECONOMIC SUSTAINABILITY 9
Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability - Assessments of economic sustainability

UNIT II SOCIAL AND ENVIRONMENTAL SUSTAINABILITY 9
Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability

UNIT III SUSTAINABILITY PRACTICES 9
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators - Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements – Cost and time model.

UNIT IV MANUFACTURING STRATEGY FOR SUSTAINABILITY 9
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT V TRENDS IN SUSTAINABLE OPERATIONS 9
Principles of sustainable operations - Life cycle assessment manufacturing and service activities - influence of product design on operations - Process analysis – Capacity management - Quality management -Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Discuss the importance of economic sustainability.
CO2: Describe the importance of sustainable practices.
CO3: Identify drivers and barriers for the given conditions.
CO4: Formulate strategy in sustainable manufacturing.
CO5: Plan for sustainable operation of industry with environmental, cost consciousness.

TEXT BOOKS:

1. Ibrahim Garbie, “Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0”, Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042.
2. Davim J.P., “Sustainable Manufacturing”, John Wiley & Sons., United States, 2010,ISBN: 978-1-848-21212-1.

REFERENCES:

1. Jovane F, Ęmper, W.E. and Williams, D.J., “The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing”, Springer,2009, United States, ISBN 978-3-540-77011-4.
2. Kutz M., “Environmentally Conscious Mechanical Design”, John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4.
3. Seliger G., “Sustainable Manufacturing: Shaping Global Value Creation”, Springer, United States, 2012, ISBN 978-3-642-27289-9.

CO’s – PO’s & PSO’s MAPPING

Mapping of COs with POs and PSOs															
COs/Pos &PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	2	-	-	-	2	2	-	1	1	2	2	2	1
CO2	3	-	-	-	-	-	2	-	-	1	1	2	1	2	2
CO3	3	-	-	-	-	-	2	3	-	1	1	2	1	2	2
CO4	3	-	3	-	-	-	2		-	1	1	2	2	2	1
CO5	3	-	3	-	-	-	2	2	-	1	1	2	2	2	1
CO/PO & PSO Average	3	-	3	-	-	-	2	2	-	1	1	2	2	2	1
1 – Slight, 2 – Moderate, 3 – Substantial															

AU3791 ELECTRIC AND HYBRID VEHICLES L T P C
3 0 0 3

COURSE OBJECTIVES:

- The objective of this course is to prepare the students to know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, and sub system design and hybrid vehicle control.

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.

UNIT II ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT III MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT V HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the student will be able to

CO1 Understand the operation and architecture of electric and hybrid vehicles
CO2 Identify various energy source options like battery and fuel cell
CO3 Select suitable electric motor for applications in hybrid and electric vehicles.
CO4 Explain the role of power electronics in hybrid and electric vehicles
CO5 Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS:

1. Iqbal Husain, " Electric and Hybrid Vehicles-Design Fundamentals", CRC Press,2003
2. Mehrdad Ehsani, " Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRCPress,2005.

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons,2003
2. Lino Guzzella, " Vehicle Propulsion System" Springer Publications,2005
3. Ron HodKinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005.

CO's – PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	2	1		3	2					2		1	3
2	1	1	2	1		3	2					2		1	3
3	1	1	2	1		3	2					2		1	3
4	1	1	2	1		3	2					2		1	3
5	1	1	2	1		3	2					2		1	3
Avg.	1	1	2	1		3	2					2		1	3

OAS352 SPACE ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- Use the standard atmosphere tables and equations.
- Find lift and drag coefficient data from NACA plots.
- Apply the concept of static stability to flight vehicles.
- Describe the concepts of stress, strain, Young's modulus, Poisson's ratio, yield strength.
- Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.

UNIT I STANDARD ATMOSPHERE 6

History of aviation – standard atmosphere - pressure, temperature and density altitude.

UNIT II AERODYNAMICS 10

Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.

UNIT III PERFORMANCE AND PROPULSION 9

Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.

UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY 10

Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - Hooke's Law- brittle and ductile materials - moment of inertia - section modulus.

UNIT V SPACE APPLICATIONS 10

History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler's laws of orbits - Newtons law of gravitation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Illustrate the history of aviation & developments over the years
CO2 Ability to identify the types & classifications of components and control systems
CO3 Explain the basic concepts of flight & Physical properties of Atmosphere
CO4 Identify the types of fuselage and constructions.
CO5 Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS:

1. John D. Anderson, Introduction to Flight, 8 th Ed., McGraw-Hill Education, New York,2015.
2. E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021.
3. Stephen. A. Brandt, " Introduction to Aeronautics: A design perspective " American Institute of Aeronautics & Astronautics,1997.

REFERENCE:

1. Kermode, A.C., "Mechanics of Flight", Himalayan Book, 1997.

OIM351 INDUSTRIAL MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce fundamental concepts of industrial management
- To understand the approaches to the study of Management
- To learn about Decision Making, Organizing and leadership
- To analyze the Managerial Role and functions
- To know about the Supply Chain Management'

UNIT I INTRODUCTION 9

Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union

UNIT II FUNCTIONS OF MANAGEMENT 9

Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization -Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.

UNIT III ORGANIZATIONAL BEHAVIOUR 9

Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches.

UNIT IV GROUPDYNAMICS 9

Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics.

UNIT V MODERN CONCEPTS 9

Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re-engineering(BPR) –Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the basic concepts of industrial management
CO2: Identify the group conflicts and its causes.
CO3: Perform swot analysis
CO4 : Analyze the learning curves
CO5 : Understand the placement and performance appraisal

REFERENCES:

Maynard H.B, “Industrial Engineering Hand book”, McGraw-Hill, sixth 2008

CO’s – PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1											2	1	
2		3	2	3											2
3	2	3	2	3									1	2	3
4	2	2	3	3										3	3
5	2	2											2		
AVg.	2	2.2	2.3	3									1.8	2	2.6

OIE354 QUALITY ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing thespecialcontrolproceduresforserviceandprocessorientedindustries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION 9

Quality Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance–Quality planning-Quality costs–Economics of quality– Quality loss function

UNIT II CONTROLCHARTS 9

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- $\bar{X}$, R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES 9

Warning and modified control limits, control chart for individual measurements, multi-vari chart, $\bar{X}$chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICALPROCESSCONTROL 9

Process stability, process capability analysis using a Histogram or probability plots and control chart.Gauge capability studies,setting specification limits.

UNITV ACCEPTANCESAMPLING 9

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables,MIL-STD-105DandMIL-STD-414E&IS2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to:

CO1: Control the quality of processes using control charts for variables in manufacturing industries.
CO2: Control the occurrence of defective product and the defects in manufacturing companies.
CO3: Control the occurrence of defects in services.
CO4: Analyzing and understanding the process capability study.
CO5: Developing the acceptance sampling procedures for incoming raw material.

CO's – PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	3		3			1	2			2	1		
2		3	3		3	3			3			3		2	
3	3	3	3		3				3			3	1		
4	3		2		3						1		1		
5		2			3				3			3			1
AVg.	2.6	2.7	2.7		3	3		1	2.7		1	2.7	1	2	1

OSF351 FIRE SAFETY ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

- To enable the students to acquire knowledge of Fire and Safety Studies
- To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance
- To learn about fire area, fire stopped areas and different types of fire-resistant doors
- To learn about the method of fire protection of structural members and their repair due to fire damage.
- To develop safety professionals for both technical and management through systematic and quality-based study programmes

UNIT I INHERENT SAFETY CONCEPTS 9

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials.

UNIT II PLANT LOCATIONS 9

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements-standard heating condition, Indian standard test method, performance criteria.

UNIT III WORKING CONDITIONS 9

Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors;

UNIT IV FIRE SEVERITY AND REPAIR TECHNIQUES 9

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures-Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V WORKING AT HEIGHTS 9

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES

On completion of the course the student will be able to

CO1: Understand the effect of fire on materials used for construction

CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.

CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.

CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.

CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS

1. Roytman, M. Y,"Principles of fire safety standards for building construction". Amerind Publishing Co. Pvt. Ltd., New Delhi,1975
2. John A. Purkiss,"Fire safety engineering design of structures" (2nd edn.), Butterworth Heinemann, Oxford, UK,2009.

REFERENCES:

1. Smith, E.E. and Harmathy, T.Z. (Editors),"Design of buildings for fire safety". ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.
2. Butcher, E. G. and Parnell, A. C, "Designing of fire safety". JohnWiley and Sons Ltd., New York, U.S.A.1983.
3. Jain, V.K,"Fire safety in buildings" (2nd edn.). New Age International(P) Ltd., New Delhi,2010. 4. Hazop&Hazan,"Identifying and Assessing Process Industry Hazards", Fourth Edition ,1999
4. Frank R. Spellman, Nancy E. Whiting,"The Handbook of Safety Engineering: Principles and Applications", 2009

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	-	1	-	-	1	-	-	-	-	-	-	-	-	-
2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
3	1	-	2	-	-	-	3	-	-	1	-	-	-	-	-
4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
5	2	-	1	-	-	1	1	1	-	1	-	1	-	-	-
AVg.	1.3	-	1.75	-	-	1	1.3	1		1	-	1	-	-	-

OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the basic importance of NDT in quality assurance.
- Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- Equipping themselves to locate a flaw in various materials, products.
- Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
- Acquiring the knowledge on the selection of the suitable NDT technique for a given application

UNIT I INTRODUCTION TO NDT & VISUAL TESTING 9

Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING 9

Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation.
Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.

UNIT III EDDY CURRENT TESTING & THERMOGRAPHY 9

Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation.
Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.

UNIT IV ULTRASONIC TESTING & AET 9

Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.

UNIT V RADIOGRAPHY TESTING 9

Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to

1. Realize the importance of NDT in various engineering fields.
2. Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.
3. Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.
4. Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.
5. Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

TEXT BOOKS:

1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition, 2011.
3. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

REFERENCES:

1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.
2. Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989.
3. Chuck Hellier, "Handbook of Nondestructive Evaluation", Mc Graw Hill, 2012.
4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.

CO's – PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C01	2	2	2	3			2	2				2	1	2	
C02	3	1	2	2			2	2				2	2	2	1
C03	3	2	1	2			2	2				2	2	2	
CO4	3	1	2	2			2	2				2	2	2	2
CO5	3	2	2	2			2	2				2	2	2	1
Avg	2.8	1.6	1.8	2.2			2	2				2	1.8	2	1.3

OMR351 **MECHATRONICS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Selecting sensors to develop mechatronics systems.
- Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs.
- Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
- Applying PLC as a controller in mechatronics system.
- Designing and develop the apt mechatronics system for an application.

UNIT I INTRODUCTION AND SENSORS 9

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.

UNIT II 8085 MICROPROCESSOR 9

Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER 9

Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONICS SYSTEM DESIGN 9

Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Select sensors to develop mechatronics systems.

CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.

CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.

CO4: Apply PLC as a controller in mechatronics system.

CO5: Design and develop the apt mechatronics system for an application.

TEXT BOOKS

1. Bolton W., “Mechatronics”, Pearson Education, 6th Edition, 2015.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Penram International Publishing Private Limited, 6th Edition, 2013.

REFERENCES

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 1993.
2. Davis G. Alciatore and Michael B. Histand, “Introduction to Mechatronics and Measurement systems”, McGraw Hill Education, 2011.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2010.
4. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applications”, McGraw Hill Education, 2015.

5. Smaili. A and Mrad. F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.

CO’s – PO’s & PSO’s MAPPING

COs/POs & PSOs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	3		2						2	3	2	3
CO2	3	2	1	3		2						2	3	2	3
CO3	3	2	1	3		2						2	3	2	3
CO4	3	2	1	3		2						2	3	2	3
CO5	3	2	1	3		2						2	3	2	3
CO/PO & PSO Average	3	2	1	3		2						2	3	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															

ORA351 FOUNDATION OF ROBOTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vision application in robots.
- To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT I FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

UNIT II ROBOT KINEMATICS 9

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT III ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper

UNIT IV SENSORS IN ROBOTICS 9

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT V PROGRAMMING AND APPLICATIONS OF ROBOT 9

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Interpret the features of robots and technology involved in the control.
CO2: Apply the basic engineering knowledge and laws for the design of robotics.
CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.
CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

TEXT BOOKS:

1. Ganesh.S.Hedge,"A textbook of Industrial Robotics", Lakshmi Publications, 2006.
2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2ND edition 2012.

REFERENCES:

1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007.
2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.
3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.
4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.

CO's – PO's & PSO's MAPPING

COs/POs& PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1								1			3
CO2	3	2	1	1								1			3
CO3	3	2	1	1								1			3
CO4	3	2	1	1								1			3
CO5	3	2	1	1								1			3
CO/PO & PSO Average															
1 – Slight, 2 – Moderate, 3 – Substantial															

OAE352 FUNDAMENTALS OF AERONAUTICAL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

UNIT I HISTORY OF FLIGHT 8

Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AIRCRAFT CONFIGURATIONS AND ITS CONTROLS 10

Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III BASICS OF AERODYNAMICS 9

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law- stress-strain diagrams-elastic constants-Factor of Safety.

UNIT V BASICS OF PROPULSION 9

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production-Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1 Illustrate the history of aircraft & developments over the years
CO2 Ability to identify the types & classifications of components and control systems
CO3 Explain the basic concepts of flight & Physical properties of Atmosphere
CO4 Identify the types of fuselage and constructions.
CO5 Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS

1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015
2. . E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021
3. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

REFERENCE

1. SADHU SINGH, "INTERNAL COMBUSTION ENGINES AND GAS TURBINE"-, SS Kataraia & sons, 2015
2. KERMODE , "FLIGHT WITHOUT FORMULAE", -, Pitman; 4th Revised edition 1989

OCE353 LEAN CONCEPTS, TOOLS AND PRACTICES L T P C
3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.

UNIT I INTRODUCTION 9

Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report-The state of the industry with respect to its management practices -construction project phases - The problems with current construction management techniques.

UNIT II LEAN MANAGEMENT 9

Introduction to lean management - Toyota's management principle-Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design - Lean project delivery system- Forms of waste in construction industry - Waste Elimination.

UNIT III CORE CONCEPTS IN LEAN 9

Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.

UNIT IV LEAN TOOLS AND TECHNIQUES 9

Value Stream Mapping – Work sampling – Last planner system – Flow and pull based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.

UNIT V LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY 9

Lean construction implementation- Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.

TOTAL : 45 PERIODS

COURSE OUTCOME:

On completion of this course, the student is expected to be able to

CO1 Explains the contemporary management techniques and the issues in present scenario.

CO2 Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.

CO3 Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.

CO4 Apply lean techniques to achieve sustainability in construction projects.

CO5 Apply lean construction techniques in design and modeling.

REFERENCES:

1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.
2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., andTzortzopoulos, P.,Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.
4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.

OAI351 URBAN AGRICULTURE L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the students the principles of agricultural crop production and the production practices of crops in modern ways.
- To delineate the role of agricultural engineers in relation to various crop production practices.

UNIT I INTRODUCTION 9

Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.

UNIT II VERTICAL FARMING 9

Vertical farming- types, green facade, living/green wall-modular green wall **,** vegetated mat wall**-** Structures and components for green wall system: plant selection, growing media, irrigation and plant nutrition: Design, light, benefits of vertical gardening. Roof garden and its types. Kitchen garden, hanging baskets: The house plants/ indoor plants

UNIT III SOIL LESS CULTIVATION 9

Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, backyard gardens- tactical gardens- street landscaping- forest gardening, greenhouses, urban beekeeping

UNIT IV MODERN CONCEPTS 9

Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops

UNIT V WASTE MANAGEMENT 9

Concept, scope and maintenance of waste management- **r**ecycle of organic waste, garden wastes-solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1 Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops
CO2 Explain different methods of crop production on roof tops
CO3 Explain nutrient and pest management for crop production on roof tops
CO4 Illustrate crop water requirement and irrigation water management on roof tops
CO5 Explain the concept of waste management on roof tops

TEXT BOOKS:

1. Martellozzo F and J S Landry. 2020. Urban Agriculture. Scitus Academics Llc.
2. Rob Roggema. 2016. Sustainable Urban Agriculture and Food Planning. Routledge Taylor and Francis Group.
3. Akrong M O. 2012. Urban Agriculture. LAP Lambert Academic Publishing.

REFERENCES:

1. Agha Rokh A. 2008. Evaluation of ornamental flowers and fishes breeding in Bushehr urban wastewater using a pilot-scale aquaponic system. Water and Wastewater, 19 (65): 47–53.
2. Agrawal M, Singh B, Rajput M, Marshall F and Bell J. N. B. 2003. Effect of air pollution on peri-urban agriculture: A case study. Environmental Pollution, 126 (3): 323–329. https://www.sciencedirect.com/science/article/pii/S0269749103002458#aep-section-id24.
3. Jac Smit and Joe Nasr. 1992. Urban agriculture for sustainable cities: using wastes and idle land and water bodies as resources. Environment and Urbanization, 4 (2):141-152.

CO's – PO's & PSO's MAPPING

PO/PSO	CO1	CO2	CO3	CO4	CO5	Overall correlation of COs with POs

PO1	Engineering Knowledge	1	2	1	1	2	1
PO2	Problem Analysis	1	1	1	1	1	2
PO3	Design/ Development of Solutions	1	2	1	1	3	2
PO4	Conduct Investigations of Complex Problems	1	1	2	2	1	1
PO5	Modern Tool Usage	1	2	1	1	1	2
PO6	The Engineer and Society	1	2	1	2	1	1
PO7	Environment and sustainability	1	2	1	1	2	1
PO8	Ethics	2	1	1	1	2	1
PO9	Individual and team work:	1	1	2	1	1	1
PO10	Communication	1	2	1	1	2	1
PO11	Project management and finance	1	1	1	1	1	2
PO12	Life-long learning:	1	2	1	1	3	2
PSO1	To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill	1	2	1	1	2	1
PSO2	To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.	2	1	2	1	1	1
PSO3	To inculcate entrepreneurial skills through strong Industry-Institution linkage.	1	2	1	2	1	2

OEN351 DRINKING WATER SUPPLY AND TREATMENT L T P C
3 0 0 3

COURSE OBJECTIVE:

- To equip the students with the principles and design of water treatment units and distribution system.

UNIT I SOURCES OF WATER 9

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

UNIT II CONVEYANCE FROM THE SOURCE 9

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

UNIT III WATER TREATMENT 9

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation –- sand filters - Disinfection -– Construction, Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT 9

Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and Maintenance aspects

UNIT V WATER DISTRIBUTION AND SUPPLY 9

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics - Computer applications – Appurtenances – Leak detection - Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: an understanding of water quality criteria and standards, and their relation to public health
CO2: the ability to design the water conveyance system
CO3: the knowledge in various unit operations and processes in water treatment
CO4: an ability to understand the various systems for advanced water treatment
CO5: an insight into the structure of drinking water distribution system

TEXTBOOKS :

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.
2. Punmia B.C, Arun K.Jain, Ashok K.Jain, " Water supply Engineering" Lakshmi publication private limited, New Delhi, 2016.
3. Rangwala "Water Supply and Sanitary Engineering", February 2022
4. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.

REFERENCES :

1. Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954.
2. Babbit.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984.
3. Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984.
4. Duggal. K.N., "Elememts of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3						3		3			3		
2		3		2		2				3			3		
3				2		2				3			3		
4			3	2				3	2	3			3		
5			3	2			1		2	3		1			
Avg.		3	3	2		2	1	3	2	3		1	3		

1.low, 2-medium, 3-high, '-"- no correlation
Note: The average value of this course to be used for program articulation matrix.

OEE352 ELECTRIC VEHICLE TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide knowledge about electric machines and special machine
- To understand the basics of power converters
- To know the concepts of controlling DC and AC drive systems
- To understand the architecture and power train components.

- To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)

UNIT I ROTATING POWER CONVERTERS 9

Magnetic circuits- DC machine and AC machine –Working principle of Generator and Motor-DC and AC - Voltage and torque equations – Characteristics and applications. Working principle of special machines like: Brushless DC motor, Switched reluctance motor and PMSM.

UNIT II STATIC POWER CONVERTERS 9

Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.

UNIT III CONTROL OF DC AND AC MOTOR DRIVES 9

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives

UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS 9

History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT V MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES 9

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Able to understand the principles of conventional and special electrical machines.
CO2: Acquired the concepts of power devices and power converters
CO3: Able to understand the control for DC and AC drive systems.
CO4: Learned the electric vehicle architecture and power train components.
CO5: Acquired the knowledge of mechanics of electric vehicles and control of electric vehicles.

REFERENCES:

1 Stephen D. Umans, “Fitzgerald & Kingsley’s Electric Machinery”, Tata McGraw Hill, 7th Edition, 2020.
2 Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011
3 Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek “Analysis of Electric Machinery and Drive Systems”, 3rd Edition, Wiley-IEEE Press, 2013.
4 Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10th Impression 2021.
5 Iqbal Husain, ‘Electric and Hybrid Electric Vehicles’, CRC Press, 2021.
6 Wei Liu, ‘Hybrid Electric Vehicle System Modeling and Control’, Second Edition, WILEY, 2017
7 James Larminie and John Lowry, ‘Electric Vehicle Technology Explained’, Second Edition, Wiley, 2012

CO’s – PO’s & PSO’s MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2			3								3	3	3

CO2	3	2	2			3			3				3	3	3
CO3	3			3		2	2						3	3	3
CO4	3	2	2		3								3	3	3
CO5	3		2								2		3	3	3
Avg	3	2	2	3	3	1	2		3		2		3	3	3

OEI353 INTRODUCTION TO PLC PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- Understand basic PLC terminologies digital principles, PLC architecture and operation.
- Familiarize different programming language of PLC.
- Develop PLC logic for simple applications using ladder logic.
- Understand the hardware and software behind PLC and SCADA.
- Exposures about communication architecture of PLC/SCADA.

UNIT I INTRODUCTION TO PLC 9

Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.

UNIT II PLC INSTRUCTIONS 9

PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays-Interlock examples- Timers, Counters, Examples.

UNIT III PLC PROGRAMMING 9

Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions

UNIT IV COMMUNICATION OF PLC AND SCADA 9

Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures

UNIT V CASE STUDIES 9

Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
5

1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Communication Network Used for PLC/SCADA.

COURSE OUTCOMES:

CO1 Know the basic requirement of a PLC input/output devices and architecture. (L1)
CO2 Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming.(L2)
CO3 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)

CO4 Able to develop a PLC logic for a specific application on real world problem. (L5)
CO5 Ability to Understand the Concepts of Communication used for PLC/SCADA.(L1)

TEXT BOOKS:

1. Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition
2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication

REFERENCES:

1. MadhuchanndMitra and SamerjitSengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd.
2. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles andApplications, Pearson publication

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/108105063
2. https://www.electrical4u.com/industrial-automation/
3. https://www.etf.ues.rs.ba/~slubura/Procesni%20racunari/Programmable%20Logic%20Controllers%20Programming%20Methods.pdf
4. https://www.electrical4u.com/industrial-automation/

CO's – PO's & PSO's MAPPING

PO, PSO / CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1					1		1					
CO2	3	3	2					1		1	2				2
CO3	3	3	3	3	1			1		1					
CO4	3	3		3	3			1		1			3	3	
CO5	3	3	3	2	1			1		1			3	3	3
Avg	3	2.9	2.25	2.6	1.6			1		1			3	3	2.9

OCH351 **NANO TECHNOLOGY** **L T P C**
3 0 0 3

UNIT I INTRODUCTION 8

General definition and size effects–important nano structured materials and nano particles-importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS 8

Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES 10

Definition- importance of nanocomposites- nano composite materials-classification of composites-metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based-influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES 10

Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V APPLICATIONS OF NANO MATERIALS 9

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots-Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.

CO2 able to acquire knowledge about the different types of nano material synthesis

CO3 describes about the shape, size,structure of composite nano materials and their interference

CO4 understand the different characterization techniques for nanomaterials

CO5 develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS

1. Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, " Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004
3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.

REFERENCES

1. R.H.J.Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006.
2. C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3. Ivor Brodie and Julius J.Muray,'The physics of Micro/Nano – Fabrication',Springer International Edition,2010

CO's – PO's & PSO's MAPPING

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications	2	3	2	3	3	-	-	-	1	1	-	3	1	1	3
CO2	acquire knowledge about the different types of nano material synthesis	2	3	1	3	3	-	-	-	1	1	-	3	2	1	3
CO3	describes about the shape, size,structure of composite nano materials and their interference	2	2	2	3	3	1	1	-	1	1	-	3	2	1	3
CO4	understand the different characterization	2	2	1	3	3	1	1	1	1	-	1	3	1	1	3

	techniques for nanomaterials															
CO5	develop a deeper knowledge in the application of nanomaterials in different fields	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**3**	**2**	**1**	**3**
Overall CO		3	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**1**

OCH352 **FUNCTIONAL MATERIALS** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I INTRODUCTION 9

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact.

UNIT II MOLECULAR SELF ASSEMBLY 9

Molecular Organization, Self-Assembly in Biology, Energetics of Self-Organization, A Few Case Studies, Synthetic Protocols and Challenges, Solvent-assisted Self-Assembly, Directed Assembly-Langmuir-Blodgett and Langmuir-Schaefer techniques, Technological Applications of SAMs.

UNIT III BIO-INSPIRED MATERIALS 9

Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, ‘Bionics’-Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization- En route to Nanotechnology.

UNIT IV SMART OR INTELLIGENT MATERIALS 9

Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composities.

UNIT V MATERIALS FOR POLYMER ELECTRONICS 9

Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

TEXT BOOK:

1. Vijayamohanan K. Pillai and MeeraParthasarathy, “Functional Materials: A chemist’s perpective”, Universities Press Hyderabad (2012).

REFERENCE:

1. Stephen Manne “Biomimetic Materials Chemistry” Wiley-VCH Newyork, 1966.

OFD352 **TRADITIONAL INDIAN FOODS** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

UNIT I HISTORICAL AND CULTURAL PERSPECTIVES 9

Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING 9

Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sundrying, osmotic drying, brining, pickling and smoking.

UNIT III TRADITIONAL FOOD PATTERNS 9

Typical breakfast, meal and snack foods of different regions of India.Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods,pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods

UNIT IV COMMERCIAL PRODUCTION OF TRADITIONAL FOODS 9

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

UNIT V HEALTH ASPECTS OF TRADIONAL FOODS 9

Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 To understand the historical and traditional perspective of foods and food habits

CO2 To understand the wide diversity and common features of traditional Indian foods and meal patterns.

TEXT BOOKS:

1. Sen, Colleen Taylor "Food Culture in India" Greenwood Press, 2005.

2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.

OFD353 INTRODUCTION TO FOOD PROCESSING L T P C

3 0 0 3

COURSE OBJECTIVE:

- The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE 9

Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT II METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III LARGE-SCALE FOOD PROCESSING 12

Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

UNIT IV FOOD WASTES IN VARIOUS PROCESSES 6

Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

UNIT V FOOD HYGIENE 9

Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course the students are expected to

CO1 Be aware of the different methods applied to processing foods.

CO2 Be able to understand the significance of food processing and the role of foodand beverage industries in the supply of foods.

TEXT BOOKS/REFERENCES:

1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice".Surbhi Publications, 2001.
3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

OPY352 IPR FOR PHARMA INDUSTRY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
- This paper is to study significance of the amended patent act on pharma industry.

UNIT I INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS 9

Introduction, Types of Intellectual Property Rights -patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II PATENTS 9

Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT III PLANT VARIETY-TRADITIONAL KNOWLEDGE –GEOGRAPHICAL INDICATIONS 9

Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position.

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

Introduction – civil remedies – injunction, damage, account of profit – criminal remedies – patent, trademark. Practical aspects – Introduction, benefits of licensing, licensing of basic types of IPR, licensing clauses of IPR. Case studies of patent infringement, compulsory licensing, simple patent license agreements.

UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY 9

International Background of Intellectual Property- Paris Convention, Berne convention, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Trade Related Aspects of Intellectual Property Rights (TRIPS) and Patent Co-operation Treaty (PCT).

TOTAL:45 PERIODS

TEXT BOOKS:

1. N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, “Intellectual Property Rights” Edu creation Publishing, New Delhi, 2017.
2. The Patents Act, 1970 (Bare Act with Short Notes) (New Delhi: Universal Law Publishing Company Pvt. Ltd. 2012.
3. B.S. Rao, P.V. Appaji, “Intellectual Property Rights in Pharmaceutical Industry: Theory and Practice”, 2015.

REFERENCES:

1. Patents for Chemicals, Pharmaceuticals, & Biotechnology-Fundamentals of Global Law, Practice and Strategy. Philip W. Grubb, Oxford University Press, 2004.
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
3. S. Lakshmana Prabu, TNK. Suriyaprakash, “Intellectual Property Rights”, 1st ed., In Tech open access, Croatia, 2017.

COURSE OUTCOME

The student will be able to

CO1 Understand and differentiate the categories of intellectual property rights.

CO2 Describe about patents and procedure for obtaining patents.

CO3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.

CO4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
CO5 Provide different organizations role and responsibilities in the protection of IPR in the international level.
CO6 Understand the interrelationships between different Intellectual Property Rights on International Society

CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12
C1	3	3		2					2	2		
C2		3	3				2	2				
C3	3	3					2	2				1
C4					2		3	3		2	2	
C5		3					3			2		1
C6	3	2				2	2					2

OTT351 BASICS OF TEXTILE FINISHING **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.

UNIT I RESIN FINISHING 9

Importance of finishing and its classification. Resin finishing: Mechanism of creasing, Types of Resins .Anti crease, wash and wear, durable press resin finishing. Study about eco friendly method of anti crease finishing.

UNIT II FLAME PROOF & WATERPROOF 9

Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES 9

Soil Release Finishing: Mechanism of soil retention & soil release. Anti pilling Finishing: chemical and mechanical methods to produce anti pilling. Concept of UV Protection finishes- Concept of antistatic finishes.

UNIT IV MECHANICAL FINISHES 9

Mechanical finishing of textile materials - calendaring, compacting, Sanforising, Peach finishing. Object of Heat setting. Various methods of heat setting and mechanism of heat setting.

UNIT V STIFFENING AND SOFTENING 9

Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET .Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to Understand the

CO1 Basics of Resin Finishing Process.
CO2 Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.
CO3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
CO4 Concept of Mechanical finishing.
CO5 Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TEXT BOOKS:

1. V.A.Shennai, "Technology of Finishing", Vol X, Sevak Publications, Mumbai
2. Perkins, W.S., "Textile colouration and finishing", Carolina Academic Press., U.K, ISBN: 0890898855.2004.

REFERENCES:

1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62
2. Chakraborty, J.N, Fundamentals and Practices in colouration of Textiles, Woodhead Publishing India, 2009, ISBN-13:978-81-908001-4-3
3. W. D. Schindler and P. J. Hauser "Chemical finishing of textiles", Woodhead Publishing Cambridge England, 2004.

OTT352 INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry

UNIT I INTRODUCTION 9

Scope of industrial engineering in apparel Industry, role of industrial engineers.
Productivity: Definition - Productivity, Productivity measures .Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

UNIT II WORK STUDY 9

Definition, Purpose, Basic procedure and techniques of work-study.
Work environment – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment
Material Handling – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments.

UNIT III METHOD STUDY 9

Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart
MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.

UNIT IV WORK MEASUREMENT 9

Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD.

UNIT V WORK STUDY APPLICATION 9

Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course the student shall be able to understand

CO1: Fundamental concepts of industrial Engineering and productivity

CO2: Method study

CO3: Motion analysis

CO4: Work measurement and SAM

CO5: Ergonomics and its application to garment industry

TEXTBOOKS:

1. George Kanwaty, "Introduction to Work Study ", ILO, Geneva, 1996, ISBN: 9221071081 |ISBN-13: 9789221071082
2. Enrick N. L., "Time study manual for Textile industry", Wiley Eastern (P) Ltd., 1989, ISBN: 0898740444 | ISBN-13: 9780898740448
3. Khanna O. P., and Sarup A., "Industrial Engineering and Management", Dhanpat Rai Publications, New Delhi, 2010, ISBN: 818992835X / ISBN: 978-8189928353

REFERENCES

1. Norberd Lloyd Enrick., "Industrial Engineering Manual for Textile Industry", Wiley Eastern (P) Ltd., New Delhi, 1988, ISBN: 0882756311 | ISBN-13: 9780882756318
2. Chuter A. J., "Introduction to Clothing Production Management", Wiley-Black well Science, U.S. A., 1995, ISBN: 0632039396 | ISBN-13: 9780632039395
3. GordanaColovic., "Ergonomics in the garment industry", Wood publishing India Pvt. Ltd., India, 2014, ISBN: 0857098225 | ISBN-13: 9780857098221
4. Rajesh Bheda, "Managing Productivity in Apparel Industry "CBS Publishers & Distributors, 2008

CO's – PO's & PSO's MAPPING

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO' 6	PO' 7	PO 8	PO' 9'	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O3
CO1	Fundamental concepts of industrial Engineering and productivity	2	2	3	3	2	1	1	2	2	1	2	2	1	1	-
CO2	Method study	1	2	3	3	2	1	1	2	2	1	2	2	1	1	-
CO3	Motion analysis	1	2	3	3	2	1	1	2	2	1	2	2	1	1	-
CO4	Work measurement and SAM	1	2	3	3	2	1	1	2	2	1	3	2	1	1	-
CO5	Ergonomics and itsapplication to garment industry	1	2	3	3	2	1	2	2	2	1	3	2	1	1	-
	Overall CO	1.2	2	3	3	2	1	1.2	2	2	1	2.4	2	1	1	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OTT353 BASICS OF TEXTILE MANUFACTURE L T P C
3 0 0 3

COURSE OBJECTIVES:

- To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing

UNIT I NATURAL FIBRES 9

Introduction: Definition of staple fibre, filament; Classification of natural and man-made fibres, essential and desirable properties of fibres. Production and cultivation of Natural Fibers: Cultivation of cotton, production of silk (sericulture), wool and jute – physical and chemical structure of these fibres..

UNIT II REGENERATED AND SYNTHETIC FIBRES 9

Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres – chemical structure, fibre forming polymers, production principles.

UNIT III BASICS OF SPINNING 9

Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculations

UNIT IV BASICS OF WEAVING 9

Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms,

UNIT V BASICS OF KNITTING AND NONWOVEN 9

Knitting – classification, principle, types of fabrics; nonwoven process –classification, principle, types of fabrics.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students shall have the basic knowledge on
CO1: Classification of fibres and production of natural fibres
CO2: Regenerated and synthetic fibres
CO3: Yarn spinning
CO4: Weaving
CO5: Knitting and nonwoven

TEXTBOOKS

1. Mishra S. P. , "A Text Book of Fibre Science and Technology", New Age Publishers, 2000, ISBN: 8122412505
2. Marks R., and Robinson. T.C., "Principles of Weaving", The Textile Institute, Manchester, 1989, ISBN: 0 900739 258.
3. Spencer D.J., "Knitting Technology", III Ed., Textile Institute, Manchester, 2001, ISBN: 185573 333 1.

REFERENCES:

1. Hornberer M., Eberle H., Kilgus R., Ring W. and Hermeling H., "Clothing Technology: From Fibre to Fabric", Europa LehrmittelVerlag, 2008, ISBN: 3808562250 / ISBN: 978-3808562253.
2. Wynne A., "Motivate Series-Textiles", Maxmillan Publications, London, 1997.
3. Carr H. and Latham B., "The Technology of Clothing Manufacture" Backwell Science, U.K., 1994, ISBN: 0632037482 / ISBN:13: 9780632037483.Klein W., "The Rieter Manual of Spinning, Vol.1", Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-1-4 / ISBN 13 978-3-9523173-1-0.
4. Klein W., "The Rieter Manual of Spinning, Vol.2", Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-2-2 / ISBN 13 978-3-9523173-2-7.
5. Klein W., "The Rieter Manual of Spinning, Vol.1-3", Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-3-0 / ISBN 13 978-3-9523173-3-4.
6. Talukdar. M.K., Sriramulu. P.K., and Ajgaonkar. D.B., "Weaving: Machines, Mechanisms, Management", Mahajan Publishers, Ahmedabad, 1998, ISBN: 81-85401-16-0.
7. Morton W. E., and Hearle J. W. S., "Physical Properties of Textile Fibres", The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95
8. Gohl E. P. G., "Textile Science", CBS Publishers and distributors, 1987, ISBN 0582685958

CO's – PO's & PSO's MAPPING

Course	Statement	Program Outcome

Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO' 6	PO' 7	PO 8	PO' 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Classification of fibres and production of natural fibres	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO2	Regenerated and synthetic fibres	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO3	Yarn spinning	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO4	Weaving	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO5	Knitting and nonwoven	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
	Overall CO	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OPE351 INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS L T P C
3 0 0 3

COURSE OBJECTIVE:

The course is aimed to

- Gain knowledge about petroleum refining process and production of petrochemical products.

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL 9

Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum - Atmospheric and Vacuum Distillation.

UNIT II CRACKING 9

Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen

UNIT III REFORMING AND HYDROTREATING 9

Catalytic Reforming of Petroleum Feed Stocks. Lube oil processing- Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining. Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance.

UNIT IV INTRODUCTION TO PETROCHEMICALS 9

Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylen e, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.

UNIT V PRODUCTION OF PETROCHEMICALS 9

Production of Petrochemicals like Dimethyl Terephathalate(DMT), Ethylene Glycol, Synthetic glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.

CO2: Understand the insights of primary treatment processes to produce the precursors.

CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.

CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.

CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.

CO6: Learn the importance of optimization of process parameters for the high yield of petroleum products.

TEXT BOOKS

1. Nelson, W. L., “Petroleum Refinery Engineering”, 4th Edition., McGraw Hill, New York,1985.
2. Wiseman. P., "Petrochemicals", UMIST Series in Science and Technology, John Wiley & Sons,1986.

REFERENCES

1. Bhaskara Rao, B. K., “Modern Petroleum Refining Processes”, 2nd Edition, Oxford and IBH Publishing Company, New Delhi, 1990.
2. Bhaskara Rao, B. K. “A Text on Petrochemicals”, 1st Edition, Khanna Publishers

CPE334 ENERGY CONSERVATION AND MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES:
At the end of the course, the student is expected to
- understand and analyse the energy data of industries
- carryout energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

UNIT I INTRODUCTION 9
Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II ELECTRICAL SYSTEMS 9
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III THERMAL SYSTEMS 9
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES 9
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – D.G. sets

UNIT V ECONOMICS 9
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students can able to analyze the energy data of industries.
CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
CO3: Skills on combustion thermodynamics and kinetics.
CO4: Apply calculation and design tube still heaters.
CO5: Studied different heat treatment furnace.
CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:
1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com. a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982

4. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987

OPT351 BASICS OF PLASTICS PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES

- Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
- To gain practical knowledge on the polymer selection and its processing
- Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting)
- To understand suitable additives for plastics compounding
- To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques

UNIT I INTRODUCTION TO PLASTICS PROCESSING 9

Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermoset processing. Additives for plastics compounding and processing: antioxidants, light stabilizers, UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents, stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization.

UNITII EXTRUSION 9

Extrusion – Principles of extrusion. Features of extruder: barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, types of extruders. Flow mechanism: process variables, die entry effects and exit instabilities. Die swell, Defects: melt fracture, shark skin, bambooing. Factors determining efficiency of an extruder. Extrusion of films: blown and cast films. Tube/pipe extrusion. Extrusion coating: wire & cable. Twin screw extruder and its applications. Applications of extrusion and new developments.

UNIT III INJECTION MOLDING 9

Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the art injection moulding techniques - Introduction to trouble shooting

UNIT IV COMPRESSION AND TRANSFER MOLDING 9

Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould- positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding

UNIT V BLOW MOLDING, THERMOFORMING AND CASTING 9

Blow moulding: principles and terminologies. Injection blow moulding. Extrusion blow moulding. Design guidelines for optimum product performance and appearance. Thermoforming: principle, vacuum forming, pressure forming mechanical forming. Casting: working principle, types and applications.

TOTAL 45 PERIODS

COURSE OUTCOMES

CO1 Ability to find out the correlation between various processing techniques with product properties.

CO2 Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.

CO3 Acquire knowledge on additives for plastic compounding and methods employed for the same

CO4 Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.

CO5 Select an appropriate processing technique for the production of a plastic product

REFERENCES

1. S. S. Schwart, S. H. Goodman, Plastics Materials and Processes, Van Nostrad Reinhold Company Inc. (1982).
2. F. Hensen (Ed.), Plastic Extrusion Technology, Hanser Gardner (1997).
3. W. S. Allen and P. N. Baker, Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors (2004).
4. M. Chanda, S. K. Roy, Plastic Technology handbook, 4th Edn., CRC Press (2007).
5. I. I. Rubin, Injection Molding Theory & Practice, Society of Plastic Engineers, Wiley (1973).
6. D.V. Rosato, M. G. Rosato, Injection Molding Hand Book, Springer (2012).
7. M. L. Berins (Ed.), SPI Plastic Engineering Hand Book of Society of Plastic Industry Inc., Springer (2012).
8. B. Strong, Plastics: Material & Processing, A, Pearson Prentice hall (2005).
9. D.V Rosato, Blow Molding Hand Book, Carl HanserVerlag GmbH & Co (2003).

OEC351 SIGNALS AND SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant,Causal & Non-causal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: determine if a given system is linear/causal/stable
CO2: determine the frequency components present in a deterministic signal
CO3: characterize continuous LTI systems in the time domain and frequency domain
CO4: characterize discrete LTI systems in the time domain and frequency domain
CO5: compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, "Signals and Systems", 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)
2. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2002

REFERENCES :

1. B. P. Lathi, "Principles of Linear Systems and Signals", 2^{nd} Edition, Oxford, 2009.
2. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	2	-	-	-	-		3	-	-	1
2	3	-	3	-	-	2	-	-	-	-		3	-	3	-
3	3	3	-	-	3	2	-	-	-	-		3	2	-	-
4	3	3	-	-	3	2	-	-	-	-		3	-	3	1
5	3	3	-	3	3	2	-	-	-	-		3	-	3	1
C	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**1**

OEC352 FUNDAMENTALS Of ELECTRONIC DEVICES AND CIRCUITS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To analyze the frequency response of small signal amplifiers
- To design and analyze single stage and multistage amplifier circuits
- To study about feedback amplifiers and oscillators principles
- To understand the analysis and design of multi vibrators

UNIT I SEMICONDUCTOR DEVICES 9

PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator

UNIT II AMPLIFIERS **9**

Load line, operating point, biasing methods for BJT and MOSFET**,** BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER **9**

Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Advantages of negative feedback – Analysis of Voltage / Current, Series , Shunt feedback Amplifiers – positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS **9**

Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits

TEXT BOOKS :

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition, 2010.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.
3. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2014.

REFERENCES :

1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010.
2. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989
3. Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.

CO’s – PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	-	-	-	-	-	1	2	1	1
2	3	2	2	3	2	2	-	-	-	-	-	1	2	1	1
3	3	3	3	2	1	2	-	-	-	-	-	1	2	1	1
4	3	3	2	3	2	2	-	-	-	-	-	1	2	1	1
5	3	2	3	2	2	1	-	-	-	-	-	1	2	1	1
CO	**3**	**3**	**3**	**3**	**2**	**2**	-	-	-	-	-	**1**	**2**	**1**	**1**

CBM348 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT **L T P C**
3 0 0 3

COURSE OOBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services

- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I BASICS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia – The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1 Define, formulate, and analyze a problem

CO2 Solve specific problems independently or as part of a team

CO3 Gain knowledge of the Innovation & Product Development process in the Business Context

CO4 Work independently as well as in teams

CO5 Manage a project from start to finish

TEXT BOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:
1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	1						1		1			
2	3	2	3	1						1		1			
3	3	2	3	1	1			1	1	1		1			
4	3	2	3	1	1			1	1	1		1			
5	3	2	3	1	1			1	1	1		1			
AVg.															

CBM333 ASSISTIVE TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:
The student should be made to:
- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology

UNIT I CARDIAC ASSIST DEVICES 9
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

UNIT II HEMODIALYSERS 9
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS 9
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES 9
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS 9
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.
CO2: Describe the underlying principles of hemodialyzer machine.
CO3: Indicate the methodologies to assess the hearing loss.
CO4: Evaluate the types of assistive devices for mobilization.
CO5: Explain about TENS and biofeedback system.

TEXT BOOKS

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press,2006
2. Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and blind,Springer Science & Business Media, 1st edition, 12-May-2010
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition,2010.

REFERENCES

1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1stedition, 2011.
2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola , Elsevier 2019 ISBN 978 -0-323-662116
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

CO's – PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	1										
2	3	1	1	1	1										
3	3	1	1	1	1										
4	3	1	1	1	1										
5	3	1	1	1	1										
AVg.															

OMA352 OPERATIONS RESEARCH L T P C
3 0 0 3

COURSE OBJECTIVES:

This course will help the students to

- determine the optimum solution for Linear programming problems.
- study the Transportation and assignment models and various techniques to solve them.
- acquire the knowledge of optimality, formulation and computation of integer programming problems.
- acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- determine the optimum solution for non-linear programming problems.

UNIT I LINEAR PROGRAMMING 9

Formulation of linear programming models – Graphical solution – Simplex method - Big M Method – Two phase simplex method - Duality - Dual simplex method.

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS 9

Matrix form of Transportation problems – Loops in T.P – Initial basic feasible solution – Transportation algorithm – Assignment problem – Unbalanced assignment problems .

UNIT III INTEGER PROGRAMMING 9

Introduction – All and mixed I.P.P – Gomory's method – Cutting plane algorithm – Branch and bound algorithm – Zero – one programming.

UNIT IV DYNAMIC PROGRAMMING PROBLEMS 9

Recursive nature of computation – Forward and backward recursion – Resource Allocation model – Cargo – loading model – Work – force size model - Investment model – Solution of L.P.P by dynamic programming .

UNIT V NON - LINEAR PROGRAMMING PROBLEMS 9

Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker Conditions – Quadratic programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.

CO2 analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.

CO3 solve the integer programming problems using various methods.

CO4 conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.

CO5 determine the optimum solution for non linear programming problems.

TEXT BOOKS:

1. Kanti Swarup, P.K.Gupta and Man Mohan, " Operations Research " , Sultan Chand & Sons, New Delhi, Fifth Edition , 1990.
2. Taha. H.A, " Operations Research – An Introduction , Pearson Education, Ninth Edition , New Delhi, 2012.

REFERENCES :

1. J.K.Sharma , " Operations Research - Theory and Applications " Mac Millan India Ltd , Second Edition , New Delhi , 2003.
2. Richard Bronson & Govindasami Naadimuthu , " Operations Research " (Schaum's Outlines – TMH Edition) Tata McGraw Hill, Second Edition, New Delhi, 2004.
3. Pradeep Prabhakar Pai , " Operations Research and Practice", Oxford University Press, New Delhi , 2012.
4. J.P.Singh and N.P.Singh , " Operations Research , Ane Books Pvt.L.td, New Delhi , 2014.
5. F.S.Hillier and G.J. Lieberman, " Introduction to Operations Research " , Tata McGraw Hill, Eighth Edition , New Delhi, 2005.

CO's – PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO2	3	3	3	2	0	0	0	0	2	0	0	2	-	-	-
CO3	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO4	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO5	3	3	2	2	0	0	0	0	2	0	0	2	-	-	-
Avg	3	3	1	0.8	0	0	0	0	2	0	0	2	-	-	-

OMA353 ALGEBRA AND NUMBER THEORY L T P C
3 0 0 3

COURSE OBJECTIVES :

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

UNIT I GROUPS AND RINGS 9

Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem.

Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.

UNIT II FINITE FIELDS AND POLYNOMIALS 9

Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS 9

Division algorithm- Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.

UNIT IV DIOPHANTINE EQUATIONS AND CONGRUENCES 9

Linear Diophantine equations – Congruence's – Linear Congruence's - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.

UNIT V CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS 9

Wilson's theorem – Fermat's Little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

CO1 Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.

CO2 Demonstrate accurate and efficient use of advanced algebraic techniques.

CO3 The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text

TEXT BOOKS :

1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007.
2. Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications , New Delhi , 2002.

REFERENCES:

1. San Ling and Chaoping Xing, "Coding Theory – A first Course", Cambridge Publications, Cambridge, 2004.
2. Niven.I, Zuckerman.H.S., and Montgomery, H.L., "An Introduction to Theory of Numbers" , John Wiley and Sons , Singapore, 2004.
3. Lidl.R., and Pitz. G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition ,2006.

CO's – PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	2	-	-	-	2	1	-	1	2	2	-	-	-
CO2	3	3	1	1	3	1	2	1	1	1	2	2	-	-	-
CO3	3	3	2	1	3	1	3	1	1	1	2	3	-	-	-
CO4	3	3	2	2	3	2	2	1	1	1	2	3	-	-	-
CO5	2	2	1	-	3	1	2	1	1	1	3	3	-	-	-
Avg	2.8	2.4	1.6	0.8	2.4	1	2.2	1	0.8	1	2.2	2.6	-	-	-

OMA354 **LINEAR ALGEBRA** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS 9

Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.

UNIT II VECTOR SPACES 9

Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.

UNIT III LINEAR TRANSFORMATION 9

Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.

UNIT IV INNER PRODUCT SPACES 9

Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION 9

Eigen value Problems : Power method, Jacobi rotation method - Singular value decomposition – QR decomposition.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After the completion of the course the student will be able to

CO1 Test the consistency and solve system of linear equations.

CO2 Find the basis and dimension of vector space.

CO3 Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.

CO4 Find orthonormal basis of inner product space and find least square approximation.

CO5 Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

TEXT BOOKS

1. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002.
2. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5^{th} Edition,2019.

REFERENCES

1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, 8^{th} Edition, 2009.
2. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 7^{th} Edition, 2007.
3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
4. Richard Branson, Matrix Operations, Schaum's outline series, 1989.
5. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, Edition, 4^{th} 2005.
6. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2014.

CO's – PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	2	2	2	1	1	1	1	3	-	-	-
CO2	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
Avg	3	3	3	3	2.8	2	2	1	1	1	1	3	-	-	-

OBT352 BASICS OF MICROBIAL TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVE:

- Enable the Non-biological student's to understand about the basics of life science and their pro and cons for living organisms.

UNIT I BASICS OF MICROBES AND ITS TYPES 9

Introduction to microbes, existence of microbes, inventions of great scientist and history, types of microorganisms – Bacteria, Virus, Fungi.

UNIT II MICROBIAL TECHNIQUES 9

Sterilization – types – physical and chemical sterilization, Decontamination, Preservation methods, fermentation, Cultivation and growth of microbes, Diagnostic methods.

UNIT III PATHOGENIC MICROBES 9

Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

UNIT IV BENEFICIAL MICROBES 9

Applications of microbes – Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.

UNIT V PRODUCTS FROM MICROBES 9

Fermentedproducts – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermi compost, Pharmaceutical products - Antibiotics, Vaccines

TOTAL: 45 PERIODS

COURSE OUTCOME:

At the end of the course the students will be able to
CO1 Microbes and their types
CO2 Cultivation of microbes
CO3 Pathogens and control measures for safety
CO4 Microbes in different industry for economy.

TEXT BOOKS

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Prescott L.M., Harley J.P., Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

OBT353 **BASICS OF BIOMOLECULES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- The objective is to offer basic concepts of biochemistry to students with diverse background in life sciences including but not limited to the structure and function of various biomolecules and their metabolism.

UNIT I CARBOHYDRATES 9

Introduction to carbohydrate, classification, properties of monosaccharide, structural aspects of monosaccharides. Introduction to disaccharide (lactose, maltose, sucrose) and polysaccharide (Heparin, starch, and glycogen) biological function of carbohydrate.

UNIT II LIPID AND FATTY ACIDS 9

Introduction to lipid, occurrence, properties, classification of lipid. Importance of phospholipids, sphingolipid and glycerolipid. Biological function of lipid. Fatty acid, Introduction, Nomenclature and classification of fatty acid Essential and non essential fatty acids.

UNIT III AMINO ACIDS AND PROTEIN. 9

Introduction to amino acid, structure, classification of protein based on polarity. Introduction to protein, classification of protein based on solubility, shape, composition and Function. Peptide bond– Structure of peptide bond. Denauration – renaturation of protein, properties of protein. Introduction to lipoprotein, glycoprotein and nucleoprotein.Biological function of protein.

UNIT IV NUCLEIC ACIDS 9

Introduction to nucleic acid, Difference between nucleotide and nucleoside, composition of DNA & RNA Structure of Nitrogen bases in DNA and RNA along with the nomenclature· DNA double helix (Watson and crick) model, types of DNA, RNA.

UNIT V VITAMINS AND HORMONES 9

Different types of vitamins, their diverse biochemical functions and deficiency related diseases. Overview of hormones. Hormone mediated signaling. Mechanism of action of steroid hormones, epinephrine, glucagons and insulin.Role of vitamins and hormones in metabolism; Hormonal disorders; Therapeutic uses ofvitamins and hormones.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Students will learn about various kinds of biomolecules and their physiological role.
CO2 Students will gain knowledge about various metabolic disorders and will help them to know the importance of various biomolecules in terms of disease correlation.

TEXT BOOKS

1. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox W.H.Freeman and Company 2017
2. Satyanarayana, U. and U. Chakerapani, “Biochemistry” 3rd Rev. Edition, Books & Allied (P) Ltd., 2006. 3. Rastogi, S.C. “Biochemistry” 2nd Edition, Tata McGraw-Hill, 2003.
4. Conn, E.E., etal., “Outlines of Biochemistry” 5th Edition, John Wiley & Sons, 1987.
5. Outlines of Biochemistry, 5th Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi.pp 693. John Wiley and Sons, New York. 1987.

REFERENCES

1. Berg, Jeremy M. et al. “Biochemsitry”, 6th Edition, W.H. Freeman & Co., 2006.
2. Murray, R.K., etal “Harper’s Illustrated Biochemistry”, 31st Edition, McGraw-Hill, 2018.
3. Voet, D. and Voet, J.G., “Biochemistry”, 4th Edition, John Wiley & Sons Inc., 2010.

OBT354 FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES:
- To provide knowledge on the fundamentals of cell biology.
- To understand the signalling mechanisms.
- Understand basic principles of molecular biology at intracellular level to regulate growth, division and development.

UNIT I INTRODUCTION TO CELL **9**
Cell, cell wall and Extracellular Matrix (ECM), composition, cellular dimensions, Evolution, Organisation, differentiation of prokaryotic and Eukaryotic cells, Virus, bacteria, cyanobacteria, mycoplasma and prions.

UNIT II CELL ORGANELLES **9**
Molecular organisation, biogenesis and functin Mitochondria, endoplasmic reticulam, golgi apparatus, plastids, chloroplast, leucoplast, centrosome, lysosome, ribosome, peroxisome, Nucleus and nucleolus. Endo membrane system, concept of compartmentalisation.

UNIT III BIO-MEMBRANE TRANSPORT **9**
Physiochemical properties of cell membranes. Molecular constitute of membranes, asymmetrical organisation of lipids and proteins. Solute transport across membrane's-fick's law, simple diffusion, passive-facilitated diffusion, active transport- primary and secondary, group translocation, transport ATPases, membrane transport in bacteria and animals. Transportmechanism- mobile carriers and pores mechanisms. Transport by vesicle formation, endocytosis, exocytosis, cell respiration.

UNIT IV CELL CYCLE **9**
Cell cycle- Cell division by mitosis and meosis, Comparision of meosis and mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, cell cycle checkpoints.

UNIT V CENTRAL DOGMA **9**
Overview of Central dogma DNA replication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments. Structure and function of mRNA, rRNA and tRNA. RNA synthesis: Initiation, elongation and termination of RNA synthesis Introduction to Genetic code- Steps in translation: Initiation, Elongation and termination of protein synthesis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 Understanding of cell at structural and functional level.
CO2 Understand the central dogma of life and its significance.
CO3 Comprehend the basic mechanisms of cell division.

TEXTBOOKS:
1. Cooper, G.M. and R.E. Hansman "The Cell: A Molecular Approach", 8th Edition, Oxford University Press, 2018
2. Friefelder, David. "Molecular Biology." Narosa Publications, 1999
3. Weaver, Robert F. "Molecular Biology" IInd Edition, Tata McGraw-Hill, 2003.

REFERENCES:
1. Lodish H, Berk A, MatsudairaP,Kaiser CA, Krieger M, Schot MP, Zipursky L, Darnell J. Molecular Cell Biology, 6th Edition, 2007.
2. Becker, W.M. etal., "The World of the Cell", 9th Edition, Pearson Education, 2003.
3. Campbell, N.A., J.B. Recee and E.J. Simon "Essential Biology", VIIrd Edition, Pearson International, 2007.
4. Alberts, Bruce etal., "Essential Cell Biology", 4th Edition, W.W. Norton, 2013.

OPEN ELECTIVE IV

OHS352 PROJECT REPORT WRITING

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVE

The Course will enable Learners to,

- Understand the essentials of project writing.
- Perceive the difference between general writing and technical writing
- Assimilate the fundamental features of report writing.
- Understand the essential differences that exist between general and technical writing.
- Learn the structure of a technical and project report.

UNIT I 9

Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.

UNIT II 9

Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis.

UNIT III 9

Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.

UNIT IV 9

Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography.

UNIT V 9

Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.

TOTAL:45 PERIODS

COURSE OUTCOMES

By the end of the course, learners will be able to

CO1 Write effective project reports.

CO2 Use statistical tools with confidence.

CO3 Explain the purpose and intension of the proposed project coherently and with clarity.

CO4 Create writing texts to suit achieve the intended purpose.

CO5 Master the art of writing winning proposals and projects.

REFERENCES

1. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall(2012)
2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012)
3. Daniel Riordan - Technical Report Writing Today (1998)
   Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.

CO's – PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	1	1	3	2	2	3	3	3	3	-	-	-
2	2	2	2	1	1	1	2	1	2	3	2	3	-	-	-
3	2	2	3	3	2	3	2	2	2	3	2	3	-	-	-
4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
AVg.	**2.4**	**2.2**	**2.4**	**2.2**	**2**	**2.6**	**2.4**	**2.2**	**2.6**	**3**	**2.6**	**3**	**-**	**-**	**-**

- 1-low, 2-medium, 3-high, '-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

OMA355 ADVANCED NUMERICAL METHODS L T P C
3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM 9

System of nonlinear equations : Fixed point iteration method - Newton's method; System of linear equations: Thomas algorithm for tri diagonal system - SOR iteration methods ; Eigen value problems: Given's method - Householder's method.

UNIT II INTERPOLATION 9

Central difference: Stirling and Bessel's interpolation formulae ; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline ; Least square approximation for continuous data (upto 3rd degree).

UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Explicit Adams - Bashforth Techniques - Implicit Adams - Moulton Techniques, Predictor -Corrector Techniques - Finite difference methods for solving two - point linear boundary value problems - Orthogonal Collocation method.

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 9

Laplace and Poisson's equations in a rectangular region : Five point finite difference schemes - Leibmann's iterative methods - Dirichlet's and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes .

UNIT V FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS 9

Parabolic equations : Explicit and implicit finite difference methods – Weighted average approximation - Dirichlet's and Neumann conditions – First order hyperbolic equations - Method of characteristics - Different explicit and implicit methods; Wave equation : Explicit scheme – Stability of above schemes.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems;

CO2: understand the interpolation theory;

CO3: understand the concepts of numerical methods for ordinary differential equations;

CO4: demonstrate the understandings of common numerical methods for elliptic equations;

CO5: understand the concepts of numerical methods for time dependent partial differential equations

TEXT BOOKS :

1. Grewal, B.S., "Numerical Methods in Engineering & Science ", Khanna Publications, Delhi, 2013.
2. Gupta, S.K., "Numerical Methods for Engineers", (Third Edition), New Age Publishers, 2015.
3. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., "Computational Methods for Partial Differential Equations", New Age Publishers, 1994.

REFERENCES:

1. Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.
2. Burden, R.L., and Faires, J.D., “Numerical Analysis – Theory and Applications”, 9 th Edition, Cengage Learning, New Delhi, 2016.
3. Gupta S.K., “Numerical Methods for Engineers”,4th Edition, New Age Publishers, 2019.
4. Sastry, S.S., “Introductory Methods of Numerical Analysis”, 5th Edition, PHI Learning, 2015.
5. Morton, K.W. and Mayers D.F., "Numerical solution of Partial Differential equations", Cambridge University press, Cambridge, 2002.

CO’s – PO’s & PSO’s MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	2	2	2	1	1	1	1	3	-	-	-
CO2	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
Avg	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-

OMA356 RANDOM PROCESSES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT I RANDOM VARIABLES 9

Discrete and continuous random variables – Moments – Moment generating functions – Joint Distribution- Covariance and Correlation – Transformation of a random variable.

UNIT II RANDOM PROCESSES 9

Classification – Characterization – Cross correlation and Cross covariance functions - Stationary Random Processes – Markov process - Markov chain.

UNIT III SPECIAL RANDOM PROCESSES 9

Bernoulli Process – Gaussian Process - Poisson process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITIES 9

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 9

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1 Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.

CO2 Apply the concept random processes in engineering disciplines.

CO3 Understand and apply the concept of correlation and spectral densities.

CO4 Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.

CO5 Analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS

1. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

REFERENCES

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.
3. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.
4. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.
5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

CO's – PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO2	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO3	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO4	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO5	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
Avg	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-

OMA357 QUEUEING AND RELIABILITY MODELLING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

UNIT I RANDOM PROCESSES 9

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT II MARKOVIAN QUEUEING MODELS 9

Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms.

UNIT III ADVANCED QUEUEING MODELS 9

M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and $M/E_K/1$ as special cases – Series queues – Open Jackson networks.

UNIT IV SYSTEM RELIABILITY 9

Reliability and hazard functions- Exponential, Normal, Weibull and Gamma failure distribution – Time - dependent hazard models – Reliability of Series and Parallel Systems.

UNIT V MAINTAINABILITY AND AVAILABILITY 9

Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1 Enable the students to apply the concept of random processes in engineering disciplines.

CO2 Students acquire skills in analyzing various queueing models.

CO3 Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.

CO4 Students can analyze reliability of the systems for various probability distributions.

CO5 Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

TEXT BOOKS

1. Shortle J.F, Gross D, Thompson J.M,Harris C.M., "Fundamentals of Queueing Theory", John Wiley and Sons, New York,2018.
2. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishing Company Ltd., New Delhi,2010.

REFERENCES

1. Medhi J, "Stochastic models of Queueing Theory", Academic Press, Elsevier, Amsterdam, 2003.
2. Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016.
3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
4. Govil A.K., "Reliability Engineering", Tata-McGraw Hill Publishing Company Ltd., New Delhi,1983.

CO's – PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO2	3	3	2	0	0	0	0	0	2	0	0	2	-	-	-
CO3	3	3	0	2	0	0	0	0	2	0	0	2	-	-	-
CO4	3	3	2	0	0	0	0	0	2	0	0	2	-	-	-
CO5	3	3	3	2	0	0	0	0	2	0	0	2	-	-	-
Avg	3	3	1.4	0.8	0	0	0	0	2	0	0	2	-	-	-

OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know the basic concept To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANGEMENT 9

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS
9

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING 9

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase-Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS 9

Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters –- Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation -Forecasting methods.

UNIT V CONTROLING PRODUCTION & OPERATIONS MANAGEMENT 9

Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X , R , p , np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing.

TOTAL 45 : PERIODS

COURSE OUTCOMES

Upon completion of this course the learners will be able :

CO1 To understand the basics and functions of Production and Operation Management for business owners.
CO2 To learn about the Production & Operation Systems.
CO3 To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.
CO4 To known about the Production & Operations Management Processes in organisations.
CO5 To comprehend the techniques of controlling , Production and Operations in industries.

REFERENCES
1. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 2007.
2. Amitabh Raturi, Production and Inventory Management, , 2008.
3. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.
4. Muhlemann, Okland and Lockyer, Production and Operation Management, Macmillan India,1992.
6. Chary S.N, Production and Operations Management, TMH Publications, 2010.
7. Terry Hill ,Operation Management. Pal Grave McMillan (Case Study).2005.

OMG355 MULTIVARIATE DATA ANALYSIS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:
- To know various multivariate data analysis techniques for business research.

UNIT I INTRODUCTION 9

Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.

UNIT II PREPARING FOR MULTIVARIATE ANALYSIS 9

Conceptualization of research model with variables, collection of data —Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

UNIT III MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS 9

Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. -Approaches to factor analysis – interpretation of results.

UNIT IV LATENT VARIABLE TECHNIQUES 9

Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

UNIT V ADVANCED MULTIVARIATE TECHNIQUES 9

Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

CO1 Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.

CO2 Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.

CO3 Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.

CO4 Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.

CO5 Make better business decisions by using advanced techniques in data analytics. ‘

REFERENCES :
1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2005.
2. Barbara G. Tabachnick, Linda S.Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012.

3. Richard A Johnson and Dean W.Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2005.
4. David R Anderson, Dennis J Seveency, and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2002

OME352 ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.
- To be acquainted with vat polymerization and material extrusion processes
- To be familiar with powder bed fusion and binder jetting processes.
- To gain knowledge on applications of direct energy deposition, and material jetting processes.
- To impart knowledge on sheet lamination and direct write technologies.

UNIT I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain - ASTM/ISO 52900 Classification - Benefits - AM Unique Capabilities - AM File formats: STL, AMF Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare. Business Opportunities in AM.

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION 9

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications.
Material Extrusion: Fused Deposition Modeling (FDM) - Process-Materials -Applications and Limitations.

UNIT III POWDER BED FUSION AND BINDER JETTING 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications.
Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations - Applications.

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION 9

Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications.
Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery - Materials -Benefits -Applications.

UNIT V SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY 9

Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation.
Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course students shall be able to:

CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.

CO3: Elaborate the process and applications of powder bed fusion and binder jetting.

CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.

CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

CME343 NEW PRODUCT DEVELOPMENT LT P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the New product qualification and Market Survey on similar products of new product development
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT I FUNDAMENTALS OF NPD 9

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD.

UNIT II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT III ESSENTIALS OF NPD 9

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.

UNIT IV CRITERIONS OF NPD 9

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT V REPORTING & FORWARD-THINKING OF NPD 9

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1 Discuss fundamental concepts and customer specific requirements of the New Product development

CO2 Discuss the Material specification standards, analysis and fabrication, manufacturing process Develop Feasibility Studies & reporting of New Product development

CO3 Analyzing the New product qualification and Market Survey on similar products of new product development

CO4 Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS:

Product Development – Sten Jonsson

Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES:

Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark

Change by Design

Toyota Product Development System – James Morgan & Jeffrey K. Liker

Winning at New Products – Robert Brands 3rd Edition

Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

CO's – PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	3	1				1	1			1	1	3	2
2	1	1	3	1				1	1			1	1	3	2
3	1	1	3	1				1	1			1	1	3	2
4	1	1	3	1				1	1			1	1	3	2
5	1	1	3	1				1	1			1	1	3	2
Low (1) ; Medium (2) ; High (3)															

OME355 INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

The course aims to

- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app

- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I UI/UX 9

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives

UNIT II APP DEVELOPMENT 9

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

UNIT III INDUSTRIAL DESIGN 9

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing

UNIT IV MECHANICAL RAPID PROTOTYPING 9

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

UNIT V ELECTRONIC RAPID PROTOTYPING 9

Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able to:

CO1 Create quick UI/UX prototypes for customer needs
CO2 Develop web application to test product traction / product feature
CO3 Develop 3D models for prototyping various product ideas
CO4 Built prototypes using Tools and Techniques in a quick iterative methodology

TEXT BOOKS

1. Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)
2. Samar Malik, Autodesk Fusion 360 - The Master Guide.
3. Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition(2014)

REFERENCES

1. https://www.adobe.com/products/xd/learn/get-star ted.html
2. https://developer.android.com/guide
3. https://help.autodesk.com/view/fusion360/ENU/courses/
4. https://help.prusa3d.com/en/categor y/prusaslicer_204

MF3010 MICRO AND PRECISION ENGINEERING LT P C
3 0 0 3

COURSE OBJECTIVES:

At the end of this course the student should be able to

- Learn about the precision machine tools
- Learn about the macro and micro components.

- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSTEMS 9

Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II FABRICATION PROCESSES FOR MICRO-SYSTEMS: 9

Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III INTRODUCTION TO PRECISION ENGINEERING 9

Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.

UNIT IV PRECISION MACHINING PROCESSES 9

Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V METROLOGY FOR MICRO SYSTEMS 9

Metrology for micro systems - Surface integrity and its characterization.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1 Select suitable precision machine tools and operate
CO2 Apply the macro and micro components for fabrication of micro systems.
CO3 Apply suitable machining process
CO4 Able to work with miniature models of existing machine tools/robots and other instruments.
CO5 Apply metrology for micro system

TEXT BOOKS:

1. Davim, J. Paulo, ed. Microfabrication and Precision Engineering: Research and Development. Woodhead Publishing, 2017
2. Gupta K, editor. Micro and Precision Manufacturing. Springer; 2017

REFERENCES:

1. Dornfeld, D., and Lee, D. E., Precision Manufacturing, 2008, Springer.
2. H. Nakazawa, Principles of Precision Engineering, 1994, Oxford University Press.
3. Whitehouse, D. J., Handbook of Surface Metrology, Institute of Physics Publishing, Philadelphia PA, 1994.
4. Murthy.R.L, ―Precision Engineering in Manufacturing‖, New Age International, New Delhi, 2005

OMF354 COST MANAGEMENT OF ENGINEERING PROJECTS LT P C
3 0 0 3

COURSE OBJECTIVES:

Summarize the costing concepts and their role in decision making
Infer the project management concepts and their various aspects in selection
Interpret costing concepts with project execution

Develop knowledge of costing techniques in service sector and various budgetary control techniques
Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.'

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:
CO1: Understand the costing concepts and their role in decision making.
CO2: Understand the project management concepts and their various aspects in selection.
CO3: Interpret costing concepts with project execution.
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.
CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

1. John M. Nicholas, Herman Steyn Project Management for Engineering, Business and Technology, Taylor & Francis, 2 August 2020, ISBN: 9781000092561.
2. Albert Lester ,Project Management, Planning and Control, Elsevier/Butterworth-Heinemann, 2007, ISBN: 9780750669566, 075066956X.

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991.
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988.
3. Charles T. Horngren et al Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011.
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003.
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007.

AU3002 BATTERIES AND MANAGEMENT SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:

The objective of this course is to make the students

- To understand the working and characteristics of different types of batteries and their management

UNIT I ADVANCED BATTERIES 9

Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. *NCR18650B* specifications.

UNIT II BATTERY PACK 9

Battery Pack- design, sizing, calculations, flow chart, real and simulation Model.Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III BATTERY MODELLING 9

Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models-Introduction. Battery Modelling software/simulation frameworks

UNIT IV BATTERY STATE ESTIMATION 9

SOC Estimation- Definition, importance, single cell Vs series batteries SOC. Estimation Methods-Load voltage, Electromotive force, AC impedance, Ah counting, Neural networks, Neuro-fuzzy forecast method, Kalman filter. Estimation Algorithms.

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS 9

Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package.ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1 Acquire knowledge of different Li-ion Batteries performance.
CO2 Design a Battery Pack and make related calculations.
CO3 Demonstrate a BatteryModel or Simulation.
CO4 Estimate State-of-Charges in a Battery Pack.
CO5 Approach different BMS architectures during real world usage.

TEXT BOOKS

1. Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles’’, Wiley, 2015.
2. Davide Andrea ,“Battery Management Systems for Large Lithium-Ion Battery Packs” ARTECH House, 2010.

REFERENCES

1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic *NCR18650B- DataSheet*
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet

AU3008 SENSORS AND ACTUATORS L T P C
3 0 0 3

COURSE OBJECTIVES:

- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS 9

Sensors: Functions- Classifications- Main technical requirement and trends Units and standards- Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error- Propagation of error- Odds and uncertainty- principle of transduction-Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers- Dynamic characteristics of first and second order transducers for standard test inputs.

UNIT II VARIABLE RESISTANCE AND INDUTANCE SENSORS 9

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS 9

Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE ACTUATORS 9

Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS 9

Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1 List common types of sensor and actuators used in vehicles.
CO2 Design measuring equipment's for the measurement of pressure force, temperature and flow.
CO3 Generate new ideas in designing the sensors and actuators for automotive application
CO4 Understand the operation of thesensors, actuators and electronic control.
CO5 Design temperature control actuators for vehicles.

TEXT BOOKS:

1. Doebelin's Measurement Systems: 7th Edition (SIE),Ernest O. Doebelin DhaneshN.Manik McGraw Hill Publishers, 2019.
2. Robert Brandy, " Automotive Electronics and Computer System", Prentice Hall,2001
3. William Kimberley," Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004.
4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5.

REFERENCES:

1. James D Halderman, " Automotive Electrical and Electronics" , Prentice Hall, USA, 2013
2. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International.
3. Patranabis.D, " Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd,2003
4. William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

OAS353 **SPACE VEHICLES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To interpret the missile space stations, space vs earth environment.
- To explain the life support systems, mission logistics and planning.
- To deploy the skills effectively in the understanding of space vehicle configuration design.
- To explain Engine system and support of space vehicle
- To interpret nose cone configuration of space vehicle

UNIT I FUNDAMENTAL ASPECTS 9

Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity.

UNIT II SELECTION OF ROCKET PROPULSION SYSTEMS 9

Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

UNIT III ENGINE SYSTEMS, CONTROLS, AND INTEGRATION 9

Propellant Budget – Performance of Complete or Multiple Rocket Propulsion Systems – Engine Design – Engine Controls – Engine System Calibration – System Integration and Engine Optimization.

UNIT IV THRUST VECTOR CONTROL 9

TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment

UNIT V NOSE CONE CONFIGURATION 9

Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
CO2 Apply knowledge in selecting the appropriate rocket propulsion systems.
CO3 interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
CO4 Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
CO5 Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

OIM352 **MANAGEMENT SCIENCE** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

Of this course are

- To introduce fundamental concepts of management and organization to students.
- Toi mpart knowledge to students on various aspects of marketing, quality control and marketing strategies.
- To make students familiarize with the concepts of human resources management.
- To acquaint students with the concepts of project management and cost analysis.
- To make students familiarize with the concepts of planning process and business strategies.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANISATION 9

Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor's Scientific Management Theory- Fayal's Principles of Management- Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's TheoryXandTheoryY-HertzbergTwoFactorTheoryofMotivation-LeadershipStyles,Social responsibilities of Management, Designing Organisational Structures: Basic concepts related to Organisation -Departmentation and Decentralisation.

UNIT II OPERATIONS AND MARKETING MANAGEMENT 9

Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production),Work Study - Basic procedure involved in Method Study and Work Measurement - BusinessProcessReengineering(BPR)-StatisticalQualityControl:controlchartsforVariablesandAttributes (simple Problems) and Acceptance Sampling, Objectives of Inventory control, EOQ,ABC Analysis, Purchase Procedure, Stores Management and Store Records - JIT System,Supply Chain Management, Functions of Marketing, Marketing Mix, and Marketing Strategies based on ProductLifeCycle.

UNIT III HUMAN RESOURCES MANAGEMENT 9

Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager:Manpower planning, Recruitment, Selection, TrainingandDevelopment,WageandSalaryAdministration,Promotion,Transfer,PerformanceAppraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating –Capability Maturity Model (CMM)Levels.

UNIT IV PROJECT MANAGEMENT 9

Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method(CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis,Project Crashing (simple problems).

UNIT V STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES 9

Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Cardas Contemporary Business Strategies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, Students will be able to

CO1:Plan an organizational structure for a given context in the organization to carryout production operations through Work-study.

CO2:Survey the markets,customers and competition better and price the given products appropriatey

CO3:Ensure quality for a given product or service.

CO4:Plan, schedule and control projects through PERTandCPM.

CO5:Evaluate strategyforabusiness orserviceorganisation.

TEXTBOOKS:

1. KanishkaBedi, Production and Operations Management,Oxford University Press,2007.
2. Stoner,Freeman,Gilbert, Management,6th Ed, PearsonEducation,NewDelhi,2004.
3. ThomasN.Duening & John M.Ivancevich Management Principles and Guidelines, Biztantra,2007.
4. P.VijayKumar,N.Appa Rao and Ashnab, Chnalill, CengageLearning India,2012.

REFERECES:

1. KotlerPhilip and KellerKevinLane: Marketing Management, Pearson, 2012.
2. KoontzandWeihrich: Essentials of Management, McGrawHill, 2012.
3. Lawrence RJauch,R.Guptaand William F. Glueck: Business Policy and Strategic Management Science,McGrawHill,2012.
4. SamuelC.Certo:Modern Management,2012.

CO's – PO's & PSO's MAPPING

5.

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3			3	3	3		3	3	2			2	3	
2	3			2	3	3		2	3	2				2	
3	3			3	2	2		3	2	2					2
4	3			3	3	2		3	2	3					3
5	3			2	3	3		2	3	3			2	1	
AVg.	3			2.6	2.8	2.6		2.6	2.6	2.4			2	2	2.5

OIM353 PRODUCTION PLANNING AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNITII WORK STUDY 9

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNITIII PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNITIV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling-Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course,

CO1:The students can able to prepare production planning and control act work study,

CO2:The students can able to prepare product planning,

CO3:The students can able to prepare production scheduling,

CO4:The students can able to prepare Inventory Control.

CO5:They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

1. James. B. Dilworth, ”Operations management – Design, Planning and Control for manufacturing and services” Mcgraw Hill International edition 1992.
2. Martand Telsang, “Industrial Engineering and Production Management”, First edition, S. Chand and Company, 2000.

REFERENCES

1. Chary. S.N., “Theory and Problems in Production & Operations Management”, Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8th Edition John Wiley and Sons, 2000
3. Jain. K.C. & Aggarwal. L.N., “Production Planning Control and Industrial Management”, Khanna Publishers, 1990
4. Kanishka Bedi, “Production and Operations management”, 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, “ Operations management – A value driven approach” Irwin Mcgraw hill.
6. Norman Gaither, G. Frazier, “Operations Management” 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corpn.1984
8. Upendra Kachru, “ Production and Operations Management – Text and cases” 1st Edition, Excel books 2007

CO’s – PO’s & PSO’s MAPPING

CO’s	**PO’s**												**PSO’s**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3			3		1				1		3		
2	3	2			3									2	
3		2			3									2	
4		2	2												
5	3	3	2											1	
AVg.	3	2.6	2		3		1				1		3	1.8	

OIE353 OPERATIONS MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVE:

- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT 9

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit , framework; Supply Chain Management

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN 9

Demand Forecasting – Need, Types, COURSE OBJECTIVES and Steps. Overview of Qualitative andQuantitative methods. Capacity Planning - Long range, Types, Developing capacity alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP. Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles, Types, Planning tools and techniques.

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS 9

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work Study – COURSE OBJECTIVES, Procedure. Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivityand Methods to improve productivity.

UNIT IV MATERIALS MANAGEMENT 9

Materials Management – COURSE OBJECTIVES, Planning, Budgeting and Control. Purchasing – COURSE OBJECTIVES,Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – COURSE OBJECTIVES, Costs and control techniques. Overview of JIT.

UNIT V SCHEDULING AND PROJECT MANAGEMENT 9

Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson"s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm's competitive advantages in the dynamic business environment.

CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.

CO3: The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.

CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.

CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

TEXT BOOKS

1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations andSupply Management, Tata McGraw Hill, 12th Edition, 2010.
2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.

REFERENCES

1. William J Stevenson, Operations Management, Tata McGraw Hill, 9th Edition, 2009.
2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.
3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
4. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.
5. Aswathappa K and Shridhara Bhat K, Production and Operations Management, HimalayaPublishing House, Revised Second Edition, 2008.

6. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007.
7. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3											2			
2		3	3											3	3
3		2	3	3									2	3	
4		3	3	3									2	3	
5			3	2											
AVg.	3	2.6	3	2.6								2	2	3	3

OSF352 **INDUSTRIAL HYGIENE** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
- Compare and contrast the roles of environmental and biological monitoring in work health and safety
- Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates
- Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures
- Provide high-level advice on managing and controlling noise and noise-related hazards

UNIT I : INTRODUCTION AND SCOPE **9**

Occupational Health and Environmental Safety Management - Principles practices. Comm on Occupational diseases: Occupational Health Management Services at the work place. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records.

UNIT II : MONITORING FOR SAFETY, HEALTH & ENVIRONMENT **9**

Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III : OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION **9**

Element of training cycle, Assessment of needs.Techniques of training, design and development of training programs.Training methods and strategies types of training.Evaluation and review of training programs. Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit .

UNIT IV : OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT **9**

Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. Importance of Industrial safety, role of safety department,

UNIT-V INDUSTRIAL HAZARDS **9**

i. Radiation: Types and effects of radiation on human body, Measurement and detection of radiation intensity. Effects of radiation on human body, Measurement – disposal of radioactive waste, Control of radiation ii. Noise and Vibration: Sources, and its control, Effects of noise on the auditory system and health, Measurement of noise , Different air pollutants in industries, Effect of different gases and particulate matter ,acid fumes ,smoke, fog on human health, Vibration: effects.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Students able to

CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems

CO2: Specify designs that avoid occupation related injuries

CO3: Define and apply the principles of work design, motion economy, and work environment design.

CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.

CO5: Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS:

1. R. K. Jain and Sunil S. Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers, New Delhi (2006)
2. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York .

REFERENCES:

1. Jeanne MagerStellman, Encyclopedia of Occupational Health and Safety (ILO) Ms. Irma Jourdan publication
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,
3. ButterworthHeinemann Ltd., London (1991). 2. Industrial Safety - National Safety Council of India
4. Frank P Lees – Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth- Heinemann Ltd., London
5. R. K. Jain and Sunil S. Rao, Industrial Safety , Health and Environment Management Systems, Khanna publishers, New Delhi (2006).

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2		2		2	-	-	-	-	-	2	-	-	-	-
2	-		2		-	-	1	-	-	-	1	-	-	-	-
3	-		-		2	-	-	-	-	-	2	-	-	-	-
4	-		-		-	-	-	-	2	-	3	-	-	-	-
5	-		-		-	-	-	1	-	-	-	-	-	-	-
AVg.	2	-	2	-	-	-	1	1	2	-	2		-	-	-

OSF353 **CHEMICAL PROCESS SAFETY** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.

- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES 9

Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS 9

Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS 9

Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS 9

Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS 9

Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to

CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.

CO2 Develop thorough knowledge about safety in the operation of chemical plants.

CO3 Apply the principles of safety in the storage and handling of gases.

CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.

CO5 Develop thorough knowledge about

TEXT BOOK

1 David A Crowl& Joseph F Louvar,"Chemical Process safety", Pearson publication, 3rd Edition,2014

2 Maurice Jones .A,"Fire Protection Systems,2nd edition, Jones & Bartlett Publishers,2015

REFERENCES:

1. Ralph King and Ron Hirst,"King´s safety in the process industries", Arnold, London, 1998.
2. Industrial Environment and its Evolution and Control, NIOSH Publication, 1973.
3. National Safety Council," Accident prevention manual for industrial operations". Chicago, 1982.

4. Lewis, Richard. J., Sr,“Sax´s dangerous properties of materials”. (Ninth edition). Van Nostrand Reinhold, New York, 1996.
5. Roy E Sanders, ”Chemical Process Safety”,3rd Edition, Gulf professional publishing, 2006

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	3	-	-	-	1	-	-	1	-	-	-	2	-	-
2	-			2	-	-	-	-	1	-		-	-	2	-
3	-	3		1	-	-	-	2	-	-	1	-	-	-	-
4	-	2	-		-	1	-	-	1	-		-	-	-	2
5	-	2	3		-	-	-	1	-	-	1	-	-	-	-
AVg.	2	2.5	3	1.5	-	1	-	1.5	1	-	1		2	2	2

OML352 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the importance of various materials used in electrical, electronics and magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- Getting equipped with the materials used in optical and optoelectronic applications.

UNIT I DIELECTRIC MATERIALS
9

Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT II MAGNETIC MATERIALS 9

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT III SEMICONDUCTOR MATERIALS 9

Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT IV MATERIALS FOR ELECTRICAL APPLICATIONS 9

Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT V OPTICAL AND OPTOELECTRONIC MATERIALS 9

Principles of photoconductivity - effect of impurities - principles of luminescence-laser principles - He-Ne, injection lasers, LED materials - binary, ternary photoelectronic materials - LCD materials -

photo detectors - applications of optoelectronic materials - optical fibres and materials - electro optic modulators - Kerr effect - Pockels effect.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to

CO1 Understand various types of dielectric materials, their properties in various conditions.
CO2 Evaluate magnetic materials and their behavior.
CO3 Evaluate semiconductor materials and technologies.
CO4 Select suitable materials for electrical engineering applications.
CO5 Identify right material for optical and optoelectronic applications

TEXT BOOKS:

1. Pradeep Fulay, “Electronic, Magnetic and Optical materials”, CRC Press, taylor and Francis, 2 nd illustrated edition, 2017.
2. “R K Rajput”, “A course in Electrical Engineering Materials”, Laxmi Publications, 2009.

REFERENCES:

1. T K Basak, “A course in Electrical Engineering Materials”, New Age Science Publications, 2009
2. TTTI Madras, “Electrical Engineering Materials”, McGraw Hill Education, 2004.
3. Adrianus J. Dekker, “Electrical Engineering Materials”, PHI Publication, 2006.
4. S. P. Seth, P. V. Gupta “A course in Electrical Engineering Materials”, Dhanpat Rai & amp; Sons, 2011.
5. C. Kittel, “Introduction to Solid State Physics”, 7th Edition, John Wiley & Sons,Singapore, (2006).

CO’s – PO’s & PSO’s MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C01	3	2	2	3								2	2	2	1
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	1
CO4	3	2	1	2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	3	1.8	1.6	2.2								2	2	2	1.2

OML353 NANOMATERIALS AND APPLICATIONS

L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I NANOMATERIALS 9

Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS 9

Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING 9

Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV STRUCTURAL CHARACTERISTICS 9

Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V APPLICATIONS 9

Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to

CO1 Evaluate nanomaterials and understand the different types of nanomaterials
CO2 Recognise the effects of dimensionality of materials on the properties
CO3 Process different nanomaterials and use them in engineering applications
CO4 Use appropriate techniques for characterising nanomaterials
CO5 Identify and use different nanomaterials for applications in different engineering fields.

TEXT BOOKS:

1. Bhusan, Bharat (Ed), “Springer Handbook of Nanotechnology”, 2nd edition, 2007.
2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.

REFERENCES:

1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003
2. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004
3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008
4. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000
5. Gutkin Y., Ovid’ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004

CO’s – PO’s & PSO’s MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C01	2	2	2	3								2	1	2	
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	
CO4	3	1		2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	2.8	1.6	1.7	2.2								2	1.8	2	1.3

OMR352 HYDRAULICS AND PNEUMATICS

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

- To knowledge on fluid power principles and working of hydraulic pumps
- To obtain the knowledge in hydraulic actuators and control components
- To understand the basics in hydraulic circuits and systems
- To obtain the knowledge in pneumatic and electro pneumatic systems
- To apply the concepts to solve the trouble shooting

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO2: Recognize the concepts in hydraulic actuators and control components
CO3: Obtain the knowledge in basics of hydraulic circuits and systems
CO4: Know about the basics concept in pneumatic and electro pneumatic systems
CO5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

TEXT BOOKS

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997.

REFERENCES

1. Shanmugasundaram.K, "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
2. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance", Tata McG Raw Hill, 2001.
3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGRaw Hill, 2007.

4. Dudley, A. Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987
5. Srinivasan. R, “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008
6. Joshi.P, Pneumatic Control”, Wiley India, 2008.
7. Jagadeesha T, “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.

CO’s – PO’s & PSO’s MAPPING

COs/POs & PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1		2	2						1	2	2	1
CO2	3	2	1		2	2						1	2	2	1
CO3	3	2	1		2	2						1	2	2	1
CO4	3	2	1		2	2						1	2	2	1
CO5	3	2	1		2	2						1	2	2	1
CO/PO & PSO Average	3	2	1		2	2						1	2	2	1
1 – Slight, 2 – Moderate, 3 – Substantial															

OMR353 SENSORS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
- To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
- To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
- To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
- To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT I SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES 9

Basics of Measurement – Classification of Errors – Error Analysis – Static and Dynamic Characteristics of Transducers – Performance Measures of Sensors – Classification of Sensors – Sensor Calibration Techniques – Sensor Outputs - Signal Types - Analog and Digital Signals, PWM and PPM.

UNIT II DISPLACEMENT, PROXIMITY AND RANGING SENSORS 9

Displacement Sensors – Brush Encoders - Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – Range Sensors - Ultrasonic Ranging - Reflective Beacons - Laser Range Sensor (LIDAR) – GPS - RF Beacons.

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gage – Types, Working, Advantage, Limitation, and Applications: Load Measurement – Force and Torque Measurement - Magnetic Sensors – Types, Principle, Advantage, Limitation, and Applications - Magneto Resistive – Hall Effect, Eddy Current Sensor - Heading Sensors – Compass, Gyroscope and Inclinometers.

UNIT IV OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS 9

Photo Conductive Cell, Photo Voltaic, Photo Resistive, LDR – Fiber Optic Sensors – Pressure – Diaphragm – Bellows - Piezoelectric - Piezo-resistive - Acoustic, Temperature – IC, Thermistor, RTD, Thermocouple – Non Contact Sensor - Chemical Sensors - MEMS Sensors - Smart Sensors.

UNIT V SIGNAL CONDITIONING 9

Need for Signal Conditioning – Resistive, Inductive and Capacitive Bridges for Measurement - DC and AC Signal Conditioning - Voltage, Current, Power and Instrumentation Amplifiers – Filter and Isolation Circuits – Fundamentals of Data Acquisition System

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the densor response.

CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.

CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.

CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.

CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

TEXT BOOKS

1. Bolton W., “Mechatronics”, Pearson Education, 6th Edition, 2015.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Penram International Publishing Private Limited, 6th Edition, 2013.

REFERENCES

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 1993.
2. Davis G. Alciatore and Michael B. Histand, “Introduction to Mechatronics and Measurement systems”, McGraw Hill Education, 2011.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2010.
4. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applications”, McGraw Hill Education, 2015.
5. Smaili. A and Mrad. F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.

CO’s – PO’s & PSO’s MAPPING

COs/POs & PSOs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2								1	2	3	2	1
CO2	3	3	2	1	1	1					1	2	3	2	1
CO3	3	3	2	1	1	1					1	2	3	2	1
CO4	3	3	2	1	1	1					1	2	3	2	1
CO5	3	3	2	1	1	1					1	2	3	2	1
CO/PO & PSO Average	3	3	2	0.8	0.8	0.8					0.8	2	3	2	1
1 – Slight, 2 – Moderate, 3 – Substantial															

ORA352 CONCEPTS IN MOBILE ROBOTS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT I INTRODUCTION TO MOBILE ROBOTICS 9

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles

UNIT II KINEMATICS 9

Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – **Manoeuvrability** – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots

UNIT III PERCEPTION 9

Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction.

UNIT IV LOCALIZATION 9

Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM).

UNIT V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS 9

Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Evaluate the appropriate mobile robots for the desired application.

CO2: Create the kinematics for given wheeled and legged robot.

CO3: Analyse the sensors for the intelligence of mobile robotics.

CO4: Create the localization strategies and mapping technique for mobile robot.

CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXTBOOK

1. Roland Siegwart and IllahR.Nourbakish, “Introduction to Autonomous Mobile Robots” MIT Press, Cambridge, 2004.

REFERENCES:

1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018
2. MohantaJagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.
3. Peter Corke, “Robotics, Vision and Control”, Springer, 2017.
4. Ulrich Nehmzow, “Mobile Robotics: A Practical Introduction”, Springer, 2003.
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.

MV3501 MARINE PROPULSION L T P C
3 0 0 3

COURSE OBJECTIVES:
- To impart knowledge on basics of propulsion system and ship dynamic movements
- To educate them on basic layout and propulsion equipment's
- To impart basic knowledge on performance of the ship
- To impart basic knowledge on Ship propeller and its types
- To impart knowledge on ship rudder and its types

UNIT I BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS 9
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.

UNIT II SHIPS MOVEMENTS AND SHIP STABILIZATION 9
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT III SHIPS SPEED AND ITS PERFORMANCE 9
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation's, ship turning radius.

UNIT IV BASICS OF PROPELLER 9
Propeller dimension, Propeller and its types – fixed propeller, control pitch propeller, kort nozzle, ducted propeller, voith schneider, Parts of propeller, 3 blade - 5 blade - 6 blade propellers and its advantages, propeller boss hub, crown nut, propeller skew, pitch of propeller - Thrust creation by propeller. Propeller Material – Propeller balancing- static and dynamic.

UNIT V BASICS OF RUDDER 9
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TEXT BOOKS:

1. GP. Ghose, "Basic Ship propulsion",2015
2. E.A. Stokoe "Reeds Ship construction for marine engineers", Vol. 5,2010
3. E.A. Stokoe, "Reeds Naval architecture for the marine engineers",4th Edition,2009

REFERENCES BOOKS:

1. DJ Eyers and GJ Bruse, "Ship Construction", 7th Edition, 2006.
2. KJ Rawson and EC Tupper, "Basic Ship theory I" Vol. 1,5th Edition,2001.

CO's – PO's & PSO's MAPPING

CO	PO												PSO			
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
1	1	1	1	1	1						1	1		1		1
2	1	1	1											1		1
3	1			1	1				1	1	1		1	1		1
4	1		1	1										1		1
5	1		1	1										1		1
Avg	5/5=1	2/2 =1	4/4 =1	4/4 =1	2/2 =1				1/1 =1	1/1=1	2/2=1	1/1=1	1/1=1	5/5=1		5/5=1

OMV351 MARINE MERCHANT VESSELS LT P C
3 0 0 3

COURSE OBJECTIVES:

At the end of the course, students are expected to acquire

- Knowledge on basics of Hydrostatics
- Familiarization on types of merchant ships
- Knowledge on Shipbuilding Materials
- Knowledge on marine propeller and rudder
- Awareness on governing bodies in shipping industry

UNIT I INTRODUCTION to HYDROSTATICS 9

Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies-Density, relative density - Displacement –Pressure –centre of pressure.

UNIT II TYPES OF SHIP 10

General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers-Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gascarriers - Chemical tankers - Passenger ships

UNIT III SHIPBUILDING MATERIALS 9

Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV MARINE PROPELLER AND RUDDER 8

Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V GOVERNING BODIES FOR SHIPPING INDUSTRY 9

Role of **IMO** (International Maritime Organization), **SOLAS** (International Convention for the Safety of Life at Sea), **MARPOL** (International Convention for the Prevention of Pollution from Ships) , **MLC** (Maritime Labour Convention), **STCW 2010** (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students would

CO1 Acquire Knowledge on floatation of ships
CO2 Acquire Knowledge on features of various ships
CO3 Acquire Knowledge of Shipbuilding Materials

CO4 Acquire Knowledge to identify the different types of marine propeller and rudder

CO5 Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:

1. D.J.Eyres, “Ship Constructions”, Seventh Edition, Butter Worth Heinemann Publishing, USA,2015
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006
3. EA Stokoe, E.A, “Naval Architecture for Marine Engineers”, Vol.4, Reeds Publications,2000

REFERENCES:

1. Kemp & Young “Ship Construction Sketches & Notes”, Butter Worth Heinemann Publishing,USA, 2011
2. MARPOL Consolidated Edition , Bhandakar Publications, 2018
3. SOLAS Consolidated Edition , Bhandakar Publications, 2016

OMV352 ELEMENTS OF MARINE ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

At the end of the course, students are expected to

- Understand the role of Marine machinery systems
- Be familiar with Marine propulsion machinery system
- Acquaint with Marine Auxiliary machinery system
- Have acquired basics of Marine Auxiliary boiler system
- Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS 9

Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM 9

Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM 9

Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM 9

Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM 9

Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students should able to,

CO1 Distinguish the role of various marine machinery systems

CO2 Relate the components of marine propulsion machinery system

CO3 Explain the importance of marine auxiliary machinery system

CO4 Acquire knowledge of marine boiler system

CO5 Understand the importance of ship propellors and steering system

TEXT BOOKS:

1. Taylor, "Introduction to Marine engineering", Revised Second Edition, Butterworth Heinemann, London, 2011
2. J.K.Dhar, "Basic Marine Engineering", Tenth Edition, G-Maritime Publications, Mumbai, 2011
3. K.Ramaraj, " Text book on Marine Engineering", Eswar Press, Chennai, 2018

REFERENCES:

1. Alan L.Rowen, "Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, "Naval Architecture and Ship Construction", The Institute of Marine Engineers (India), Mumbai, 2015

CRA332	**DRONE TECHNOLOGIES**	**LT P C** **3 0 0 3**

COURSE OBJECTIVES:

- To understand the basics of drone concepts
- To learn and understand the fundaments of design, fabrication and programming of drone
- To impart the knowledge of an flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

UNIT I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

UNIT IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Know about a various type of drone technology, drone fabrication and programming.

CO2: Execute the suitable operating procedures for functioning a drone

CO3: Select appropriate sensors and actuators for Drones

CO4: Develop a drone mechanism for specific applications

CO5: Createthe programs for various drones

TEXT BOOKS

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCES

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

CO's – PO's & PSO's MAPPING

COs/Pos&PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	1	3	2						1	2	1	3
CO2	1	2	3	1	3	2						1	2	1	3
CO3	1	2	3	1	3	2						1	2	1	3
CO4	1	2	3	1	3	2						1	2	1	3
CO5	1	2	3	1	3	2						1	2	1	3
CO/PO & PSO Average	1	2	3	1	3	2						1	2	1	3
1 – Slight, 2 – Moderate, 3 – Substantial															

OAI352 AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT L T P C

3 0 0 3

COURSE OBJECTIVES

- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT 9

Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE 9

Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE 9

Entrepreneurship - Essence of managerial Knowledge -Management functions- Planning-organizing-Directing-Motivation-ordering-leading-supervision- communication and control-Understanding Financial Aspects of Business - Importance of financial statements-liquidity ratios-leverage ratios, coverage ratios-turnover ratios-Profitability ratios. Agro-based industries-Project-Project cycle-Project appraisal and evaluation techniques-undiscounted measures-Payback period-proceeds per rupee of outlay, Discounted measures-Net Present Value (NPV)-Benefit-Cost Ratio(BCR)-Internal Rate of Return(IRR)-Net benefit investment ratio(N/K ratio)-sensitivity analysis.

UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE 9

Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.

UNITV ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT 9

Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis-Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1 Judge about agricultural finance, banking and cooperation
CO2 Evaluate basic concepts, principles and functions of financial management
CO3 Improve the skills on basic banking and insurance schemes available to customers
CO4 Analyze various financial data for efficient farm management
CO5 Identify the financial institutions

TEXT BOOKS

1. Joseph L. Massie, 1995, "Essentials of Management", prentice Hall of India Pvt limited, New Delhi
2. Khanka S, 1999, Entrepreneurial Development, S, Chand and Co, New Delhi
3. Mohanty S K, 2007, Fundamentals of Entrepreneurship, Prentice Hall India, New Delhi.

REFERENCES

1. Harih S B, Conner U J and Schwab G D, 1981, Management of the Farm Business, Prentice Hall Inc, New Jersey
2. Omri Ralins, N.1980, Introduction to Agricultural: Prentice Hall Inc, New Jersey
3. Gittenger Price, 1989, Economic Analysis of Agricultural project, John Hopkins University, Press, London.
4. Thomas W Zimmer and Norman M Scarborough, 1996, Entrepreneurship, Prentice Hall, New Jersey.
5. Mar J Dollinger, 1999, Entrepreneurship strategies and resources, Prentice –Hall, Upper Saddal Rover, New Jersey.

CO's – PO's & PSO's MAPPING

PO/PSO		CO1	CO2	CO3	CO4	CO5	Overall correlation of COs with POs
PO1	Engineering Knowledge	1	2	1	1	1	2
PO2	Problem Analysis	2	1	1	1	2	1
PO3	Design/ Development of Solutions	1	1	1	2	1	2
PO4	Conduct Investigations of Complex Problems	1	1	2	1	1	1
PO5	Modern Tool Usage	2	1	1	1	1	2
PO6	The Engineer and Society	1	2	1	2	1	1
PO7	Environment and sustainability	1	1	2	1	1	1
PO8	Ethics	1	2	1	1	1	1
PO9	Individual and team work:	1	1	1	2	1	1

PO10	Communication	1	1	1	1	2	1
PO11	Project management and finance	1	1	2	1	1	1
PO12	Life-long learning:	1	2	1	1	1	2
PSO1	To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill	1	2	1	1	1	1
PSO2	To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.	1	1	2	1	1	1
PSO3	To inculcate entrepreneurial skills through strong Industry-Institution linkage.	1	2	1	1	2	1

OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I OVERVIEW OF IWRM **9**

Facts about water - Definition – Key challenges - Paradigm shift - Water management Principles - Social equity - Ecological sustainability – Economic efficiency - SDGs - World Water Forums.

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION **9**

Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.

UNIT III WATER ECONOMICS **9**

Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV RECENT TREANDS IN WATER MANAGEMENT **9**

River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.

UNIT V IMPLEMENTATION OF IWRM **9**

Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.

CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
CO2 Discuss on the different water uses; how it is impacted and ways to tackle these impacts.
CO3 Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.

CO4 Illustrate the recent trends in water management.
CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga P. *et al.* " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.

REFERENCES

1. Technical Advisory Committee, Background Papers No: 1, 4 and 7, Stockholm, Sweden. 2002.
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).
3. Tutorial on Basic Principles of Integrated Water Resources Management ,CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrm/Tutorial_text.pdf
4. Pramod R. Bhave, 2011, Water Resources Systems, Narosa Publishers.
5. The 17 Goals, United Nations, https://sdgs.un.org/goals.

OEN352 BIODIVERSITY CONSERVATION L T P C
3 0 0 3

COURSE OBJECTIVE:

- The identification of different aspects of biological diversity and conservation techniques.

UNIT I INTRODUCTION 9

Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY 9

Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

UNIT III MICROBIAL DIVERSITY 9

Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

UNIT IV MEGA DIVERSITY 9

Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio- economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V CONSERVATIONS OF BIODIVERSITY 9

In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

TOTAL: 45 PERIODS

TEXT BOOKS:

1. A textbook of Botany: Angiosperms- Taxonomy, Anatomy, Economic Botany & Embryology. S. Chand, Limited, Pandey, B. P. January 2001
2. Principles of Systematic Zoology, Mcgraw-Hill College, Ashlock, P.D., Latest Edition.
3. Microbiology, MacGraw Hill Companies Inc, Prescott, L.M., Harley, J.P., and Klein D.A. (2022).
4. Microbiology, Pearson Publisher, Gerard J. Tortora, Berdell R. Funke, Christine L.Case, 13th Edition 2019

REFERENCES:

1. Ecological Census Technique: A Handbook, Cambridge University Press, Sutherland, W.
2. Encyclopedia of Biodiversity, Academic Press, Simonson Asher Levin.

COURSE OUTCOMES

Upon successful completion of this course, students will:

CO1: An insight into the structure and function of diversity for ecosystem stability.
CO2: Understand the concept of animal diversity and taxonomy
CO3: Understand socio-economic issues pertaining to biodiversity
CO4: An understanding of biodiversity in community resource management.
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		2						2		2			2	2	
2		2		2	2	2							3	2	
3				2		2							3	2	3
4	3	2			2			2	2	2	2		3	2	3
5		2	3	2			1					1		2	
Avg.	3	2	3	2	2	2	1	2	2	2	2	1	3	2	3

1.low, 2-medium, 3-high, '-"- no correlation
Note: The average value of this course to be used for program articulation matrix.

OEE353 INTRODUCTION TO CONTROL SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model

UNIT I MATHEMATICAL MODELS OF PHYSICALSYSTEMS 9

Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE 9

Standard test signals – Steady state error & error constants – Time Response of I and II order system–Root locus–Rules for sketching root loci.

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS 9

Concept of stability – Necessary condition – RH criterion – Relative stability – Nyquist stability criterion — Stability from Bode plot — Relative stability from Nyquist & Bode — Closed loop frequency response.

UNITV STATE VARIABLE ANALYSIS 9

Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Ability to

CO1: Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS

1. Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back McGraw Hill Education, 2018.
2. Katsuhiko Ogata, 'Modern Control Engineering', Pearson, 5th Edition2015.
3. J. Nagrath and M. Gopal, Control Systems Engineering (Multi Colour Edition), New Age International, 2018.

REFERENCES

1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2010.
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System AnalysisandDesign, 5th Edition, CRC PRESS, 2003.
4. S. Palani, Control System Engineering, McGraw-Hill Education Private Limited, 2009.
5. Yaduvir Singh and S.Janardhanan, Modern Control, Cengage Learning, First Impression2010.

CO's – PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2							2	3	3	3
CO2	3	3	2	3	1								3	3	3
CO3	3	3	3	2	2								3	3	3
CO4	3	3	3	2	2							2	3	3	3
CO5	3	3	3	1	1							1	3	3	3
													3	3	3

OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C
3 0 03

COURSE OBJECTIVES:

- To educate on design of signal conditioning circuits for various applications.
- To Introduce signal transmission techniques and their design.
- Study of components used in data acquisition systems interface techniques
- To educate on the components used in distributed control systems
- To introduce the communication buses used in automation industries.

UNIT I INTRODUCTION 9

Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems : Modbus & Profibus

UNIT II AUTOMATION COMPONENTS 9

Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS 9

Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9

Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V DISTRIBUTED CONTROL SYSTEM 9

Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
5

1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Industrial Data Networks.

COURSE OUTCOMES:

Students able to

CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function BIock.(L3)
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:

1. S.K.Singh, “Industrial Instrumentation”, Tata Mcgraw Hill, 2nd edition companies,2003.
2. C D Johnson, “Process Control Instrumentation Technology”, Prentice Hall India,8th Edition, 2006.
3. E.A.Parr, Newnes NewDelhi,“Industrial Control Handbook”,3rd Edition, 2000.

REFERENCES:

1. John W. Webb and Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications”, 5th Edition, Prentice Hall Inc., New Jersey, 2003.
2. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2016.

3. Krishna Kant, “Computer - Based Industrial Control”, 2nd Edition, Prentice Hall, New Delhi, 2011.
4. Gary Dunning, Thomson Delmar,“Programmable Logic Controller”, CeneageLearning, 3 rd Edition,2005.

List of Open Source Software/ Learning website:

1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063
3. https://www.electrical4u.com/industrial-automation/
4. https://realpars.com/what-is-industrial-automation/
5. https://automationforum.co/what-is-industrial-automation-2/

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	1	1	-	1	-	1	-	1	1	-	1
CO2	3	`1	1	-	1	-	-	1	-	1	-	-	1	-	1
CO3	3	-	1	-	1	-	-	1	-	1	-	-	1	-	1
CO4	3	3	3	3	1			1		1			1		1
CO5	3	3	3	3	1	1		1		1			1		1
AVg.	3	2.25	2	2.6	1	1	-	1	-	1	-	-	1	-	1

OCH353 ENERGY TECHNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION 8

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY 8

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY 10

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY 10

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V ENERGY CONSERVATION 9

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.

CO2: Students will excel as professionals in the various fields of energy engineering

CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.

CO4: Explain the technological basis for harnessing renewable energy sources.

CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCES

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

CO's – PO's & PSO's MAPPING

Course Outcomes	Program Outcomes															
	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.	2	3	2	3	3	-	-	-	1	1	-	3	1	1	3
CO2	Students will excel as professionals in the various fields of energy engineering	2	3	1	3	3	-	-	-	1	1	-	3	2	1	3
CO3	Compare different renewable energy technologies and choose the most appropriate based on local conditions.	2	2	2	3	3	1	1	-	1	1	-	3	2	1	3
CO4	Explain the technological basis for harnessing renewable energy sources.	2	2	1	3	3	1	1	1	1	-	1	3	1	1	3
CO5	Identify and critically evaluate current developments and emerging trends within	2	2	1	3	3	1	1	1	1	-	1	3	2	1	3

	the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level															
OVERALL CO		**2**	**2**	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**2**	**1**	**3**

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OCH354 SURFACE SCIENCE L T P C
3 0 0 3

COURSE OBJECTIVE:

- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES 9

Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES 9

Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES 9

Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS 9

Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES 9

Origin of surface forces, Role of stress and strain in epitaxial growth, Energetic and growth modes, Nucleation theory, Nonequilibrium growth modes, MBE, CVD and ablation techniques, Catalytic growth of nanotubes, Etching of surfaces, Formation of nanopillars and nanorods and its application in photoelectrochemical processes, Polymer surfaces and biointerfaces.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:

1. K. W. Kolasinski, "Surface Science: Foundations of catalysis and nanoscience" II Edition, John Wiley & Sons, New York, 2008.

REFERENCE:

1. Gabor A. Somorjai and Yimin Li "Introduction to Surface Chemistry and catalysis", II Edition John Wiley & Sons, New York, 2010.

OFD354 FUNDAMENTALS OF FOOD ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

The course aims to

- acquaint and equip the students with different techniques of measurement of engineering properties.
- make the students understand the nature of food constituents in the design of processing equipment

UNIT I 9

Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II 9

Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III 9

Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV 9

Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for lo.w- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V 9

Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 understand the importance of food polymers

CO2 understand the effect of various methods of processing on the structure and texture of food materials

CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

TEXTBOOKS:

1. R.L. Earle. 2004. Unit Operations in Food Processing. The New Zealand Intitute of Food Science & Technology, Nz. Warren L. McCabe, Julian Smith, Peter Harriott. 2004.
2. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA. Christie John Geankoplis. 2003.
3. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
4. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
5. J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed.

OFD355 FOOD SAFETY AND QUALITY REGULATIONS L T P C
3 0 0 3

COURSE OBJECTIVES

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world
- To ensure processed food meets global standards

UNIT I 10

Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II 8

Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III 9

Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV 9

Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V 9

Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:

1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
3. Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc., New York 1979
4. Microbiological safety of Food by Hobbs BC, 1973
5. Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003

OPY353 **NUTRACEUTICALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION AND SIGNIFICANCE 6
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS 11
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, caratenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY 11
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different *in vitro* methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV ROLE IN HEALTH AND DISEASE 11
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V SAFETY ISSUES 6
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bisset, Normal Grainger and Max Wich H "Herbal Drugs and Phytopharmaceuticals", 2nd Edition, CRC, 2001.
2. Handbook of Nutraceuticals and Functional Foods: Robert Wildman, CRC, Publications 2006

3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006
4. Ikan, Raphael "Natural Products: A Laboratory Guide", 2nd Edition, Academic Press / Elsevier, 2005.

REFERENCES:

1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007
2. Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson (Author), Blackwell Publishing, 2007
3. Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink.
4. Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Wood head Publ., 2000
5. Hanson, James R. "Natural Products: The Secondary Metabolites", Royal Society of Chemistry, 2003.

COURSE OUTCOMES

CO1 acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits.
CO2 acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes
CO3 attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.
CO4 distinguish the various *In vitro* and *In vivo* assessment of Antioxidant activity of compounds from plant sources.
CO5 gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases.
CO6 Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.

CO's – PO's & PSO's MAPPING

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO 1	3											1
CO 2	3											1
CO 3	3					2						
CO 4	3											
CO 5	3					2						1
CO 6	3							2				1

OTT354 BASICS OF DYEING AND PRINTING L T P C
3 0 0 3

COURSE OBJECTIVE:

- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION 9

Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,

UNIT II PRE TREATMENT 9

Desizing-Objective of Desizing- types of Desizing- Objective of Scouring- Mechanism of Scouring– Degumming of Silk, Scouring of wool - Bio Scouring. Bleaching -Objective of Bleaching: Bleaching mechanism of Hydrogen Peroxide, Hypo chlorites. Objective of Mercerizing - Physical and Chemical changes of Mercerizing.

UNIT III DYEING **9**

Dye - Affinity, Substantively, Reactivity, Exhaustion and Fixation. Classification of dyes. Direct dyes: General properties, principles and method of application on cellulosic materials. Reactive dyes – principles and method of application on cellulosic materials hot brand, cold brand.

UNIT IV PRINTING **9**

Definition of printing – Difference between printing and dying- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V MACHINERIES **9**

Fabric Processing - winch, jigger and soft flow machines. Beam dyeing machines: Printing -flat bed screen - Rotary screen. Thermo transfer printing machinery. Garment dyeing machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to Understand the

CO1: Basics of grey fabric
CO2: Basics of pre treatment
CO3: Concept of Dyeing
CO4: Concept of Printing
CO5: Machinery in processing industry

TEXT BOOKS:

1. Trotman, E.R., Textile Scouring and Bleaching, Charless Griffins, Com. Ltd., London 1990.
2. Shenai V.A. “Technology of Textile Processing Vol. IV” 1998, Sevak Publications, Mumbai.

REFERENCES:

1. Trotman E. R., “Dyeing and Chemical Technology of Textile Fibres”, Charles Griffin & Co. Ltd., U.K., 1984, ISBN : 0 85264 165 6.
2. Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018
3. Mathews Kolanjikombil., ”Dyeing of Textile substrates III –Fibres, Yarns and Knitted fabrics”, Wood head publishing India , 2021
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series
5. Chakraborty, J.N, "Fundamentals and Practices in colouration of Textiles", Wood head Publishing India, 2009, ISBN-13:978-81-908001-4-3.

CO’s – PO’s & PSO’s MAPPING

Course Outcomes	Program Outcome														
	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Classification of fibres and production of natural fibres	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO2	Regenerated and synthetic fibres	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO3	Yarn spinning	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO4	Weaving	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO5	Knitting and nonwoven	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
Overall CO		-	-	-	-	-	-	-	2	1	-	1	1	-	1	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

FT3201 FIBRE SCIENCE L T P C
3 0 0 3

COURSE OBJECTIVE

- To enable the students to learn about the types of fibre and its properties

UNIT I INTRODUCTION TO TEXTILE FIBRES 9

Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.

UNIT II REGENERATED FIBRES 9

Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel ,Tencel

UNIT III SYNTHEITC FIBRES 9

Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass ,carbon .Introduction to spin finishes and texturization

UNIT IV SPECIALITY FIBRES 9

Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V FUNCTIONAL SPECIALITY FIBRES 9

Properties and end uses : Fibres for medical application – Biodegradable fibres based on PLA ,Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the student would be able to
CO1 Understand the process sequence of various fibres
CO2 Understand the properties of various fibres

TEXT BOOKS:

1. Morton W. E., and Hearle J. W. S., “Physical Properties of Textile Fibres”, The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95
2. Meredith R., and Hearle J. W. S., “Physical Methods of Investigation of Textiles”, Wiley Publication, New York, 1989, ISBN: B00JCV6ZWU | ISBN-13:
3. Mukhopadhyay S. K., “Advances in Fibre Science”, The Textile Institute,1992, ISBN: 1870812379

REFERENCES:

1. Meredith R., “Mechanical Properties of Textile Fibres”, North Holland, Amsterdam, 1986, ISBN: 1114790699, ISBN-13: 9781114790698
2. Hearle J. W. S., Lomas B., and Cooke W. D., “Atlas of Fibre Fracture and Damage to Textiles”, The Textile Institute, 2nd Edition, 1998, ISBN: 1855733196.
3. Raheel M. (ed.)., “Modern Textile Characterization Methods”, Marcel Dekker, 1995, ISBN:0824794737
4. Mukhopadhyay. S. K., “The Structure and Properties of Typical Melt Spun Fibres”, Textile Progress, Vol. 18, No. 4, Textile Institute, 1989, ISBN: 1870812115
5. Hearle J.W.S., “Polymers and Their Properties: Fundamentals of Structures and Mechanics Vol 1”, Ellis Horwood, England, 1982, ISBN: 047027302X | ISBN-13: 9780470273029 36

OTT355 GARMENT MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVE:

- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing

UNIT I PATTERN MAKING, MARKER PLANNING, CUTTING 9

Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES 9

Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III COMPONENTS AND TRIMS USED IN GARMENT 9

Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV GARMENT INSPECTION AND DIMENSIONAL CHANGES 9

Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V GARMENT PRESSING, PACKING AND CARE LABELING 9

Garment pressing – categories and equipment, packing; care 282abelling of apparels

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to Understand

CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing and careabelling

TEXT BOOKS:

1. Carr H., and Latham B., "The Technology of Clothing Manufacture", Blackwell Science Ltd., Oxford, 1994.
2. Gerry Cooklin, "Introduction to Clothing Manufacture" Blackwell Science Ltd., 1995. 64
3. Harrison.P.W Garment Dyeing, The Textile Institute Publication, Textile Progress, Vol .19 No.2,1988.

REFERENCES:

1. Winifred Aldrich., "Metric Pattern Cutting", Blackwell Science Ltd., Oxford, 1994
2. Peggal H., "The Complete Dress Maker", Marshall Caverdish, London, 1985
3. Jai Prakash and Gaur R.K., "Sewing Thread", NITRA, 1994
4. Ruth Glock, Grace I. Kunz, "Apparel Manufacturing", Dorling Kindersley Publishing Inc., New Jersey, 1995.
5. Pradip V.Mehta, "An Introduction to Quality Control for the Apparel Industry", J.S.N. Internationals, 1992.

CO's – PO's & PSO's MAPPING

CO's	PO's												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	1	-	2	-	1	1	-	2	3	1	2	3	1	3
2	2	2	1	1	1	-	1	1	-	2	2	1	2	2	1	2
3	1	1	1	1	1	1	1	1	-	1	2	1	1	3	1	3
4	2	1	1	1	2	2	2	1	1	2	3	1	2	3	1	3
5	2	2	1	1	1	1	2	1	-	2	2	1	2	2	1	2
Avg	1.6	1.2	1	0.8	1.4	0.8	1.4	1	0.2	1.8	2.4	1	1.8	2.6	1	2.6

OPE353 **INDUSTRIAL SAFETY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION 9

Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE 9

Definition of the term occupational health and hygiene - Categories of health hazards - Exposure pathways and human responses to hazardous and toxic substances - Advantages and limitations of environmental monitoring and occupational exposure limits - Hierarchy of control measures for occupational health risks - Role of personal protective equipment and the selection criteria - Effects on humans - control methods and reduction strategies for noise, radiation and excessive stress.

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS 9

Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and colour, Ventilation and Heat Control – Electrical Safety – Fire Safety – Safe Systems of work for manual handling operations – Machine guarding – Working at different levels – Process and System Safety.

UNIT IV HAZARDS AND RISK MANAGEMENT 9

Safety appraisal - analysis and control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques – major accident hazard control – Onsite and Offsite emergency Plans.

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT 9

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and methods of its effective implementation and review – Elements of Management Principles – Education and Training – Employee Participation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the student is expected to be able to:

CO1 Describe, with example, the common work-related diseases and accidents in occupational setting

CO2 Name essential members of the Occupational Health team

CO3 What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354 **UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I FLUID MECHANICS CONCEPTS 9

Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton's Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler's equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II FLOW MEASUREMENTS & MECHANICAL OPERATIONS 9

Different types of flow measuring devices (Orifice meter, Venturimeter, Rotameter) with derivations, flow measurements –. Pumps – types of pumps (Centrifugal & Reciprocating pumps), Energy calculations and characteristics of pumps. Size reduction–characteristics of comminute products, sieve analysis, Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numerical of differential and cumulative analysis. Size reduction, crushing laws, working principle of ball mill. Filtration & types, filtration equipments (plate and frame, rotary drum). Conceptual numericals.

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER 9

Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV BASICS OF MASS TRANSFER 9

Diffusion-Fick's law of diffusion. Types of diffusion. Steady state molecular diffusion in fluids at rest and laminar flow (stagnant / unidirection and bi direction). Measurement of diffusivity, Mass transfer coefficients and their correlations. Conceptual numerical.

UNIT V MASS TRANSFER OPERATIONS 9

Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction).Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1 State and describe the nature and properties of the fluids.

CO2 Study the different flow measuring instruments, the principles of various size reductions, conveying equipment's, sedimentation and mixing tanks.

CO3 Comprehend the laws governing the heat and mass transfer operations to solve the problems.

CO4 Design the heat transfer equipment suitable for specific requirement.

TEXTBOOKS

1. Unit operations in Chemical Engineering Warren L. McCabe, Julian C. Smith & Peter Harriot McGraw-Hill Education (India) Edition 2014
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008
3. Introduction to Chemical Engineering Badger W.I. and Banchero, J.T., Tata McGraw Hill New York 1997

REFERENCES

1. Principles of Unit Operations Alan S Foust, L.A. Wenzel, C.W. Clump, L. Maus, and L.B. Anderson John Wiley & Sons 2nd edition 2008
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996
3. Heat Transfer J P Holman McGraw Hill International Ed

OPT352 PLASTIC MATERIALS FOR ENGINEERS L T P C
3 0 0 3

COURSE OBJECTIVES

- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I INTRODUCTION TO PLASTIC MATERIALS 9

Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS 9

Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III THERMOSETTING PLASTICS 9

Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS 9

Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers-their synthesis, properties and applications

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS 9

Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1 To study the importance, advantages and classification of plastic materials

CO2 Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics

CO3 To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins

CO4 Know the manufacture, properties and uses of thermosetting resins based onpolyester, epoxy, silicone and PU

CO5 To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

1. Marianne Gilbert (Ed.), Brydson’s Plastics Materials, 8th Edn., Elsevier (2017).
2. J.A.Brydson, Plastics Materials, 7th Edn., Butterworth Heinemann (1999).
3. Manas Chanda, Salil K. Roy, Plastics Technology Handbook, 4th Edn., CRC press (2006).
4. A. Brent Strong, Plastics: Materials and Processing, 3rd Edn., Pearson Prentice Hall (2006).
5. Olagoke Olabisi, Kolapo Adewale (Eds.), Handbook of Thermoplastics 2nd Edn., CRC press(2016).

6. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill, New York, 1999.
7. H. Dominighaus, Plastics for Engineers, Hanser Publishers, Munich, 1988.

OPT353 PROPERTIES AND TESTING OF PLASTICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS 9

Introduction- Standard organizations: BIS, ASTM, ISO, BS, DIN etc. Standards and specifications. Importance of standards in the quality control of polymers and polymer products. Preparation of test pieces, conditioning and test atmospheres. Tests on elastomers: processability parameters of rubbers – plasticity, Mooney viscosity, scorch time, cure time, cure rate index, Processability tests carried out on thermoplastics and thermosets: MFI, cup flow index, gel time, bulk density, bulk factor.

UNIT II MECHANICAL PROPERTIES 9

Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers

UNIT III THERMAL RHEOLOGICAL PROPERTIES 9

Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV ELECTRICAL AND OPTICAL PROPERTIES 9

Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence**.**

UNIT V ENVIRONMENTAL AND CHEMICAL RESISTANCE 9

Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone resistance, permeability and adhesion. Tests for chemical resistance. Acids, alkalies, Flammability tests- oxygen index test.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1 Understand the relevance of standards and specifications.
CO2 Summarize the various test methods for evaluating the mechanical properties of the polymers.
CO3 To know the thermal, electrical & optical properties of polymers.

CO4 Identify various techniques used for characterizing polymers.
CO5 Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES

1. F.Majewska, H.Zowall, Handbook of analysis of synthetic polymers and plastics, Ellis Horwood Limited Publisher 1977.
2. J.F.Rabek, Experimental Methods in Polymer Chemistry, John Wiley and Sons 1980.
3. R.P.Brown, Plastic test methods, 2nd Edn., Harlond, Longman Scientific, 1981.
4. A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastcis, Allied Publishers Pvt. Ltd., New Delhi, 2003.
5. Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edn., John Wiley & Sons 2007.
6. S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.

OEC353 VLSI DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES

- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.
- Understand the design of arithmetic building blocks

UNIT I MOS TRANSISTOR PRINCIPLES 9

MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics ,small signal analysis of MOSFET.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation.

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES 9

Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design .

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE 9

Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS 9

Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXTBOOKS

1. Jan D Rabaey, Anantha Chandrakasan, “Digital Integrated Circuits: A Design Perspective”, PHI, 2016.(Units II, III IV and V).
2. Neil H E Weste, Kamran Eshranghian, “Principles of CMOS VLSI Design: A System Perspective,” Addison Wesley, 2009.(Units - I).

REFERENCES

1. D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983
2. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001
3. Samiha Mourad and Yervant Zorian, “Principles of Testing Electronic Systems”, Wiley 2000
4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers,2000

CO’s – PO’s & PSO’s MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
1	3	3	2	2	1	3	-	-	-	-	2	3	3	3	3
2	3	3	2	2	1	-	-	-	-	-	-	2	3	3	3
3	3	-	3	2	1	2	-	-	-	-	3	2	3	2	3
4	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
5	2	-	3	2	2	1	-	-	-	-	1	1	3	2	2
Avg	**3**	**3**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**3**

CBM370 WEARABLE DEVICES L T P C
3 0 0 3

COURSE OBJECTIVES

The student should be made to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques-Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study-smart fabric for monitoring biological parameters - ECG, respiration.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL :45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the concepts of wearable system.

CO2: Explain the energy harvestings in wearable device.

CO3: Use the concepts of BAN in health care.

CO4: Illustrate the concept of smart textile

CO5: Compare the various wearable devices in healthcare system

TEXT BOOKS

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCES

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2			1					1		1
2	3	2	1	1	2			1					1		1
3	3	2	1	1	2			1					1		1
4	3	2	1	1	2			1					1		1
5	3	2	1	1	2			1					1		1
AVg.															

CBM356 MEDICAL INFORMATICS L T P C
3 0 0 3

Preamble:

1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING 9

Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD 9

Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING 9

Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1 Explain the structure and functional capabilities of Hospital Information System.
CO2 Describe the need of computers in medical imaging and automated clinical laboratory.
CO3 Articulate the functioning of information storage and retrieval in computerized patient record system.
CO4 Apply the suitable decision support system for automated clinical diagnosis.
CO5 Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

1. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003.
2. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata Mcgraw Hill,2005

REFERENCES:

1. Kathryn J. Hannah, Marion J Ball, “Health Informatics”, 3rd Edition, Springer, 2006.

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2			1					1	1	1
2	3	2	1	1	2			1					1	1	1
3	3	2	1	1	2			1					1	1	1
4	3	2	1	1	2			1					1	1	1
5	3	2	1	1	2			1					1	1	1
AVg.															

OBT355 BIOTECHNOLOGY FOR WASTE MANAGEMENT L T P C
3 0 0 3

UNIT I BIOLOGICAL TREATMENT PROCESS 9

Fundamentals of biological process - Anaerobic process – Pretreatment methods in anaerobic process – Aerobic process, Anoxic process, Aerobic and anaerobic digestion of organic wastes - Factors affecting process efficiency - Solid state fermentation – Submerged fermentation – Batch and continous fermentation

UNIT II WASTE BIOMASS AND ITS VALUE ADDITION 9

Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application

UNIT III BIOCONVERSION OF WASTES TO ENERGY 9

Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV CHEMICALS AND ENZYME PRODUCTION FROM WASTES 9

Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V BIOCOMPOSTING OF ORGANIC WASTES 9

Overview of composting process - Benefitis of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students should be able

CO1 To learn the various methods biological treatment
CO2 To know the details of waste biomass and its value addition
CO3 To develop the bioconversion processes to convert wastes to energy
CO4 To synthesize the chemicals and enzyme from wastes
CO5 To produce the biocompost from wastes
CO6 To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

1. Antoine P. T., (2017) "Biofuels from Food Waste Applications of Saccharification Using Fungal Solid State Fermentation", CRC press
2. Joseph C A., (2019)"Anaerobic Waste-Wastewater Treatment and Biogas Plants-A Practical Handbook", CRC Press,

REFERENCES

1. Palmiro P. and Oscar F.D'Urso, (2016) 'Biotransformation of Agricultural Waste and By-Products',The Food, Feed, Fibre, Fuel (4F) Economy, Elsevier
2. Kaur Brar S., Gurpreet Singh D. and Carlos R.S., (Eds), (2014)'Biotransformation of Waste Biomass into High Value Biochemicals', Springer.
3. Keikhosro K, Editor, (2015) 'Lignocellulose-Based Bioproducts', Springer.
4. John P, (2014) 'Waste Management Practices-Municipal, Hazardous, and Industrial', Second Edition, CRC Press, 2014

OBT356 LIFESTYLE DISEASES L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER 9

Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES 9

Coronoary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse -– Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY 9

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES 9

Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.Kumar&Meenal Kumar, "Guide to Prevention of Lifestyle Diseases", Deep & Deep Publications, 2003
2. Gary Eggar et al, "Lifestyle Medicine", 3rd Edition, Academic Press, 2017

REFERENCES:

1. James M.R, "Lifestyle Medicine", 2nd Edition, CRC Press, 2013
2. Akira Miyazaki et al, "New Frontiers in Lifestyle-Related Disease", Springer, 2008

OBT357 BIOTECHNOLOGY IN HEALTH CARE L T P C
3 0 0 3

COURSE OBJECTIVES

The aim of this course is to

- Create higher standard of knowledge on healthcare system and services
- Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I PUBLIC HEALTH 9

Definition and Concept of Public Health, Historical aspects of Public Health, Changing Concepts of Public Health, Public Health versus Medical Care, Unique Features of Public Health, Determinants of Health (Social, Economic, Cultural, Environmental, Education, Genetics, Food and Nutrition). Indicators of health, Burden of disease, Role of different disciplines in Public Health.

UNIT II CLINICAL DISEASES 9

Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III VACCINOLOGY 9

History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV OUTPATIENT & IN PATIENT SERVICES 9

Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V BASICS OF IMAGING MODALITIES 9

Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
2. Thomas M. Devlin.Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers
3. The Vaccine Book (2nd Ed.), Rafi Ahmed, Roy M. Anderson et. al.Editor(s): Barry R. Bloom, PaulHenri Lambert, Academic Press, 2016, Pages xxi-xxiv.

REFERENCES

1. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011
2. Burtis & Ashwood W.B. Tietz Textbook of Clinical chemistry. Saunders Company
3. Levine, M. M. (2004). New Generation Vaccines. New York: M. Dekker

VERTICAL 1: FINTECH AND BLOCK CHAIN

CMG331 FINANCIAL MANAGEMENT LT P C
3 0 0 3

COURSE OBJECTIVES

- To acquire the knowledge of the decision areas in finance.
- To learn the various sources of Finance
- To describe about capital budgeting and cost of capital.
- To discuss on how to construct a robust capital structure and dividend policy
- To develop an understanding of tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANGEMENT 9

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT II . SOURCES OF FINANCE 9

Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III INVESTMENT DECISIONS: 9

Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting -– Payback -ARR – NPV – IRR –Profitability Index.

Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION 9

Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure .

Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy

UNIT V WORKING CAPITAL DECISION 9

Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd

REFERENCES .

1. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning,.
2. Prasanna Chandra, Financial Management,
3. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011

CMG332 FUNDAMENTALS OF INVESTMENT LT P C
3 0 0 3

COURSE OBJECTIVES:

- Describe the investment environment in which investment decisions are taken.
- Explain how to Value bonds and equities
- Explain the various approaches to value securities
- Describe how to create efficient portfolios through diversification
- Discuss the mechanism of investor protection in India.

UNIT I THE INVESTMENT ENVIRONMENT 9

The investment decision process, Types of Investments – Commodities, Real Estate and FinancialAssets, the Indian securities market, the market participants and trading of securities, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflationonreturn.

UNIT II FIXED INCOME SECURITIES 9

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, defaultrisk andcreditrating.

UNIT III APPROACHES TOEQUITYANALYSIS 9

Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES 9

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT V INVESTOR PROTECTION 9

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness andactivism

TOTAL : 45 PERIODS

REFERENCES

1. Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14TH Edition, 2019.
2. Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th, Edition, 2017.

3. Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.
4. ZviBodie, Alex Kane, Alan J Marcus, PitabusMohanty, Investments, McGraw Hill Education (India), 11 Edition(SIE), 2019

CMG333 BANKING, FINANCIAL SERVICES AND INSURANCE LT P C
3 0 0 3

COURSE OBJECTIVES

- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM 9
Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS 9
Liquid Assets - Investment in securities - Advances - Loans.Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes.Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY 9
Payment system in India – paper based – e payment –electronic banking –plastic money – e-money –forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.

UNIT IV FINANCIAL SERVICES 9
Introduction – Need for Financial Services – Financial Services Market in India – NBFC –– Leasing and Hire Purchase –– mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking

UNIT V INSURANCE 9
Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim

TOTAL : 45 PERIODS

REFERENCES :

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.
2. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010
3. Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2017

CMG334 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS LT P C
3 0 0 3

UNIT I INTRODUCTION TO BLOCKCHAIN 9
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain

UNIT III ETHEREUM 9

Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV WEB3 AND HYPERLEDGE ` 9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT V EMERGING TRENDS 9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL : 45 PERIODS

REFERENCE

1. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
3. ArshdeepBahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.

CMG335 FINTECH PERSONAL FINANCE AND PAYMENTS LT P C
3 0 0 3

UNIT I CURRENCY EXCHANGE AND PAYMENT 9

Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI).Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations.Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE 9

A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH 9

InsurTech Introduction , Business model disruption AI/ML in InsurTech ● IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV PEER TO PEER LENDING 9

P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V REGULATORY ISSUES **9**

FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: StartupsRegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection

TOTAL : 45 PERIODS

REFERENCES:

1. Swanson Seth, Fintech for Beginners: Understanding and Utilizing the power of technology, Createspace Independent Publishing Platform,2016.
2. Models AuTanda, Fintech Bigtech And Banks Digitalization and Its Impact On Banking Business, Springer, 2019
3. Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016
4. Jacob William, FinTech:TheBeginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016
5. IIBF, Digital Banking, Taxmann Publication, 2016
6. Jacob William, Financial Technology, Create space Independent Pub, 2016
7. Luke Sutton, Financial Technology: Bitcoin & Blockchain, Createspace Independent Pub, 2016

CMG336	**INTRODUCTION TO FINTECH**	**L T P C**
		3 0 0 3

COURSE OBJECTIVES:

- To learn about history, importance and evolution of Fintech
- To acquire the knowledge of Fintech in payment industry
- To acquire the knowledge of Fintech in insurance industry
- To learn the Fintech developments around the world
- To know about the future of Fintech

UNIT I INTRODUCTION **9**

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY **9**

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY **9**

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT IV FINTECH AROUND THE GLOBE **9**

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT V FUTURE OF FINTECH **9**

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL : 45 PERIODS

REFERENCES

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016
3. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
5. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

VERTICAL 2: ENTREPRENEURSHIP

CMG337	**FOUNDATIONS OF ENTREPRENEURSHIP**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To develop and strengthen the entrepreneurial quality and motivation of learners.
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of entrepreneurship and management in Technology oriented businessess.
- To empower the learners to run a Technology driven business efficiently and effectively

UNIT I INTRODUCTION TO ENTREPRENEURSHIP **9**

Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entreprenrship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVRIONMENT **9**

Types of Business Ownership – Buiness Envrionemental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Reosurces Mobilisation-Basics of Managing Finance- Esentials of Marketing Management - Production and Operations Planning – Systems Management and Administration

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP **9**

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characterisitcis of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportuinites in Technopreneurship - Recent trends

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP **9**

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship -– Success Stories of Technopreneurs - Case Studies

UNIT V EMERGING TRENDS IN ENTREPRENERUSHIP **9**

Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneruship - NGO Entrepreneurship – Recent Entrperneruial Develoments - Local – National – Global perspectives.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO1 Learn the basics of Entrepreneurship

CO2 Understand the business ownership patterns and evnironment

CO3 Understand the Job opportunites in Industries relating to Technopreneurship

CO4 Learn about applications of tehnopreneurship and successful technopreneurs

CO5 Acquaint with the recent and emerging trends in entrepreneruship

TEXT BOOKS:

1) S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi, 2021.
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

REFERENCES :

1) Daniel Mankani. 2003. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall
2) Edward Elgar. 2007. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub.
3) Lang, J. 2002, The High Tech Entrepreneur's Handbook, Ft.com.
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
5) HarperBusiness,https://fanny.staff.uns.ac.id/files/2013/12/Technopreneur-BASED-EDUCATION-REVOLUTION.pdf
6) JumpStart: A Technoprenuership Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009
7) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businessess.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively

UNIT I INTRODUCTION TO MANAGING TEAMS **9**

Introduction to Team - Team Dynamics - Team Formation – Stages of Team Devlopment - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS **9**

Team-based Organisations- Leadershp roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP 9

Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment .

UNIT IV LEADERSHIP IN ORGANISATIONS 9

Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.

UNIT V LEADERSHIP EFFECTIVENESS 9

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL 45 : PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO1 Learn the basics of managing teams for business.
CO2 Understand developing effective teams for business management.
CO3 Understand the fundamentals of leadership for running a business.
CO4 Learn about the importance of leadership for business development.
CO5 Acquaint with emerging trends in leadership effectiveness for entreprenerus.''

REFERENCES :

1. Hughes, R.L., Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience ,9th Ed, McGraw Hill Education, Chennai, India. (2019).
2. Katzenback, J.R., Smith, D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, (2015).
3. Haldar, U.K., Leadership and Team Building, Oxford University Press, (2010).
4. Daft, R.L., The Leadership Experience, Cengage, (2015).
5. Daniel Levi, Group Dynamics for Teams ,4th Ed, (2014), Sage Publications.
6. Dyer, W. G., Dyer, W. G., Jr., & Dyer, J. H..Team building: Proven strategies for improving team performance, 5thed, Jossey-Bass, (2013).

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entprerenship.
- To develeop innovative business models for business.

UNIT I CREATIVITY 9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE 9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION 9

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system

UNIT IV INNOVATION AND ENTREPRENEURSHIP 9

Innovation and Entrepreneurship: Entrepreneurial Mindset , Motivations and Behaviours-Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities-Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit

UNIT V INNOVATIVE BUSINESS MODELS 9

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO1 Learn the basics of creativity for developing Entrepreneurship

CO2 Understand the importance of creative inteligence for business growth

CO3 Understand the advances through Innovation in Industries

CO4 Learn about applications of innovation in building successful ventures

CO5 Acquaint with developing innovative business models to run the business effecientlty and effectively

Suggested Readings:

Creativity and Inovation in Entrepreneurship, Kankha, Sultan Chand
Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004.
Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.
Innovation Management, C.S.G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.
A. Dale Timpe, Creativity, Jaico Publishing House, 2003.
Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.

CMG340	**PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT 9

Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT II MARKETING ENVIRONMENT 9

Introduction - Environmental Scanning - Analysing the Organisation’s Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment

Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

UNIT III PRODUCT AND PRICING MANAGEMENT 9

Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT IV PROMOTION AND DISTRIBTUION MANAGEMENT 9

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing - E-Marketing or Online Marketing.

TOTAL 45 : PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to :

CO1 Have the awareness of marketing management process

CO2 Understand the marketing environment

CO3 Acquaint about product and pricing strategies

CO4 Knowledge of promotion and distribution in marketing management.

CO5 Comprehend the contemporary marketing scenairos and offer solutions to marketing issues.

REFERENCES:

1. Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.
2. Marketing Management , Philip Kortler and Kevin Lane Keller, PHI 15th Ed, 2015.
3 Marketing Management- An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.
4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy & S.Namakumari, Macmillan Publishers India,5th edition, 2015.
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.
6. Marketing Management- text and Cases, Dr. C.B.Gupta & Dr. N.Rajan Nair, 17th edition, 2016.

CMG341	**HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
- To create an awareness of the roles, functions and functioning of human resource department.
- To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM **9**

Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles-Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.

UNIT II HUMAN RESOURCE PLANNING **9**

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation-Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION **9**

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT **9**

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices

UNIT V CONTROLLING HUMAN RESOURCES **9**

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course the learners will be able:

CO1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO2 To learn about the HR Planning Methods and practices.
CO3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO4 To known about the methods of Training and Employee Development.
CO5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES

1) Gary Dessler and Biju Varkkey, Human Resource Management, 14e , Pearson, 2015.
2) Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
3) David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
4) R. Wayne Mondy, Human Resource Management, Pearson , 2015.
5) Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012
6) John M. Ivancevich, Human Resource Management,12e, McGraw Hill Irwin,2013.
7) K. Aswathappa, Sadhna Dash , Human Resource Management - Text and Cases , 9th Edition, McGraw Hill, 2021.
8) Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012

CMG342 FINANCING NEW BUSINESS VENTURES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and quity financing.
- To empower the learners towards fund rasiing for new ventures effectively.

UNIT I ESSENTIALS OF NEW BUSINES VENTURE **9**

Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT II INTRODUCTION TO VENTURE FINANCING 9

Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Dent and Equity - Challenges and Opportunities.

UNIT III SOURCES OF DEBT FINANCING 9

Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.

UNIT IV SOURCES OF EQUITY FINANCING 9

Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES 9

Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds - Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

CO1 Learn the basics of starting a new business venture.
CO2 Understand the basics of venture financing.
CO3 Understand the sources of debt financing.
CO4 Understanf the sources of equity financing.
CO5 Acquaint with the methods of fund raising for new business ventures.

REFERENCES :

1) Principles of Corporate Finance by Brealey and Myers et al.,12TH ed, McGraw Hill Education (India) Private Limited, 2018
2) Prasanna Chandra, Projects : Planning ,Analysis,Selection ,Financing,Implementation and Review, McGraw Hilld Education India Pvt Ltd ,New Delhi , 2019.
3) Introduction to Project Finance. Andrew Fight,Butterworth-Heinemann, 2006.
4) Metrick, Andrew; Yasuda, Ayako. Venture Capital And The Finance Of Innovation. Venture Capital And The Finance Of Innovation, 2nd Edition, Andrew Metrick And Ayako Yasuda, Eds., John Wiley And Sons, Inc, 2010.
5) Feld, Brad; Mendelson, Jason. Venture Deals. Wiley, 2011.
6) May, John; Simons, Cal. Every Business Needs An Angel: Getting The Money You Need To Make Your Business Grow. Crown Business, 2001.
7) Gompers, Paul Alan; Lerner, Joshua. The Money Of Invention: How Venture Capital Creates New Wealth. Harvard Business Press, 2001.
8) Camp, Justin J. Venture Capital Due Diligence: A Guide To Making Smart Investment Choices And Increasing Your Portfolio Returns. John Wiley & Sons, 2002.
9) Byers, Thomas. Technology Ventures: From Idea To Enterprise. Mcgraw-Hill Higher Education, 2014.
10) Lerner, Josh; Leamon, Ann; Hardymon, Felda. Venture Capital, Private Equity, And The Financing Of Entrepreneurship. 2012.

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343	PRINCIPLES OF PUBLIC ADMINISTRATION	L T P C
		3 0 0 3

UNIT I (9)

1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT II **(9)**

1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT III **(9)**

1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT IV **(9)**

1. Bureaucratic Approach: Max Weber
2. Human Relations Approach : Elton Mayo
3. Ecological Approach : Riggs

UNIT V **(9)**

1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers
3. Decision Making: Decision Making - Types, Techniques and Processes.

TOTAL: 45 PERIODS

REFERENCES:

1. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
2. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.
3. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.
4. Rumki Basu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013.
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CMG344 **CONSTITUTION OF INDIA** **L T P C**
3 0 0 3

UNIT I **(9)**

1. Constitutional Development Since 1909 to 1947
2. Making of the Constitution.
3. Constituent Assembly

UNIT II **(9)**

1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT III **(9)**

1. President
2. Parliament
3. Supreme Court

UNIT IV **(9)**

1. Governor
2. State Legislature
3. High Court

UNIT V **(9)**

1. Secularism
2. Social Justice
3. Minority Safeguards

TOTAL: 45 PERIODS

REFERENCES:

1. Basu. D.D.: Introduction to Indian Constitution ; Prentice Hall; New Delhi.
2. Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

CMG345 PUBLIC PERSONNEL ADMINISTRATION **L T P C 3 0 0 3**

UNIT I **(9)**

1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT II **(9)**

1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

UNIT III **(9)**

1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT IV **(9)**

1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT V **(9)**

1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

TOTAL: 45 PERIODS

REFERENCES:

1. Stahl Glean O: Public Personnel Administration
2. Parnandikar Pai V.A: Personnel System for Development Administration.
3. Bhambhiru . P: Bureaucracy and Policy in India.
4. Dwivedi O.P and Jain R.B: India's Administrative state.
5. Muttalis M.A: Union Public Service Commission.
6. Bhakara Rao .V: Employer Employee Relations in India.
7. Davar R.S. Personnel Management & Industrial Relations

CMG346 ADMINISTRATIVE THEORIES L T P C
3 0 0 3

UNIT I (9)
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

UNIT II (9)
Theories of Organization: Scientific Management Theory, Classical Model,
Human Relations Theory

UNIT III (9)
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV (9)
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT V (9)
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker

TOTAL: 45 PERIODS

REFERENCES:

1. Crozior M : The Bureaucratic phenomenon (Chand)
2. Blau. P.M and Scott. W : Formal Organizations (RKP)
3. Presthus. R : The Organizational Society (MAC)
4. Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.
5. Keith Davis : Organization Theory (MAC)

CMG347 INDIAN ADMINISTRATIVE SYSTEM L T P C
3 0 0 3

UNIT I (9)
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II (9)
Role & Functions of the District Collector, Relationship between the District
Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT III (9)
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV (9)
Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT V (9)
Corruption – Ombudsman, Lok Pal & Lok Ayuktha

TOTAL: 45 PERIODS

REFERENCES:
1. S.R. Maheswari : Indian Administration
2. Khera. S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

CMG348 PUBLIC POLICY ADMINISTRATION L T P C
3 0 0 3

UNIT I (9)
Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration.

UNIT II (9)
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model

UNIT III (9)
Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation.

UNIT IV (9)
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT V (9)
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

TOTAL: 45 PERIODS

REFERENCES:
1. Rajesh Chakrabarti & Kaushik Sanyal : Public Policy in India, Oxford University Press, 2016.
2. Kuldeep Mathur : Public Policy and Politics in India, Oxford University Press, 2016.
3. Bidyutv Chakrabarty: Public Policy: Concept, Theory and Practice, 2015.
4. Pradeep Saxena : Public Policy Administration and Development
5. Sapru R.K. : Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers, 2016.

VERTICAL 4: BUSINESS DATA ANALYTICS

CMG349 STATISTICS FOR MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVE:
- To learn the applications of statistics in business decision making.

UNIT I INTRODUCTION 9
Basic definitions and rules for probability, Baye's theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION **9**

Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETIRC TESTS **9**

Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS **9**

Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov – test for goodness of fit, Mann – Whitney U test and Kruskal Wallis test.

UNIT V CORRELATION AND REGRESSION **9**

Correlation –Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1To facilitate objective solutions in business decision making.
CO2 understand and solve business problems
CO3 To apply statistical techniques to data sets, and correctly interpret the results.
CO4 To develop skill-set that is in demand in both the research and business environments
CO5 To enable the students to apply the statistical techniques in a work setting.

REFERENCES:

1. Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
3. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
4. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.
5. David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James J.Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.
6. N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017.

CMG350 **DATAMINING FOR BUSINESS INTELLIGENCE** **L T P C**
3 0 0 3

COURSE OBJECTIVES :

- To know how to derive meaning form huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION **9**

Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS **9**

Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES **9**

Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES **9**

Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI **9**

Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Learn to apply various data mining techniques into various areas of different domains.
CO2 Be able to interact competently on the topic of data mining for business intelligence.
CO3 Apply various prediction techniques.
CO4 Learn about supervised and unsupervised learning technique.
CO5 Develop and implement machine learning algorithms

REFERENCES :

1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
3. W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.
4. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition,2013.
5. Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011
6. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011
7. G. K. Gupta, Ïntroduction to Data mining with Case Studies, Prentice hall of India, 2011
8. Giudici, Applied Data mining – Statistical Methods for Business and Industry, John Wiley. 2009
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011
10. Michalewicz Z., Schmidt M. Michalewicz M and Chiriac C, Adaptive Business Intelligence, Springer – Verlag, 2007
11. GalitShmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence – Concepts, Techniques and Applications Wiley, India, 2010.

CMG351 **HUMAN RESOURCE ANALYTICS** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I INTRODUCTION TO HR ANALYTICS **9**

People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.

UNIT II HR ANLYTICS I: RECRUITMENT **9**

Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.

UNIT III HR ANALYTICS - TRAINING AND DEVELOPMENT **9**

Training & Development Metrics : Percentage of employees trained- Internally and externally trained -Training hours and cost per employee - ROI.

UNIT IV HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9

Employee Engagement Metrics :Talent Retention index - Voluntary and involuntary turnover-grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT 9

Workforce Diversity and Development Metrics : Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity
index - Gender mix

TOTAL: 45 PERIODS

COURSE OUTCOME:

CO1 The learners will be conversant about HR metrics and ready to apply at work settings.
CO2 The learners will be able to resolve HR issues using people analytics.

REFERENCES:

1. JacFitzenz , The New HR Analytics, AMACOM , 2010.
2. Edwards M. R., & Edwards K, Predictive HR Analytics: Mastering the HR Metric.London: Kogan Page.2016.
3. Human Resources kit for Dummies – 3 rd edition – Max Messmer, 2003
4. Dipak Kumar Bhattacharyya, HR Analytics ,Understanding Theories andApplications, SAGE Publications India ,2017.
5. Sesil, J. C. , Applying advanced analytics to HR management decisions: Methods fo selection, developing incentives, and improving collaboration. Upper Saddle River,New Jersey: Pearson Education,2014.
6. Pease, G., & Beresford, B, Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments. Wiley ,2014.
7. Phillips, J., & Phillips, P.P, Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and OUTCOME. McGraw-Hill,2014.
8. HR Scorecard and Metrices, HBR, 2001.

CMG352 MARKETING AND SOCIAL MEDIA WEB ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVE:

- To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I MARKETING ANALYTICS 9

Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II COMMUNITY BUILDING AND MANAGEMENT 9

History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages-Linking Social Media Accounts-The Viral Impact of Social Media.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS 9

Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV WEB ANALYTICS 9

Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS 9

Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
3. Bittu Kumar, Social Networking, V & S Publishers, 2013
4. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004
6. Takeshi Moriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016

CMG353 OPERATION AND SUPPLY CHAIN ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVE:

- To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I INTRODUCTION 9

Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II WAREHOUSING DECISIONS 9

P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III INVENTORY MANAGEMENT 9

Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV TRANSPORTATION NETWORK MODELS 9

Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Set covering and Set Partitioning Problems, Travelling Salesman Problem, Scheduling Algorithms.

UNIT V MCDM MODELS 9

Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

COURSE OUTCOME:

CO1 To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.

3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
4. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management , I.K. International Publishing House Pvt. Ltd., 2016.
5. Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

CMG354 FINANCIAL ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVE:

- This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I CORPORATE FINANCE ANALYSIS 9
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II FINANCIAL MARKET ANALYSIS 9
Estimation and prediction of risk and return (bond investment and stock investment) –Time series- examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III PORTFOLIO ANALYSIS 9
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV TECHNICAL ANALYSIS 9
Prediction using charts and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices.

UNIT V CREDIT RISK ANALYSIS 9
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

COURSE OUTCOME
CO1 The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

1. Financial analytics with R by Mark J. Bennett, Dirk L. Hugen, Cambridge university press.
2. Haskell Financial Data Modeling and Predictive Analytics Paperback – Import, 25 Oct 2013 by Pavel Ryzhov.
3. Quantitative Financial Analytics: The Path To Investment Profits Paperback – Import, 11 Sep 2017 by Edward E Williams (Author), John A Dobelman.
4. Python for Finance - Paperback – Import, 30 Jun 2017 by Yuxing Yan (Author).
5. Mastering Python for Finance Paperback – Import, 29 Apr 2015 by James Ma Weiming.

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

CES331 SUSTAINABLE INFRASTRUCTURE DEVELOPMENT **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

UNIT I SUSTAINABLE DEVELOPMENT GOALS 9

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT II SUSTAINABLE INFRASTRUCTURE PLANNING 9

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

UNIT III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES 9

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS 9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies

UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS 9

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management

Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

TOTAL: 45 PERIODS

COURSE OUTCOME:

On completion of the course, the student is expected to be able to

CO1 Understand the environment sustainability goals at global and Indian scenario.
CO2 Understand risks in development of projects and suggest mitigation measures.
CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.
CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
5. New Building Materials and Construction World magazine
6. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher:Belhaven Press,ISBN:1852930039.
7. Munier N, "Introduction to Sustainability", Springer2005
8. Sharma, "Sustainable Smart Cities In India: Challenges And Future Perspectives", SPRINGER, 2022.
9. Ralph Horne, Tim Grant, KarliVerghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009
10. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010
11. Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).
12. GregerLundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2		1	1		2	3	1	1		2	1	1	2	1
2	3	1	3	2	1	2	2		1	1	1	2	2	2	2
3	2	2	3	1	1	1	1				1	1	1	3	1
4	3	1	3	2	2	1	3	1	1	1	1	2	2	2	2
5	3	1	2	2	2	2	3	1		1	1	2	2	3	2
Avg.	3	1	3	2	2	2	3	1	1	1	1	2	2	3	2

CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS 9

Ecosystem definition - Biotic *Vs*. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT 9

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT 9

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production **-** Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

COURSE OUTCOME

- On completion of the course, the student is expected to be able to

CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture

CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases

CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources

CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas

CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020
3. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016
4. Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016
5. Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021
6. Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		2						2		2			2	2	
2		2		2	2	2							3	2	
3				2		2							3	2	3
4	3	2			2			2	2	2	2		3	2	3
5		2	3	2			1					1		2	
Avg.	3	2	3	2	2	2	1	2	2	2	2	1	3	2	3

1 – Low; 2 – Medium; 3 – High; '- "– No correlation

CES333 SUSTAINABLE BIOMATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES

- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT I INTRODUCTION TO BIOMATERIALS 9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials-Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials

UNIT II BIO POLYMERS
9

Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT III BIO CERAMICS AND BIOCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al_2O_3) -Zirconia (ZrO_2)-Carbon-Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Compsite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)–glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT IV METALS AS BIOMATERIALS 9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT V NANOBIOMATERIALS 9

Meatllicnanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosizenanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs -Biosensor**-** Bioimaging/Molecular Imaging**-** challenges and future perspective.

TOTAL : 45 PERIODS

COURSE OUTCOMES

CO1 Students will gain familiarity with Biomaterials and they will understand their importance.
CO2 Students will get an overview of different biopolymers and their properties
CO3 Students gain knowledge on some of the important Bioceramics and Biocomposite materials
CO4 Students gain knowledge on metals as biomaterials
CO5 Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani "Introduction to Biomaterials Basic Theory with Engineering Applications" Cambridge University Press, 2014.
2. Donglu shi "Introduction to Biomaterials" Tsinghua University press, 2006.
3. Joon Park, R.S.Lakes "Biomaterials An Introduction" third edition, Springer 2007.
4. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh "Characterization of Biomaterials" Wood head publishing, 2013.
5. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013.
6. VasifHasirci, NesrinHasirci "Fundamentals of Biomaterials" Springer, 2018
7. Leopoido Javier Rios Gonzalez. "Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process" Apple academic press, 2021.
8. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad "Functional Bionanomaterials" springer, 2020.
9. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.

CES334 MATERIALS FOR ENERGY SUSTAINABILITY L T P C
3 0 0 3

OBJECTIVES

- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

COURSE OBJECTIVES

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- To provide fundamental knowledge about electrochemical devices and the materials used.
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UNIT I SUSTAINABLE ENERGY SOURCES
9

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II ELECTROCHEMICAL DEVICES 9

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O_2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, $LiCoO_2$, $LiFePO_4$, $LiMn_2O_4$) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT III FUEL CELLS 9

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

UNIT IV PHOTOVOLTAICS 9

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se_2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)

UNIT V SUPERCAPACITORS 9

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

COURSE OUTCOMES

CO1 Students will acquire knowledge about energy sustainability.
CO2 Students understand the principles of different electrochemical devices.
CO3 Students learn about the working of fuel cells and their application.
CO4 Students will learn about various Photovoltaic applications and the materials used.
CO5 The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES

1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.
3. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.
4. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

6. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.
7. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.
8. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.

CES335	**GREEN TECHNOLOGY**	**L T P C**
		3 0 0 3

COURSE OBJECTIVES:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To provide green engineering solutions to energy demand, reduced energy footprint.

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9

Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT II POLLUTION TYPES 9

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS 9

Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV DESIGNING GREEN PROCESSES 9

Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V GREEN NANOTECHNOLOGY 9

Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: To understand the principles of green engineering and technology
CO2: To learn about pollution using hazardous chemicals and solvents
CO3: To modify processes and products to make them green and safe.
CO4: To design processes and products using green technology
CO5: To understand advanced technology in green synthesis

TEXT BOOKS

1. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
2. Green Chemistry – An introductory text - M. Lancaster, RSC,2016.
3. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) , Wiley publications,2008

REFERENCE

1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I: ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction- Environmental Standards- Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India- Ambient air quality standards- water quality standard- Environmental Monitoring-Need for environmental monitoring- Concepts of environmental monitoring- Techniques of Environmental Monitoring.

UNIT II: MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT III: ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV : ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT 9

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification-exposure assessment- dose-response assessment; risk characterization.

UNIT V: AUTOMATED DATA ACQUISITION AND PROCESSING 9

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students will know

CO1 Basic concepts of environmental standards and monitoring.
CO2 the ambient air quality and water quality standards;
CO3 the various instrumental methods and their principles for environmental monitoring
CO4 The significance of environmental standards in monitoring quality and sustainability of the environment.
CO5 the various ways of raising environmental awareness among the people.
CO6 Know the standard research methods that are used worldwide for monitoring the environment.

TEXTBOOKS

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES

1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

CO's- PO's & PSO's MAPPING

Course Outcomes	Program Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	1	1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	1	1	1	1	1	-	-	-	1	-	2	2	2	1	1
CO3	1	1	2	1	1	-	-	-	2	-	1	1	1	-	-
CO4	1	2	3	3	1	-	-	-	2	-	3	3	1	-	-
CO5	1	1	3	2	1	-	-	-	3	-	3	1	2	-	-
CO6	3	2	3	3	2	-	-	-	3	-	3	3	3	1	1
Over all	3	2	3	3	2	-	-	-	3	-	3	3	3	1	1

CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To create awareness on the energy scenario of India with respect to world
- To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
- Familiarisation on the concept of sustainable development and its benefits
- Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
- Acquainting with energy policies and energy planning for sustainable development

UNIT I ENERGY SCENARIO 9

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT II ENERGY AND ENVIRONMENT 9

Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) - Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Income and growth.

UNIT IV RENEWABLE ENERGY TECHNOLOGY 9

Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT 9

National & State Energy Policy - National solar mission - Framework of Central Electricity Authority - National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol blending, Energy Efficiency and Energy Mix

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1 Understand the world and Indian energy scenario
CO2 Analyse energy projects, its impact on environment and suggest control strategies
CO3 Recognise the need of Sustainable development and its impact on human resource development
CO4 Apply renewable energy technologies for sustainable development
CO5 Fathom Energy policies and planning for sustainable development.

REFERENCES:

1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Robert Ristirer and Jack P. Kraushaar, "Energy and the environment", Willey, 2005.
3. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012
4. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.
5. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006.
6. M.H. Fulekar,Bhawana Pathak, R K Kale,"Environment and Sustainable Development" Springer,2016
7. https://www.niti.gov.in/verticals/energy

CES338 ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES:
- To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
- To create awareness on energy audit and its impacts
- To acquaint the techniques adopted for performance evaluation of thermal utilities
- To familiarise on the procedures adopted for performance evaluation of electrical utilities
- To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT 9
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING 9
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES 9
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVTION IN ELECTRICAL UTILITIES 9
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty,

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1 Understand the prevailing energy scenario
CO2 Familiarise on energy audits and its relevance
CO3 Apply the concept of energy audit on thermal utilities
CO4 Employ relevant techniques for energy improvement in electrical utilities
CO5 Understand Sustainable development and its impact on human resource development

REFERENCES:

1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Eastop.T.D& Croft D.R, “Energy Efficiency for Engineers and Technologists”, Logman Scientific & Technical, ISBN-0-582-03184, 1990
3. W.R. Murphy and G. McKay “Energy Management” Butterworths, London 1987
4. Pratap Bhattacharyya, “Climate Change and Greenhouse Gas Emission”, New India Publishing Agency- Nipa,2020
5. Matthew John Franchetti , Defne Apul “Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies” CRC Press,2012
6. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, “Energy and the Environment”, 4th Edition,Wiley,2022
7. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016
8. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.