DEPARTMENT OF CHEMICAL ENGINEERING

ANNA UNIVERSITY, CHENNAI

Vision:

Department of Chemical Engineering strives to become well known in India by creating quality chemical engineers who will be highly successful in academia, industries and research. The research motive is to develop sustainable technologies for the betterment of society.

Mission:

1. To disseminate high quality Chemical Engineering Education
2. To perform high impact research for the benefit of community
3. To collaborate with industries for innovative concepts/ideas
4. To develop quality engineers and technocrats with inter-disciplinary skills

ANNA UNIVERSITY: : CHENNAI: 600 025

UNIVERSITY DEPARTMENTS

B. TECH. CHEMICAL ENGINEERING

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM (CBCS)

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

- To inculcate conceptual knowledge in the fields of Chemical Engineering.
- To impart problem solving, analytical skills in the contemporary processes.
- To expedite state of art laboratory facility to offer practical Knowledge.
- To design and develop eco-friendly sustainable technologies with the aid of computational skills
- To facilitate the ability to learn, innovate and communicate technical developments for the benefit of humanity
- To disseminate the knowledge related to intellectual property ownership rights, ethics, professionalism, entrepreneurship, and their societal impact.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Chemical Engineering Graduates will exhibit ability to:

	Graduate attribute	**Programme Outcome**
PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	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.

PO6	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.
PO7	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.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Chemical Engineering Programme the student will have following Program-specific outcomes.

1. Graduates will have a strong foundation in engineering, science and current Chemical Engineering practices and will have experience in solving structured and unstructured problems using conventional and innovative solutions.
2. Graduates will be able to effectively describe the Chemical Engineering problem, analyze the data, develop potential solutions, evaluate these solutions, and present the results using their oral, written and electronic media skills.
3. Graduates will have an understanding of ethical and professional responsibilities of an engineer and the impact of engineering solutions on society and the global environment.

4.MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVE WITH PROGRAMME OUTCOMES

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	3	3	1	3	1	1	1	-	-	-	-	3	3	3	-
II	2	3	3	1	2	-	2	-	-	-	-	3	3	3	-
III	2	1	2	3	2	-	-	-	2	-	-	3	3	3	-
IV	2	2	3	-	3	3	3	2	-	-	-	3	2	2	3
V	2	2	3	1	-	3	3	2	-	2	2	3	2	2	3
VI	-	-	-	-	-	3	3	3	-	3	3	3	1	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

5. MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

		Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
YEAR 1	Semester 1	Technical English															
		Engineering Mathematics I															
		Engineering Physics															
		Engineering Chemistry															
		Engineering Graphics															
		Basic Sciences Laboratory															
		Workshop Practices Laboratory															
	Semester 2	Professional Communication															
		Engineering Mathematics II															
		Problem Solving and Python Programming															
		Basics of Electrical and Electronics Engineering															
		Engineering Mechanics															
		Principles of Chemical Engineering	3	3	3	1	1	1	1	1	-	-	1	2	2	2	-
		Problem Solving and Python Programming Laboratory															
		Electrical and Electronics Engineering Laboratory															

YEAR 2	Semester 3	Probability and Statistics															
		Elective - Humanities I															
		Mechanical Engineering for Technologists	3	3	3	2	2	2	3	2	3	2	2	3	3	2	-
		Organic Chemistry	3	2	1	3	-	1	2	2	1	-	3	3	2	2	3
		Process Calculations	3	3	2	2	2	2	1	1	3	2	2	3	3	3	2
		Fluid Mechanics for Chemical Engineers	3	3	3	3	3	2	3	2	1	1	2	3	3	3	3
		Organic Chemistry Laboratory	3	2	1	2	1	1	2	1	2	-	2	2	3	2	2
		Mechanical Engineering Laboratory	3	3	3	2	2	2	3	2	3	2	2	3	3	2	-
	Semester 4	Elective - Humanities II															
		Environmental Sciences															
		Audit Course - I															
		Heat Transfer	2	3	3	2	2	1	1	1	1	1	1	2	2	2	2
		Chemical Engineering Thermodynamics I	3	3	2	2	2	2	2	2	3	2	2	2	2	2	2
		Mechanical Operations	3	3	3	3	1	1	1	-	3	3	3	2	3	3	1
		Chemical Technology	3	2	3	2	3	1	-	1	1	1	1	1	2	2	2
		Fluid Mechanics Laboratory	3	3	3	3	2	2	2	3	3	3	3	3	3	3	3
		Mechanical Operations Laboratory	3	3	2	2	2	2	3	2	3	2	2	2	3	3	2
YEAR 3	Semester5	Principles of Management															
		Audit Course - II															
		Chemical Engineering Thermodynamics II	3	3	3	3	3	-	-	-	-	-	-	3	3	3	-
		Mass Transfer I	3	3	3	-	-	1	1	1	-	-	-	3	2	1	-
		Chemical Reaction Engineering I	3	3	3	2	2	2	2	-	-	-	-	-	3	3	-
		Professional Elective 1															
		Heat Transfer Laboratory	3	3	3	3	2	1	1	1	2	3	2	2	3	3	-
		Computational Chemical Engineering Laboratory	3	3	3	3	3	-	2	1	1	-	-	-	3	3	-
		Internship /Industrial Training															
	Semester 6	Chemical Reaction Engineering II	3	3	3	3	2	2	2	-	-	-	-	3	3	3	-
		Mass Transfer II	3	3	2	-	-	1	1	1	-	1	-	3	3	2	2
		Process Dynamics and Control	3	3	3	3	2	2	3	-	2	2	2	2	3	3	1
		Professional Elective 2															
		Professional Elective 3															
		Open Elective I															

		Process Control Laboratory for Chemical Engineers	3	3	2	3	3	2	1	1	1	1	1	1	2	3	1
		Mass Transfer Laboratory	3	3	-	3	-	-	-	-	2	-	-	2	3	3	-
		Internship / Training (Minimum 4 Weeks)															
YEAR 4	Semester 7	Transport Phenomena	3	3	3	2	1	-	-	-	1	-	-	1	3	3	-
		Process Equipment Design	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		Professional Elective 4															
		Professional Elective 5															
		Open Elective II															
		Chemical Reaction Engineering Laboratory	3	3	3	3	2	1	1	1	2	3	2	2	3	3	-
		Comprehension	3	1	3	2	1	-	-	-	-	1	2	3	3	3	2
		Internship / Training (Minimum 4 Weeks)	3	2	2	2	2	1	1	1	2	2	1	2	3	3	1
		Project – I	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Semester 8	Professional Elective 6															
		Professional Elective 7															
		Total Quality Management															
		Project – II	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

ANNA UNIVERSITY: : CHENNAI: 600 025

UNIVERSITY DEPARTMENTS

B. TECH. CHEMICAL ENGINEERING

REGULATIONS – 2019

CURRICULAAND SYLLABI FOR I TO VIII SEMESTERS

(Applicable to Students admitted from the Academic Year 2020-2021 onwards)

SEMESTER I

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS5151	Technical English	HSMC	4	0	0	4	4
2.	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
3.	PH5151	Engineering Physics	BSC	3	0	0	3	3
4.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE5151	Engineering Graphics	ESC	1	0	4	5	3
PRACTICALS								
6.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
7.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2
			TOTAL	**14**	**1**	**12**	**27**	**21**

SEMESTER II

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS5251	Professional communication	HSMC	4	0	0	4	4
2.	MA5252	Engineering Mathematics II	BSC	3	1	0	4	4
3.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
4.	EE5251	Basics of Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
6.	CH5201	Principles of Chemical Engineering	PCC	3	0	0	3	3
PRACTICALS								
7.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
8.	EE5261	Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
			TOTAL	**19**	**2**	**8**	**29**	**25**

SEMESTER III

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5354	Probability and Statistics	BSC	3	1	0	4	4
2.		Elective - Humanities I	HSMC	3	0	0	3	3
3.	CH5301	Mechanical Engineering for Technologists	ESC	2	0	0	2	2
4.	CY5252	Organic Chemistry	BSC	3	0	0	3	3
5.	CH5302	Process Calculations	PCC	2	1	0	3	3
6.	CH5303	Fluid Mechanics for Chemical Engineers	PCC	2	1	0	3	3
PRACTICALS								
7.	CY5361	Organic Chemistry Laboratory	BSC	0	0	4	4	2
8.	CH5311	Mechanical Engineering Laboratory	ESC	0	0	2	2	1
			TOTAL	**15**	**3**	**6**	**24**	**21**

SEMESTER IV

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Elective - Humanities II	HSMC	3	0	0	3	3
2.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
3.		Audit Course -I*	AC	3	0	0	3	0
4.	CH5401	Heat Transfer	PCC	2	1	0	3	3
5.	CH5402	Chemical Engineering Thermodynamics I	PCC	2	1	0	3	3
6.	CH5403	Mechanical Operations	PCC	2	1	0	3	3
7.	CH5404	Chemical Technology	PCC	3	0	0	3	3
PRACTICALS								
8.	CH5411	Fluid Mechanics for Chemical Engineering Laboratory	PCC	0	0	4	4	2
9.	CH5412	Mechanical Operations Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**3**	**8**	**29**	**22**

***** Audit Course is optional

SEMESTER V

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MG5451	Principles of Management	HSMC	3	0	0	3	3
2.		Audit Course -II*	AC	3	0	0	3	0
3.	CH5501	Chemical Engineering Thermodynamics II	PCC	2	1	0	3	3
4.	CH5502	Mass Transfer I	PCC	2	1	0	3	3
5.	CH5503	Chemical Reaction Engineering I	PCC	2	1	0	3	3
6.		Professional Elective I	PEC	3	0	0	3	3
7		Professional Elective II	PEC	3	0	0	3	3
8		Professional Elective III	PEC	3	0	0	3	3
PRACTICALS								
7.	CH5511	Heat Transfer Laboratory	PCC	0	0	4	4	2
8.	CH5512	Computational Chemical Engineering Laboratory	PCC	0	0	4	4	2
9.	CH5713	Internship / Training[1,**]	EEC	-	-	-	-	-
			TOTAL	**21**	**3**	**8**	**32**	**25**

* Audit Course is optional

[1]Minimum of 2 weeks at the end of 5th semester and 6th semester each, or a minimum of 4 weeks at the end of 6th semester.

**Assessment for Internship / Training will be done during 7th semester

SEMESTER VI

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CH5601	Chemical Reaction Engineering II	PCC	2	1	0	3	3
2.	CH5602	Mass Transfer II	PCC	2	1	0	3	3
3.	CH5603	Process Dynamics and Control	PCC	2	1	0	3	3
4.		Professional Elective IV	PEC	3	0	0	3	3
5.		Professional Elective V	PEC	3	0	0	3	3
		Professional Elective VI	PEC	3	0	0	3	3
6.		Open Elective I	OEC	3	0	0	3	3
PRACTICALS								
7.	CH5611	Process Control Laboratory for Chemical Engineers	PCC	0	0	4	4	2
8.	CH5612	Mass Transfer Laboratory	PCC	0	0	4	4	2
9.	CH5713	Internship / Training (Minimum 4 Weeks)[#]	EEC	-	-	-	-	-
			TOTAL	**18**	**3**	**8**	**29**	**25**

[#] Assessment for Internship / Training will be done during 7th semester

SEMESTER VII

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CH5751	Transport Phenomena	PCC	3	1	0	4	4
2.	CH5701	Process Equipment Design	PCC	1	2	0	3	3
3.	GE5451	Total Quality Management	PCC	3	0	0	3	3
5.		Professional Elective VII	PEC	3	0	0	3	3
6.		Open Elective II	OEC	3	0	0	3	3
PRACTICALS								
6.	CH5711	Chemical Reaction Engineering Laboratory	PCC	0	0	4	4	2
7.	CH5712	Comprehension	PCC	0	0	4	4	2
8.	CH5713	Internship / Industrial Training (Minimum 4 Weeks)	EEC	-	-	-	-	2
9.	CH5714	Project – I	EEC	0	0	6	6	3
			TOTAL	**13**	**3**	**14**	**30**	**25**

SEMESTER VIII

SI. NO.	CODE NO.	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	CH5811	Project – II	EEC	0	0	16	16	8
			TOTAL	**0**	**0**	**16**	**16**	**8**

TOTAL NO. OF CREDITS:172

B. TECH. CHEMICAL ENGINEERING

PROFESSIONAL ELECTIVE [PEC]

Sl. No.	Code No.	Course title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	CH5001	Drugs and Pharmaceutical Technology	3	0	0	3
2.	CH5002	Electrochemical Engineering	3	0	0	3
3.	CH5003	Energy Technology	3	0	0	3
4.	CH5004	Frontiers of Chemical Engineering	3	0	0	3
5.	CH5005	Modern Separation Techniques	3	0	0	3
6.	CH5006	Optimization of Chemical Processes	3	0	0	3
7.	CH5007	Petroleum Refining and Petrochemicals	3	0	0	3
8.	CH5008	Polymer Technology	3	0	0	3
9.	CH5009	Process Modeling and Simulation	3	0	0	3
10.	AS5073	Process Plant Utilities	3	0	0	3
11.	CH5010	Chemical Process Design	3	0	0	3
12.	CH5011	Materials of Construction	3	0	0	3
13.	CH5012	Biochemical Engineering	3	0	0	3
14.	GE5071	Disaster Management	3	0	0	3
15.	CH5013	Industrial Process Plant Safety	3	0	0	3
16.	CH5014	Instrumental Methods of Analysis	3	0	0	3
17.	CH5015	Process Engineering Economics	3	0	0	3

HUMANITIES AND SOCIAL SCIENCES (HSMC) – MANAGEMENT AND OTHERS						
Sl. No.	**Course No.**	**Course Title**	**L**	**T**	**P**	**C**
1.	HS5151	Technical English	4	0	0	4
2.	HS5251	Professional Communication	4	0	0	4
3.	MG5451	Principles of Management	3	0	0	3
					Total Credits	**11**

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5171	Language and Communication	3	0	0	3
2.	HU5172	Values and Ethics	3	0	0	3
3.	HU5173	Human Relations at Work	3	0	0	3
4.	HU5174	Psychological Process	3	0	0	3
5.	HU5175	Education, Technology and Society	3	0	0	3
6.	HU5176	Philosophy	3	0	0	3
7.	HU5177	Applications of Psychology in Everyday Life	3	0	0	3

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5271	Gender Culture and Development	3	0	0	3
2.	HU5272	Ethics and Holistic Life	3	0	0	3
3.	HU5273	Law and Engineering	3	0	0	3
4.	HU5274	Film Appreciation	3	0	0	3
5.	HU5275	Fundamentals of Language and Linguistics	3	0	0	3
6.	HU5276	Understanding Society and Culture through Literature	3	0	0	3

BASIC SCIENCE COURSE(BSC)						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	MA5158	Engineering Mathematics I	3	1	0	4
2.	PH5151	Engineering Physics	3	0	0	3
3.	CY5151	Engineering Chemistry	3	0	0	3
4.	BS5161	Basic Science Laboratory	0	0	4	2
5.	MA5252	Engineering Mathematics II	3	1	0	4
6.	MA5354	Probability and Statistics	3	1	0	4
7.	GE5251	Environmental Sciences	3	0	0	3
8.	CY5252	Organic Chemistry	3	0	0	3
9.	CY5361	Organic Chemistry Laboratory	0	0	4	2
					Total Credits	**28**

ENGINEERING SCIENCE COURSE(ESC)						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	GE5151	Engineering Graphics	1	0	4	3
2.	GE5162	Workshop Practices Laboratory	0	0	4	2
3.	GE5153	Problem Solving and Python Programming	3	0	0	3
4.	EE5251	Basics of Electrical and Electronics Engineering	3	0	0	3
5.	GE5152	Engineering Mechanics	3	1	0	4
6.	EE5261	Electrical and Electronics Engineering Laboratory	0	0	4	2
7.	GE5161	Problem Solving and Python Programming Laboratory	0	0	4	2
8.	CH5301	Mechanical Engineering for Technologists	2	0	0	2
9.	CH5311	Mechanical Engineering Laboratory	0	0	2	1
					Total Credits	**22**

PROFESSIONAL CORE COURSES (PCC)						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1.	CH5201	Principles of Chemical Engineering	3	0	0	3
2.	~~CY5252~~	~~Organic Chemistry~~	~~3~~	~~0~~	~~0~~	~~3~~
3.	CH5302	Process Calculations	2	1	0	3
4.	CH5303	Fluid Mechanics for Chemical Engineers	2	1	0	3
5.	CH5401	Heat Transfer	2	1	0	3
6.	~~CY5361~~	~~Organic Chemistry Laboratory~~	~~0~~	~~0~~	~~4~~	~~2~~
7.	CH5402	Chemical Engineering Thermodynamics I	2	1	0	3
8.	CH5403	Mechanical Operations	2	1	0	3
9.	CH5404	Chemical Technology	3	0	0	3
10.	CH5411	Fluid Mechanics for Chemical Engineering Laboratory	0	0	4	2
11.	CH5412	Mechanical Operations Laboratory	0	0	4	2
12.	CH5501	Chemical Engineering Thermodynamics II	2	1	0	3
13.	CH5502	Mass Transfer I	2	1	0	3
14.	CH5503	Chemical Reaction Engineering I	2	1	0	3
15.	CH5511	Heat Transfer Laboratory	0	0	4	2
16.	CH5601	Chemical Reaction Engineering II	2	1	0	3
17.	CH5512	Computational Chemical Engineering Laboratory	0	0	4	2
18.	CH5602	Mass Transfer II	2	1	0	3
19.	CH5603	Process Dynamics and Control	2	1	0	3
20.	CH5611	Process Control Laboratory for Chemical Engineers	0	0	4	2
21.	CH5612	Mass Transfer Laboratory	0	0	4	2
22.	CH5751	Transport Phenomena	3	1	0	4
23.	CH5701	Process Equipment Design	1	2	0	3
24.	CH5711	Chemical Reaction Engineering Laboratory	0	0	4	2
25.	CH5712	Comprehension	0	0	4	2
26.	GE5451	Total Quality Management	3	0	0	3
					Total Credits	**64**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)						
Sl. No.	**CODE No.**	**COURSE TITLE**	**L**	**T**	**P**	**Credits**
1.	CH5713	Internship / Training (Minimum 4 Weeks)	0	0	0	2
2..	CH5714	Project I	0	0	6	3
3.	CH5811	Project II	0	0	16	8
					Total Credits	**13**

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No.	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1.	AD5091	Constitution of India	3	0	0	0	**4/5**
2.	AD5092	Value Education	3	0	0	0	
3.	AD5093	Pedagogy Studies	3	0	0	0	
4.	AD5094	Stress Management by Yoga	3	0	0	0	
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	0	
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	0	
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	0	
8	AD5098	Sanga Tamil Literature Appreciation	3	0	0	0	

SUMMARY

Name of the Programme										
	Subject Area	**Credits per Semester**								**Credits Total**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	Humanities and Social Sciences Including Management Courses (HSMC)	4	4	3	3	3				17
2	Basic Science Course [BSC]	12	4	9	3					25
3	Engineering Science Course [ESC]	5	14	3						22
4	Professional Core Courses [PCC]		3	6	16	13	13	14		65
5	Professional Elective [PEC]					3	9	3		21
6	Open Elective Courses [OEC]						3	3		6
7	Employability Enhancement Courses [EEC]							5	8	13
8	Audit Course(AC) (Non Credit)				0	0				0
		21	25	21	22	25	25	25	8	**172**

HS5151 **TECHNICAL ENGLISH** **L T P C**
4 0 0 4

OBJECTIVES:

The first semester English course entitled 'Technical English ' aims to,

- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF 12

Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself –introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution

UNIT II DIALOGUE WRITING 12

Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions-**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)- **VocabularyDevelopment**: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING 12

Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic- **Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)- **Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement-**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS 12

Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 12

Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison - compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL : 60 PERIODS

Learning Outcomes

At the end of the course the students will have gained,

- Exposure to basic aspects of technical English.
- The confidence to communicate effectively I various academic situations.
- Learnt the use of basic features of Technical English

Textbook:

1. Revised Edition of ‘English for Engineers and Technologists’ Volume 1 published by Orient Black Swan Limited 2019.

Assessment Pattern

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158	ENGINEERING MATHEMATICS – I	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes in I Semester)	3	1	0	4

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 **12**

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of eigen values and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **12**

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

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

UNIT IV INTEGRAL CALCULUS **12**

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.

UNIT V MULTIPLE INTEGRALS **12**

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.

TOTAL :60 PERIODS

OUTCOMES:

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

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools n solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, New Delhi, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, 14th Edition, New Delhi, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”,Narosa Publications, 5th Edition, New Delhi, 2017.
5. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi , 2012.
6. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

PH5151 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E / B.Tech. programmes) **3 0 0 3**

OBJECTIVE

- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS 9

Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES 9

Gauss's law – Faraday's law - Ampere's law - 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 - 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 - interferometers - air wedge experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser - applications.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOMES:

After completion of this course, the students should able to

- Understanding the importance of mechanics.
- Express the knowledge of electromagnetic waves.
- Know the basics of oscillations, optics and lasers.
- Understanding the importance of quantum physics.
- Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker. Principles of Physics. John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer- Verlag, 2012.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications. Springer, 2012.

CY5151 ENGINEERING CHEMISTRY L T P C
(COMMON TO ALL BRANCHES) 3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photo processes and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

UNIT II NANOCHEMISTRY 9

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photoquenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV ENERGY CONVERSIONS AND STORAGE 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H_2-O_2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY 9

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning - zeolite (permutit) and ion exchange demineralization. Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

TOTAL: 45 PERIODS

OUTCOMES:

- To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
- To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, "A text book of Engineering Chemistry", Chand Publications, 2014.

REFERENCE BOOKS:

1. Schdeva M V, "Basics of Nano Chemistry", Anmol Publications Pvt Ltd
2. B.Sivasankar, "Instrumental Methods of Analysis", Oxford University Press. 2012.
3. Friedrich Emich, "Engineering Chemistry", Scientific International Ltd.
4. V RGowariker, N V Viswanathan and JayadevSreedhar, "Polymer Science" New AGE International Publishers

GE5151 **ENGINEERING GRAPHICS** **L T P C**
1 0 4 3

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

1. Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
2. Drawing orthographic projections of lines and planes.
3. Drawing orthographic projections of solids.
4. Drawing development of the surfaces of objects.
5. Drawing isometric and perspective views of simple solids.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

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 AND FREE HANDSKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by different methods – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection- principles-Principle 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 trapezoidal 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 15

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 15

Sectioning of 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. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V SOMETRIC AND PERSPECTIVE PROJECTIONS 1

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 and miscellaneous problems. Perspective projection of simple solids-Prisms pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use

TOTAL- 75 PERIODS

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

1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

TEXT BOOKS:

1. Bhatt, N. D.,Panchal V M and Pramod R. Ingle, "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Agrawal, B. and Agrawal C.M., "Engineering Drawing", Tata McGraw, N.Delhi, 2008.
2. Gopalakrishna, K. R., "Engineering Drawing", Subhas Stores, Bangalore, 2007.
3. Natarajan, K. V., "A text book of Engineering Graphics", 28thEd., Dhanalakshmi Publishers, Chennai, 2015.
4. Shah, M. B., and Rana, B. C., "Engineering Drawing", Pearson, 2ndEd., 2009.
5. Venugopal, K. and Prabhu Raja, V., "Engineering Graphics", New Age,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.
4. The students will be permitted to use appropriate scale to fit solution within A3 size.
5. The examination will be conducted in appropriate sessions on the same day.

BS5161 **BASIC SCIENCES LABORATORY** **L T P C**

(Common to all branches of B.E. / B.Tech Programmes) **0 0 4 2**

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVES

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

LIST OF EXPERIMENTS:

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

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 polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS:

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To determine the molecular weight of polymers by viscometric method.
- To quantitatively analyse the impurities in solution by electroanalytical techniques
- To design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS:

1. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).
2. Vogel's Textbook of Quantitative Chemical Analysis (8^{th} edition, 2014).

GE5162	WORKSHOP PRACTICES LABORATORY	LT P C
	(Common to all Branches of B.E. / B.Tech. Programmes)	0 0 4 2

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

1. 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 common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. 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.
4. 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 in household appliances.

WOOD WORK:

a) Sawing,
b) Planning 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

WIRING WORK:

a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
b) Wiring Stair case light.
c) Wiring tube – light.
d) Preparing wiring diagrams for a given situation.

Wiring Study:

a) Studying an Iron-Box wiring.
b) Studying a Fan Regulator wiring.
c) Studying an Emergency Lamp wiring.

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 air conditioner.

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) Studying a FM radio.
b) Studying an electronic telephone.

TOTAL (P: 60) = 60 PERIODS

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

1. 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.
2. Wire various electrical joints in common household electrical wire work.
3. 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.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

SEMESTER II

		L	T	P	C
HS5251	**PROFESSIONAL COMMUNICATION**	**4**	**0**	**0**	**4**

COURSE OBJECTIVES

The course entitles 'professional communication' aims to,

- Improve the relevant language skills necessary for professional communication.
- Develop linguistic and strategic competence in workplace context.
- Enhance language proficiency and thereby the employability of budding engineers and technologists.

UNIT I TECHNICAL COMMUNICATION 12

Listening: Listening to telephone conversations (intent of the speaker and note taking exercises)- Speaking: Role play exercises based on workplace contexts, introducing oneself- Reading: Reading the interview of an achiever and completing exercises (skimming, scanning and predicting)- Writing: Writing a short biography of an achiever based on given hints- Grammar: Asking and answering questions, punctuation in writing, prepositional phrases- Vocabulary Development: use of adjectives.

UNIT II SUMMARY WRITING 12

Listening: Listening to talks/lectures both general and technical and summarizing the main points- Speaking: Participating in debates- Reading: Reading technical essays/ articles and answering comprehension questions-Writing: Summary writing-Grammar: Participle forms, relative clauses- Vocabulary Development: Use of compound words, abbreviations and acronyms.

UNIT III PROCESS DESCRIPTION 12

Listening: Listening to a process description and drawing a flowchart-Speaking: Participating in Group Discussions, giving instructions- Reading: Reading instruction manuals- Writing: Writing process descriptions- Writing instructions- Grammar: Use of imperatives, active and passive voice, sequence words- Vocabulary Development: Technical jargon

UNIT IV REPORT WRITING 12

Listening: Listening to a presentation and completing gap-filling exercises- Speaking: Making formal presentations- Reading: Reading and interpreting charts/tables and diagrams- Writing: Interpreting charts/tables and diagrams, writing a report- Grammar: Direct into indirect speech, use of phrases- Vocabulary Development: reporting words

UNIT V WRITING JOB APPLICATIONS 12

Listening: Listening to a job interview and completing gap=filling exercises- Speaking: Mock interview, telephone interviews- Reading: Reading a job interview, SOP, company profile and completing comprehension exercises- Writing: job applications and resumes and SOPs-Grammar: Present perfect and continuous tenses- Vocabulary Development: Technical vocabulary.

TOTAL : 60PERIODS

LEARNING OUTCOMES

At the end of the second semester the learners should be able to,

- Read and comprehend technical texts effortlessly.
- Write reports of a technical kind.
- Speak with confidence in interviews and thereby gain employability

Textbook

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

Assessment Pattern

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5252	ENGINEERING MATHEMATICS – II (Common to all branches of B.E. / B.Tech. Programmes in II Semester)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in Engineering problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Stoke's theorem and Gauss divergence theorem – Verification and application in evaluating line, surface and volume integrals.

UNIT II ANALYTIC FUNCTION 12

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation $w = c + z,\ az,\ 1/z,\ z^2$.

UNIT III COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT IV DIFFERENTIAL EQUATIONS 12

Method of variation of parameters – Method of undetermined coefficients – Homogenous equations of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

OUTCOMES:

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

- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Construct analytic functions and use their conformal mapping property in application problems.

- Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
- Apply various methods of solving differential equation which arise in many application problems.
- Apply Laplace transform methods for solving linear differential equations.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodesand Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

Suggested Activities:

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods:

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS 9

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

Suggested Activities:

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Group Discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON 10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

Suggested Activities:

- Implementing python program using lists, tuples, sets for the following scenario:
  - Simple sorting techniques
  - Student Examination Report
  - Billing Scheme during shopping.

- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES 10

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

Suggested Activities:

- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

Suggested Evaluation Methods:

- Tutorials on the above activities.

UNIT V FILE HANDLING AND EXCEPTION HANDLING 7

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

Suggested Activities:

- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks -for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Write simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries etc.
6. Read and write data from/to files in Python programs.

TEXT BOOK:

1. ReemaThareja, "Python Programming using Problem Solving Approach", Oxford University Press, 2017.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff/O'Reilly Publishers, 2016. (http://greenteapress.com/wp/thinkpython/).

REFERENCES:

1. Guido van Rossum, Fred L. Drake Jr., "An Introduction to Python – Revised and Updated for Python 3.2", Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and Expanded Edition, MIT Press , 2013
3. Charles Dierbach, "Introduction to Computer Science using Python", Wiley India Edition, 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", Cengage Learning, 2012.

EE5251 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LT P C
3 0 0 3

OBJECTIVES:

- To understand the basic concepts of electric circuits, magnetic circuits and wiring.
- To understand the operation of AC and DC machines.
- To understand the working principle of electronic devices and circuits.

UNIT I BASIC CIRCUITS AND DOMESTIC WIRING 9

Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law-Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

UNIT II THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS 9

Three phase supply – Star connection – Delta connection –Balanced and Unbalanced Loads- Power in three-phase systems – Comparison of star and delta connections – Advantages-Magnetic circuits-Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.

UNIT III ELECTRICAL MACHINES 9

Working principle of DC generator, motor-EMF and Torque equation-Types –Shunt, Series and Compound-Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single phase induction motor-Applications. Working principles of alternator-EMF equation-Operating principles of Synchronous motor, stepper motor-Applications.

UNIT IV BASICS OF ELECTRONICS 9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits-Wave shaping.

UNIT V CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES9

Working principle and characteristics - BJT, SCR, JFET, MOSFET.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 To be able to understand the concepts related with electrical circuits and wiring.
CO2 To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3 Capable of understanding the operating principle of AC and DC machines.
CO4 To be able to understand the working principle of electronic devices such as diode and zener diode.
CO 5 To be able to understand the characteristics and working of current controlled and voltage controlled devices.

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, 2014
2. Del Toro, “Electrical Engineering Fundamentals”, Second edition, Pearson Education, New Delhi, 1989.
3. John Bird, “Electrical Circuit theory and technology”, Routledge; 5th edition, 2013

REFERENCES:

1. Thomas L. Floyd, ‘Electronic Devices’, 10th Edition, Pearson Education, 2018.
2. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017
3. Kothari DP and I.J Nagrath, “Basic Electrical Engineering”, McGraw Hill, 2010.
4. Muhammad H.Rashid, “Spice for Circuits and electronics”, 4th ed.,Cengage India,2019.

GE5152 **ENGINEERING MECHANICS** **LTPC**
3104

COURSE OBJECTIVES:

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

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES (9+3)

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNITII EQUILIBRIUM OF RIGID BODIES (9+3)

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNITIII DISTRIBUTED FORCES (9+3)

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration

UNIT IV FRICTION (9+3)

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

UNITV DYNAMICS OF PARTICLES (9+3)

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a

Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

TOTAL (L: 45 + T: 15)=60 PERIODS

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

1. Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11th Edition, 2017.

1. Vela Murali, “Engineering Mechanics-Statics and Dynamics”, Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

CH5201 **PRINCIPLES OF CHEMICAL ENGINEERING**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Introduce and provide an overview of Chemical Engineering

UNIT I **5**

Chemistry, Chemical Engineering and Chemical Technology; Historical overview of Chemical Engineering; Chemical Engineering in everyday life; Greatest achievements of Chemical Engineering.

UNIT II **12**

Units and dimensions, Basic Chemical Calculations, Dimensional Analysis, Concepts of Fluid flow, Heat and Mass Transfer, Basics of Thermodynamics, Chemical Kinetics and introduction to Process Control.

UNIT III **12**

Concept of Unit Processes and Unit Operations; Description and representation of different Unit Processes and Unit Operations; Designing of equipments; Flow sheet representation of process plants, Evolution of an Industry – Sulphuric acid and Soda ash manufacture. Plant visit to a chemical industry.

UNIT IV **12**

Role of Basic Sciences in Chemical Engineering; Role of Computers and their Applications; Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical, Electronics etc.

UNIT V **4**

Paradigm shifts in Chemical Engineering; Range of scales in Chemical Engineering; Opportunities for Chemical Engineers; Future of Chemical Engineering.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the history and development of chemical industry since origin.

CO2: Understand the basic transport process in chemical engineering.

CO3: Understand various unit operations and unit processes and to represent a chemical industry in terms of process flow diagram.

CO4: Understand the need of basic sciences and computers in chemical engineering.

CO5: Understand the role and functions of chemical engineers in the engineering industry and to know the basics of interdisciplinary engineering fields.

CO6: Know the future challenges in chemical engineering.

TEXT BOOKS:

1. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, 6th Edition, Tata McGraw Hill, 1997.
2. Ghosal, S.K, Sanyal S.K. and Dutta.S, “Introduction to Chemical Engineering” TMH Publications, New Delhi, 1998.
3. Dryden, C.E., “Outlines of Chemicals Technology”, Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press, 1993.
4. Randolph Norris Shreve, George T. Austin, “Shreve’s Chemical Process Industries”, 5th edition, McGraw Hill, 1984

REFERENCES:

1. McCabe, W.L., Smith, J. C. and Harriot, P. “Unit operations in Chemical Engineering”, McGraw Hill, 7th Edition, 2001
2. Finlayson, B. A., “Introduction to Chemical Engineering Computing”, John Wiley & Sons, New Jersey, 2006.
3. Pushpavanam, S, “Introduction to Chemical Engineering”, PHI Learning Private Ltd, New Delhi, 2012
4. Bhatt B. I. and Vora, S. M, “Stoichiometry”, 4th edition, McGraw Hill, 2004.

Course Articulation Matrix:

Course Outcomes	Program Outcomes														
	Statements	**PO1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand the history and development of chemical industry since origin.	1	2	1	1	-	-	-	-	-	-	-	1	1	1	-
CO2	Understand the basic transport process in chemical engineering.	3	3	3	1	-	-	-	-	-	-	-	1	2	2	-
CO3	Understand various unit operations and unit processes and to represent a chemical industry in terms of process flow diagram.	3	3	3	1	-	-	-	-	-	-	1	2	2	2	-
CO4	Understand the need of basic sciences and computers in chemical engineering.	3	3	3	2	3	1	1	1	-	-	1	1	2	2	-
CO5	Understand the role and functions of chemical engineers in the engineering industry and to know the basics of interdisciplinary engineering fields.	1	1	1	-	-	-	-	-	-	-	-	2	2	2	-
CO6	Know the future challenges in chemical engineering.	2	1	2	-	-	-	-	-	-	-	-	2	1	2	-
Overall CO		3	3	3	1	1	1	1	1	-	-	1	2	2	2	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

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

EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
8. Implementing programs using written modules and Python Standard Libraries.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Develop algorithmic solutions to simple computational problems
- Develop and execute simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python data structures.

Apply Python features in developing software applications.

EE5261 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVES

1. To impart hands on experience in verification of circuit laws and measurement of circuit parameters
2. To train the students in performing various tests on electrical motors.
3. It also gives practical exposure to the usage of CRO, power sources & function generators

List of Experiments

1. Verification of Kirchhoff's Law.
2. Steady state response of AC and DC circuits (Mesh, Node Analysis)
3. Frequency response of RLC circuits.
4. Measurement power in three phase circuits by two-watt meter method.
5. Regulation of single phase transformer.
6. Performance characteristics of DC shunt generator.
7. Performance characteristics of single phase induction motor.
8. Characteristics of PN diode and Zener diode
9. Characteristics of Zener diode
10. Half wave and full wave Rectifiers
11. Application of Zener diode as shunt regulator.
12. Characteristics of BJT and JFET

TOTAL: 60 PERIODS

OUTCOMES:

1. To become familiar with the basic circuit components and know how to connect them to make a real electrical circuit;
2. Ability to perform speed characteristic of different electrical machines
3. Ability to use logic gates and Flip flops

SEMESTER III

MA 5354 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES

To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.

To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the Central Limit theorem.

To apply the small/ large sample tests through Tests of hypothesis.

To understand the concept of analysis of variance and use it to investigate factorial dependence.

To monitor a process and detect a situation when the process is out of control.

UNIT I RANDOM VARIABLES 12

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

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

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 III TESTS OF SIGNIFICANCE 12

Type I and Type II errors – Tests for single mean, proportion, 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 – Non-parametric tests: Test for Randomness and Rank – Sum test (Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 12

Completely Randomized Design – Randomized Block Design – Latin Square Design – factorial design – Taguchi's robust parameter desig n.

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) Tolerance limits – Acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES

- To analyze the performance in terms of probabilities and distributions achieved by the determined solutions
- To be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis
- To apply the basic principles underlying statistical inference(estimation and hypothesis testing)
- To demonstrate the knowledge of applicable large sample theory of estimators and tests
- To obtain a better understanding of the importance of the methods in modern industrial processes.

TEXT BOOKS:

1. Devore, J.L. “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, 9th Edition, Boston, 2017.
2. Johnson, R.A. and Gupta, C.B. “Miller and Freund’s Probability and Statistics for Engineers”, Pearson India Education, Asia, 9th Edition, New Delhi, 2017.
3. Walpole, R.E., Myers R.H., Myres S.L., and Ye, K. “Probability and Statistics for Engineers and Scientists”, Pearson Education, Asia, 9th Edition, New Delhi, 2011.

REFERENCES:

1. Krishnaiah, K. and Shahabudeen, P. “Applied Design of Experiments and Taguchi Methods”, Prentice Hall of India, New Delhi, 2012.
2. Milton, J.S. and Arnold, J.C. “Introduction to Probability and Statistics”, Tata McGraw Hill, 4th Edition, 3rd Reprint, New Delhi, 2008.
3. Ross, S.M. “Introduction to Probability and Statistics for Engineers and Scientists”, Elsevier, 5th Edition, New Delhi, 2014.
4. Spiegel, M.R., Schiller, J., Srinivasan, R.A. and Goswami, D., “Schaum’s Outline of Theory and Problems for Probability and Statistics”, McGraw Hill Education, 3rd Edition, Reprint, New Delhi, 2017.

CH5301 MECHANICAL ENGINEERING FOR TECHNOLOGISTS

L	T	P	C
2	0	0	2

OBJECTIVE:

The course is aimed to

- Impart knowledge on thermodynamics and thermal engineering power generating units such as engines and theory of machines

UNIT I **6**

Basic concepts and hints; Zeroth law; First Law of Thermodynamics - Statement and application; Steady flow energy equation-problems- Second law of Thermodynamics – Kelvin - Plank statement and Clausius statement- problems; Limitations; Heat Engine, Refrigerator and Heat Pump, Available energy, Equivalence entropy; Reversibility: Entropy charts; Third law of Thermodynamics - Statement.

UNIT II **6**

Expressions for work done, Internal energy and heat transfer for Constant Pressure, Constant Volume, Isothermal, Adiabatic and Polytropic processes-Derivations and problems; Free expansion and Throttling process.

UNIT III **6**

Carnot cycle; Stirling cycle; Joule cycle; Otto cycle; Diesel cycle; Dual Combustion Cycle - Derivations and problems.

UNIT IV **6**

Engine nomenclature and classification; SI Engine; CI Engine; Four Stroke cycle, Two stroke cycle; Performance of I.C.Engine; Brake power, Indicated power, Brake thermal efficiency, Indicated Thermal Efficiency, Volumetric efficiency, Specific fuel consumption.
Steam - Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Dry steam; Superheated steam. Use of steam tables; volume of wet steam, volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle.

UNIT V **6**

Definition of Kinematic Links, Pairs and Kinematic Chains; Working principle of Slider Crank mechanism and inversions; Double slider crank mechanism and inversions.
Flywheel-Turning moment Diagram; Fluctuation of Energy.
Belt and rope drives; Velocity ratio; Slip; Creep; Ratio of tensions; Length of belt; Power Transmitted; gear trains-types.

TOTAL: 30 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the basic concepts and Laws of thermodynamics and its applications
CO2: Understand the various processes with its derivation and gaining knowledge of various processes in Chemical Industries
CO3: Understand the various thermodynamic cycles with its derivation
CO4: Understand the Engine applications and flywheel in Industries
CO5: Understand the applications of various drives like belts, gear drives in Chemical Process Industries
CO6: Understand the properties of steam and its applications in Chemical Process Industries

TEXT BOOKS:

1. Nag, P.K., “Engineering Thermodynamics ", Fourth Edition, Tata McGraw Hill Publishing Co., Ltd., 2008.
2. Ganesan, V, “Thermodynamics – Basic and Applied", McGraw Hill Education (India) Private Limited, 2018.
3. Rajput, R .K, “Thermal Engineering”, Sixth Edition, Laxmi publications (P) Ltd, 2010.
5. Khurmi R.S., and Gupta J.K, “Theory of Machines”, Eurasia Publishing House (P) Ltd., 2006

REFERENCES:

1. Smith, “Chemical Thermodynamics", Reinhold Publishing Co., 1977.
2. Bhaskaran, K.A., and Venkatesh, A., “Engineering Thermodynamics", Tata McGraw Hill, 1973
3. Pandya A. and Shah, “Theory of Machines", Charatakar Publishers, 1975.
4. Bansal, R.K. and Brar, J.S., “A Text book of Theory of Machines", Third Edition Laxmi publications (P) Ltd, 2004.
5. Khurmi R.S., and Gupta J.K, “A text book of Thermal Engineering”, S.Chand& Company (P) Ltd., 2001.
6. Dhomkundwar. S., Kothandaraman.C.P., and Dhomkundwar. A.V., “A Course in Thermal Engineering (SI Units)”, Dhanpat Rai and Sons, Delhi (2004)

Course Articulation Matrix:

Course Outcomes	Program Outcomes														
	Statements	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO1	Understand the basic concepts and Laws of thermodynamics and its applications	3	3	3	2	2	2	3	2	3	2	2	3	3	2	-
CO2	Understand the various processes with its derivation and gaining knowledge of various processes in Chemical Industries	2	2	3	2	2	2	2	3	3	2	3	3	3	2	2
CO3	Understand the various thermodynamic cycles with its derivation	2	2	2	-	-	2	-	2	3	2	2	3	2	2	2
CO4	Understand the Engine applications and flywheel in Industries	3	3	3	2	-	-	-	-	2	2	2	2	2	-	2
CO5	Understand the applications of various drives like belts, gear drives in Chemical Process Industries	3	3	3	2	3	3	2	3	2	2	3	3	2	2	2
CO6	Understand the properties of steam and its applications in Chemical Process Industries	3	2	3	2	-	3	2	3	3	2	3	3	3	3	2
Overall CO		3	3	3	2	2	2	3	2	3	2	2	3	3	2	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CY5252 **ORGANIC CHEMISTRY**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Learn various reaction mechanisms, preparation of organic compounds and their properties. This will be a precursor for the study on Chemical Reaction Engineering

UNIT I **9**

Introduction – various definitions and classifications of carbohydrates – Configurations of aldoses and ketoses upto six carbon atoms- D and L configurations – Anomerism- Epimerism- Preparation, Chemical properties, different structures (Fisher, Haworth, Pyranose and Furanose) and Uses of Monosaccharides (Glucose & Fructose). Ascending in carbohydrate series – (Aldo pentose to aldo hexose by Kiliani- Fischer, Improved Kiliani Fischer, Wolfrom and Sowden methods) – Descending in carbohydrate series (Aldo hexose to aldo pentose by Ruff, Wohl and Mac Donald methods) - aldose to isomeric Ketose – Ketose to isomeric Aldose – Aldose to epimer

UNIT II **9**

Different preparative methods, Physical & Chemical properties (Oxidation, reduction, Electrophilic and nucleophilic) and Uses of Pyrrole, Furan, Furfural, Tetrahydro Furan, Thiophene, Indole, Pyridine, Quinoline and Isoquinoline. Conversion of THF into Nylon 6-6

UNIT III **9**

Preparations of Benzil from benzyl aldehydes - Furyl from furfural, Vannilin from catechol through guaiacol, Gramine from indole, N-actetyl-5- bromoindoline from indole, Salol from phenol, Alanine from propionic acid, Heteroauxin from indole - Uses, Preparation of Chlorampenicol (by Baltz and Long's method)- Uses

Reaction and mechanism of acyloin condensation, Baeyer-Villigar reaction, Gabriel's synthesis of phthalimide, Bartoli Indole synthesis

UNIT IV **9**

Preparation and Synthetic utilities of Grignard reagent, Ethyl aceto acetate and Malonic ester for obtaining possible higher alkanes, alkenes, alkynes, acids, esters, aldehydes, ketones, alcohols, higher normal dicarboxylic acids, diketones and cyclic compounds etc.

UNIT V **9**

Synthesis of Malonyl urea, Phenacetin, Isoniazid, Para amino benzoic acid (PABA), Tryptophan Isopentaquine, chloroquine (precursors from m-chloroaniline and Ethyl aceto acetate) - Sulphaniliamide from aniline, chloro benzene, and p- toluene sulphonamide - Sulphapyridine from N- ASC and p-nitrochlorobenzene.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the preparation and classifications of carbohydrates

CO2: Understand the physical and chemical properties of heterocyclic compounds

CO3: Understand the various methods for preparing synthetic intermediates

CO4: Understand the various synthesis mechanisms

CO5: Understand the procedure for synthesizing alkanes, alkynes and various cyclic compounds

CO6: Understand the basic chemistry in pharmaceutical industry

TEXT BOOKS:

1. R.T. Morrison and R.N. Boyd “Organic Chemistry” VI Edition Prentice Hall Inc (1996) USA.
2. K.S. Tiwari, N.K. Vishnoi and S.N. Malhotra “A text book of Organic Chemistry” Second Edition, Vikas Publishing House Pvt. Ltd. (1998) New Delhi.

REFERENCES:

1. Chemistry in Engineering and Technology, Vol.2, TMH Publishing Co Ltd., New Delhi, 1994.
2. I L Finar “Organic Chemistry” ELBS (1994).

Course Articulation Matrix:

Course Outcomes	Program Outcomes														
	Statements	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO 3**
CO1	Understand the preparation and classifications of carbohydrates	2	-	2	-	-	1	1	1	-	2	3	2	2	2	2
CO2	Understand the physical and chemical properties of heterocyclic compounds	2	3	1	2	-	1	2	1	1	1	2	3	3	2	2
CO3	Understand the various methods for preparing synthetic intermediates	3	2	-	3	1	2	2	2	1	1	3	3	2	3	2
CO4	Understand the various synthesis mechanisms	2	3	1	3	1	1	2	2	1	2	3	2	2	3	2
CO5	Understand the procedure for synthesizing alkanes, alkynes and various cyclic compounds	3	2	-	3	1	2	2	2	1	1	3	3	2	3	2
CO6	Understand the basic chemistry in pharmaceutical industry	3	2	2	2	-	2	3	3	-	2	3	2	2	2	3
Overall CO		3	2	1	3	-	1	2	2	1	-	3	3	2	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5302 **PROCESS CALCULATIONS**

	L	T	P	C
OBJECTIVE:	**2**	**1**	**0**	**3**

The course is aimed to

- Acquire knowledge in concept of solving basic calculations in chemical engineering and to systematically formulate and solve material and energy balance problems found in the refining and chemical industries

UNIT I UNITS AND CONVERSIONS **5**

System and conversion of units, Dimensional consistency, Basic chemical calculations: Density, concentration, Pressure, Flow rates, Degrees of freedom.

UNIT II MATERIAL BALANCE **12**

Material balances-Introduction, Single unit system- Material balance problems without reactions, Material balance with reactions and material balance for multi-unit systems

UNIT III IDEAL AND REAL GASES **12**

Ideal gases, Real gases- Equation of state, Real gases- Compressibility charts, Real gas mixtures, Multi phase equilibrium- phase diagram and phase rule, Single component two phase systems, multi component vapor liquid equilibrium, Combustion processes.

UNIT IV ENERGY BALANCE **10**

Energy balances-Introduction, Energy balances without reaction, steady and unsteady state condition, Energy balances with chemical reaction, Humidity chart and their applications.

UNIT V MATERIAL AND ENERGY BALANCE **6**

Steady and unsteady state material and energy balances. Solving material and energy balances using process simulators.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the concepts of dimensional consistency and effective application of units and dimensions.

CO2: Analyze a problem statement and balance the material flowing through single and various operations.

CO3: Understand the gas behavior and its properties and vapor-liquid pattern

CO4: Understand general energy balance, simplify and apply to open and closed systems

CO5: Write material and energy balance for unsteady state how material and energy balances are formulated for equation- and modular based flow sheeting codes

CO6: Apply the knowledge to process flow sheeting in industries

TEXT BOOKS:

1. David M. Himmelblau and James B. Riggs, “Basic Principles and Calculations in Chemical Engineering”, Eighth Edition, Prentice Hall Inc., 2014
2. Felder, R. M. and Rousseau, R. W., “Elementary Principles of Chemical Processes”, 3rd Edn., John Wiley & Sons, New York, 2005.
3. Narayanan K.V. and Lakshmikutty B, “Stoichiometry and Process Calculations”, 2nd Edition, Prentice Hall Inc., 2016.

REFERENCES:

1. Hougen O A, Watson K M and Ragatz R A, “Chemical process principles” Part I, CBS publishers (1973).
2. Bhatt, B.L., Vora, S.M., “Stoichiometry “, 4th Edition,Tata McGraw-Hill (2004)

Course Articulation Matrix:

Course Outcomes	Program Outcomes														
	Statements	**PO1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	Understand the concepts of dimensional consistency and effective application of units and dimensions.	3	3	-	1	3	2	-	-	3	2	-	3	3	3	-
CO2	Analyze a problem statement and balance the material flowing through single and various operations.	3	3	1	2	3	2	-	-	3	2	-	3	3	3	-
CO3	Understand the gas behavior and its properties and vapor-liquid pattern	3	3	3	3	3	2	2	2	1	-	1	2	3	3	3
CO4	Understand general energy balance, simplify and apply to open and closed systems	3	3	2	1	3	1	-	-	3	1	1	3	3	3	1
CO5	Write material and energy balance for unsteady state how material and energy balances are formulated for equation- and modular based flow sheeting codes	3	2	2	3	3	2	1	-	3	1	3	3	3	3	2
CO6	Apply the knowledge to process flow sheeting in industries	3	2	3	3	3	2	1	-	3	1	3	3	3	3	3
	Overall CO	3	3	3	2	2	2	2	1	1	3	2	2	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5303 FLUID MECHANICS FOR CHEMICAL ENGINEERS

	L	T	P	C
OBJECTIVE:	**2**	**1**	**0**	**3**

The course is aimed to

- Acquire a sound knowledge on fluid properties, fluid statics, dynamic characteristics of fluid flow, flow measurement, pressure drop calculations in fluid flow systems, and performance characteristics of fluid machineries

UNIT I **9**

Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion.

UNIT II **9**

Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometer – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III **9**

The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude – relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies

UNIT IV **9**

Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

UNIT V **9**

Flow measurement - Constant and variable head meters; Velocity measurement techniques; Type and characteristics of valves; Classification, performance characteristics and sizing of pumps, compressors.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamental properties of fluids, stress-strain relationship in fluids, and its characteristics under static conditions and establish force balance in static systems.

CO2: Apply Bernouli principle, Navier - Stokes equation and compute pressure variation in static fluid.

CO3: Use of dimensional analysis to derive relationships among process or system variables. Further they would develop dimensionless groups that help in scale-up studies.

CO4: Understand the different types of flow conditions in fixed bed and fluidized beds.

CO5: Describe function of flow metering devices, apply Bernoulli equation to determine the performance of flow-metering devices and also analyze the performance aspects of fluid machinery such as pumps, compressors and valves.

CO6: Understand the impact of technology change and also develop responsibilities to the professional engineering practices.

TEXT BOOKS:

1. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991).
2. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, 2005
3. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition“, John Wiley, 2006

REFERENCES:

1. White, F.M., “Fluid Mechanics “, IV Edition, McGraw-Hill Inc., 1999.
2. James O Wilkes and Stacy G Bike, “Fluid Mechanics for Chemical Engineers’ Prentice Hall PTR (International series in Chemical Engineering) (1999)

Course Articulation Matrix:

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	PSO 1	PSO 2	PSO 3
CO1	Understand the fundamental properties of fluids, stress-strain relationship in fluids, and its characteristics under static conditions and establish force balance in static systems.	3	3	-	-	-	-	-	-	-	1	2	-	3	1	-
CO2	Apply Bernouli principle, Navier - Stokes equation and compute pressure variation in static fluid.	-	3	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	Use of dimensional analysis to derive relationships among process or system variables. Further they would develop dimensionless groups that help in scale-up studies.	-	3	3	3	2	-	2	-	-	3	1	2	-	-	2
CO4	Understand the different types of flow conditions in fixed bed and fluidized beds.	3	-	3	3	2	-	2	-	-	-	-	3	3	-	-
CO5	Describe function of flow metering devices, apply Bernoulli equation to determine the performance of flow-metering devices and also analyze the performance aspects of fluid machinery such as pumps, compressors and valves.	2	3	-	3	-	2	1	1	-	-	-	-	-	2	2

CO6	Understand the impact of technology change and also develop responsibilities to the professional engineering practices.	2	2	2	-	2	3	3	3	3	1	1	2	1	3	3
Overall CO		3	3	3	3	3	3	2	3	2	1	1	2	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CY5361 ORGANIC CHEMISTRY LABORATORY L T P C
0 0 4 2

OBJECTIVES

The course is aimed to

- To learn basic principles involved in analysis and synthesis of different organic derivatives.
- To identify the functional groups
- To know the separation of organic mixtures
- To prepare simple organic compounds
- To study the preparation of dyes

LIST OF EXPERIMENTS

1. Identification and characterization of various functional groups by their characteristic reactions: a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) phenol f) primary, secondary and tertiary amines
2. preparation of solid derivatives: a) 2,4 tri nitro phenyl hydrazone for aldehydes and ketones, b) acetyl and benzoyl derivatives for amine and phenol c) diazotization of aromatic amine
3. Preparation of Methyl red and Fluorescein
4. Separation of organic mixtures: a) aldehyde and acid, b) amine and phenol
5. Recrystallization of benzoic acid and acetanilide
6. Preparation of simple organic compounds like a) Naphthalene – Nitro naphthalene – 4 nitro – 1 – amino naphthalene b) Benzene – Benzil – benzylic acid.
7. Detection of peroxide in ether and its removal

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of the course students are expected to

CO1: Conduct simple experiments to identify the functional group

CO2: Prepare derivatives for aldehydes, ketones, sugars, amine and phenol

CO3: Analyzing various procedure to separate organic mixtures

CO4:Steps to carry out recrystallization

CO5:Preparation of synthetic organic compounds like
a) Naphthalene – Nitro naphthalene – 4 nitro – 1 – amino naphthalene
b) Benzene – Benzil – benzylic acid.

REFERENCE:

1. Practical organic chemistry, S.P. Bhutani, Ane books. 2009
2. Practical chemistry, V K Ahluwalia, University press. 2011
3. Text book of practical organic chemistry. Brain S Furniss, Pearson education 2011
4. Practical Organic Chemistry by Dey and Raman
5. Laboratory Manual of Organic Synthesis by M.N.Khramkina MIR publishers Moscow, First published in 1980, revised editions once in every five year. Last revised edition 2010.
6. Practical Chemistry by Balwant Rai Satija, Allied Publishers Pvt Ltd 1988.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	Conduct simple experiments to identify the functional group.	-	-	-	3	3	3	2	-	2	-	1	-	-	3	3	-
CO2	Prepare derivatives for aldehydes, ketones, sugars, amine and phenol	3	-	3	-	-	2	2	-	-	1	1	-	3	-	-	-
CO3	Analyzing various procedure to separate organic mixtures	-	3	3	3	-	1	-	–	2	-	-	-	-	3	3	2
CO4	Steps to carry out recrystallization	-	-	3	3	3	-	-	-	2	1	-	-	3	-	-	-
CO5	Preparation of synthetic organic compounds like a) Naphthalene – Nitro naphthalene – 4 nitro – 1 – amino naphthalene b) Benzene – Benzil – benzylic acid.	3	-	3	3	-	2	2	-	1	–	1	-	3	-	3	-
Overall CO		3	3	3	3	3	3	2	-	2	1	1	-	3	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5311 **MECHANICAL ENGINEERING LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVE:

The course is aimed to

- Impart practical knowledge in operating IC engines and conduct experiments. To understand test procedures in testing material for engineering applications

LIST OF EXPERIMENTS*

1. Port timing diagram
2. Valve timing diagram
3. Study of 2,4 stroke I C Engines
4. Load test on 4-stroke petrol engine
5. Performance test on 4-stroke single cylinder diesel engine
6. Performance test on 4-stroke twin cylinder diesel engine
7. Heat balance test on diesel engines
8. Tension test
9. Compression test
10. Deflection test
11. Hardness test (Rockwell and Brinell)
12. Spring test
13. Torsion test
14. Impact test

EQUIPMENTS REQUIRED

1. Single cylinder diesel engine coupled with Electrical loading
2. Single cylinder diesel engine coupled with Electrical loading with temperature indicators
3. Single cylinder slow speed diesel engine coupled with Mechanical loading
4. Twin cylinder diesel engine coupled with Electrical loading with Heat balance test setup
5. Single cylinder petrol engine coupled with Electrical loading
6. Two stroke IC Engine model
7. Four stroke IC Engine model
8. Small IC Engine models for study
9. UTM and Hardness test apparatus

*Minimum 10 experiments shall be offered

TOTAL: 30 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Determine Brake power, Indicated power and frictional power of single cylinder diesel engines.

CO2: Determine Brake power, Indicated power and frictional power of twin cylinder diesel engines.

CO3: Determine Brake power, Indicated power and frictional power of single cylinder petrol engines.

CO4: Evaluate the heat distribution from engine and preparing heat balance chart.

CO5: Estimate the engine performance with mechanical loading

CO6: Estimate the PTD and VTD of two and four stroke engines

Course Articulation Matrix:

Course Outcomes	Program Outcomes														
	Statements	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Determine Brake power, Indicated power and frictional power of single cylinder diesel engines.	3	3	3	2	2	2	3	2	3	2	2	3	3	2	-
CO2	Determine Brake power, Indicated power and frictional power of twin cylinder diesel engines.	2	2	3	2	2	2	2	3	3	2	3	3	3	2	2
CO3	Determine Brake power, Indicated power and frictional power of single cylinder petrol engines.	2	2	2	-	-	2	-	2	3	2	2	3	2	2	2
CO4	Evaluate the heat distribution from engine and preparing heat balance chart.	3	3	3	2	-	-	-	-	2	2	2	2	2	-	2
CO5	Estimate the engine performance with mechanical loading	3	3	3	2	3	3	2	3	2	2	3	3	2	2	2
CO6	Estimate the PTD and VTD of two and four stroke engines	3	2	3	2	-	3	2	3	3	2	3	3	3	3	2
	Overall CO	3	3	3	3	2	2	2	3	2	3	2	2	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

SEMESTER IV

GE5251 ENVIRONMENTAL SCIENCES L T P C
3 0 0 3

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 non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – 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 conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO2:To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate 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 different forms of energy and apply them for suitable applications in for technological advancement and societal development.

CO5:To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

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).

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
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).

Course Articulation Matrix:

Course Outcomes	Statement	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.	-	-	-	3	-	2	2	3	3	-	-	-	-	-	3
CO2	To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.	-	-	-	3	-	2	2	3	3	-	-	-	-	-	3
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.	-	-	-	3	-	2	2	3	3	-	-	-	-	-	3
CO4	To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.	-	-	-	3	-	2	2	3	3	-	-	-	-	-	3

CO5	To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyseeffect of population dynamics on human value education, consumerism and role of technology in environmental issues.	-	-	-	3	-	2	2	3	3	-	-	-	-	-	3
Overall CO		-	-	-	3	-	2	2	3	3	-	-	-	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5401 **HEAT TRANSFER**

L	T	P	C
2	1	0	3

OBJECTIVE:

The course is aimed to

- Teach the fundamental concepts of heat transfer viz., conduction, convection, radiation, boiling and condensation and its application to the students

UNIT I **9**

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer ; One dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres - Thermal conductivity measurement-effect of temperature on thermal conductivity; Heat transfer in extended surfaces; Transient heat conduction

UNIT II **11**

Concepts of heat transfer by convection - Natural and forced convection, Hydrodynamic and thermal Boundary layers; analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Coulburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, and flow through packed beds and fluidized beds

UNIT III **8**

Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling

UNIT IV **8**

Evaporation- single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring's rule. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces.

UNIT V **9**

Heat Exchangers – classification and design, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger, NTU and efficiency of Heat exchangers

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: To familiarize the students with the fundamental concepts of Heat Transfer. provide the student with knowledge about heat transfer by conduction in solids for steady state

CO2: Students will understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows

CO3: The course gives the student insight about boundary layer flow, laminar and turbulent flows

CO4: Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers

CO5: The course provides the student with knowledge about heat transfer with phase change (boiling and condensation) and evaporation

CO6: Students will understand radiative heat transfer including blackbody radiation and Kirchoff'slaw,and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems

TEXT BOOKS:

1. Holman, J. P., 'Heat Transfer ', 8th Edn., McGraw Hill, 1997.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering",6th Edn., McGraw-Hill, 2001.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998

Course Articulation Matrix:

Course Outcomes	Program Outcomes														
	Statements	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	To familiarize the students with the fundamental concepts of Heat Transfer. provide the student with knowledge about heat transfer by conduction in solids for steady state.	3	3	3	2	1	1	-	-	-	-	-	1	2	2	2
CO2	Students will understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows	2	2	3	3	2	1	-	1	1	1	1	-	1	2	2
CO3	The course gives the student insight about boundary layer flow, laminar and turbulent flows	3	2	2	2	2	1	1	1	1	1	-	1	1	1	1
CO4	Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers	2	2	3	2	3	1	1	-	-	-	-	2	2	1	1
CO5	The course provides the student with knowledge about heat transfer with phase change (boiling and condensation) and evaporation	2	3	3	2	3	1	1	-	1	-	1	1	2	2	1
CO6	Students will understand radiative heat transfer including blackbody radiation and Kirchhoff's law, and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems	2	3	3	2	2	-	1	-	1	1	1	2	3	2	2
	Overall CO	3	2	3	3	2	2	1	1	1	1	1	1	2	2	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5402 CHEMICAL ENGINEERING THERMODYNAMICS - I

L	T	P	C
2	1	0	3

OBJECTIVE:

The course is aimed to

- Learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

UNIT I **9**

Terminologies of thermodynamics, the variables and quantities of thermodynamics, characteristics of systems and processes, energy classifications, point and path functions, energy in transition work and heat. zeroth law; temperature scales

UNIT II **9**

The first law of thermodynamics, statements of first law for the flow and non-flow processes. PVT behaviour of fluids; Mathematical representation of PVT behaviour; Generalized compressibility factor correlation; Generalized equations of state

UNIT III **9**

Joule's experiment, energy balance for closed systems, mass and energy balance for open systems, Statements of the second law of thermodynamics, heat engine and refrigerator, Carnot cycle and Carnot theorems, thermodynamic temperature scale, entropy and its calculation, second law of thermodynamics for a control volume, Third law of thermodynamics, entropy from a microscopic point of view.

UNIT IV **9**

Thermodynamic potentials – internal energy, enthalpy, Helmholtz free energy, Gibbs free energy; thermodynamic property relations – Maxwell relations – partial derivatives and Jacobian method; residual properties; thermodynamic property tables and diagrams.

UNIT V **9**

Thermodynamic aspects of compression, expansion processes and duct flow of compressible fluids, steam power plant, internal combustion engines, jet and rocket engines.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamental concepts of thermodynamics and its related functions

CO2: Relate PVT behaviour of fluids and understand the real gas behavior

CO3: Apply second law and analyse the feasibility of system/devices

CO4: Analyse the thermodynamic property relations and their application to fluid flow

CO5: Develop the significance of thermodynamic potentials and their use in the analysis of processes

CO6: Formulate thermodynamic formulations and the working of compressors and expanders

TEXT BOOKS:

1. Smith J.M., VanNess,H.C., &Abbot M.C," Introduction to Chemical Engineering Thermodynamics",McGraw Hill VII Edition 2004
2. Kyle B.G.,"Chemical and Process Thermodynamics", Pearson International third Edition.
3. Rao Y.V.C.,"Chemical Engineering Thermodynamics"Universities Press, 2005

REFERENCES:

1. Sandler,S.I.,"Chemical and Engineering Thermodynamics",II Edition,Wiley,1989.
2. Narayanan K.V"A Text Book of Chemical Engineering Thermodynamics"Prentice Hall of India Pvt.Ltd.2001.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understand the fundamental concepts of thermodynamics and its related functions	3	2	1	-	1	-	2	-	-	2	1	-	3	-	-
CO2	Relate PVT behaviour of fluids and understand the real gas behavior	3	2	-	2	1	-	-	-	1	1	-	1	-	-	-
CO3	Apply second law and analyse the feasibility of system/devices	3	3	3	2	-	2	2	1	3	2	1	1	3	2	2
CO4	Analyse the thermodynamic property relations and their application to fluid flow	2	2	2	2	2	1	1	2	3	1	2	2	2	3	2
CO5	Develop the significance of thermodynamic potentials and their use in the analysis of processes	2	2	1	-	-	1	1	2	1	1	2	-	-	2	1
CO6	Formulate thermodynamic formulations and the working of compressors and expanders	3	2	2	2	-	1	1	2	2	1	2	3	2	2	1
Overall CO		3	3	3	2	2	2	2	2	2	3	2	2	2	2	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5403 **MECHANICAL OPERATIONS**

L	T	P	C
2	1	0	3

OBJECTIVE:

The course is aimed to

- Make students learn about characterization of solids, size reduction, techniques of solid – fluid separation and mixing

UNIT I **9**

General characteristics of solids, different techniques of size analysis, shape factor, surface area determination, estimation of particle size. Screening methods and equipment, screen efficiency, ideal and actual screens.

UNIT II **9**

Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding, power requirement, work index; size enlargement - principle of granulation, briquetting, pelletisation, and flocculation.

UNIT III **9**

Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment, cyclones and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging

UNIT IV **9**

Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.

UNIT V **9**

Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage and Conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, conveyer selection, different types of conveyers and their performance characteristics.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand and determine various properties of particulates

CO2: Gain Preliminary understanding on Size Reduction and Size Enlargement

CO3: Understand various separation and purification techniques employed in solid particles

CO4: Enhance their knowledge on Filtration Process

CO5: Understand Handling, Storage and Transportation of Solids

CO6: Obtain knowledge on various unit operations and their applications

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edn., McGraw-Hill, 2005.
2. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, Tata McGraw Hill, 1997.
3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., “Principles of Unit Operations”, 2nd Edn., John Wiley & Sons, 1994.

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understand and determine various properties of particulates	3	3	3	3	1	1	1	-	3	3	3	2	3	3	1
CO2	Gain Preliminary understanding on Size Reduction and Size Enlargement	3	2	2	2	2	1	1	-	1	2	2	2	2	3	1
CO3	Understand various separation and purification techniques employed in solid particles	3	2	2	3	3	1	3	2	1	2	3	2	2	3	3
CO4	Enhance their knowledge on Filtration Process	2	2	2	1	1	1	2	1	1	1	1	1	2	2	1
CO5	Understand Handling, Storage and Transportation of Solids	2	2	3	2	1	2	3	1	1	1	2	2	1	1	3
CO6	Obtain knowledge on various unit operations and their applications	3	3	1	2	2	2	3	-	-	1	3	2	2	2	1
Overall CO		3	3	3	3	2	2	3	1	2	2	3	3	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5404 **CHEMICAL TECHNOLOGY**

L	T	P	C
3	0	0	3

OBJECTIVES:

The course is aimed to

- Impart knowledge about unit process and unit operations in various industries
- Develop understanding of manufacturing process flow drawing for the manufacturing chemical processes, its applications and major engineering problems encountered in the process

UNIT I **9**

Introduction to chemical processing; symbolic representation of different unit operations and unit processes to build a flow sheet ; Production of pulp and paper, Manufacture of sugar, starch and starch derivatives.

UNIT II **9**

Alkalies and Acids: Chlor - alkali Industries: Manufacture of Soda ash, Manufacture of caustic soda and chlorine - common salt. Sulphur and Sulphuric acid: Mining of sulphur and manufacture of sulphuric acid, Manufacture of hydrochloric acid.

UNIT III **9**

Cement -Types and Manufacture of Portland cement, , Refining of edible oils and fats, fatty acids, Manufacture of Soaps and detergents ;Manufacture of paints and Varnishes – Pigments

UNIT IV **9**

Natural and synthetic fibres- Manufacture of nylon 6,6 and nylon 6 fibres, viscose rayon and polyester fibres; Nature, types, composition and uses of glass -its manufacture, melting, shaping, annealing and finishing operations; Basic principles of polymerization reactions: stepwise and chain polymerization, general polymerization systems: bulk, solution, suspension and emulsion polymerisation.

UNIT V **9**

Fertilizers: Nitrogen Fertilizers; Synthetic ammonia, nitric acid, Urea, Phosphorous Fertilizers: Phosphate rock, phosphoric acid, super phosphate and Triple Super phosphate

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the various unit operations and processes with their symbols.

CO2: Understand the various chemical reactions involved in the process

CO3: Understand the manufacturing process involved

CO4: Know to draw the process Flow sheet and understand the major engineering problems encountered in the processes

CO5: Learn manufacturing processes of organic and Inorganic Chemicals and its applications.

CO6: Understand the role of chemical Engineering in the production

TEXT BOOKS:

1. Dryden, C. E., “Outlines of Chemicals Technology”, Edited and Revised by Gopala Rao, M. and M. Sittig, Second Edition, Affiliated East-West press, 1993.
2. Austin, G. T., “Shreve’s Chemical Process Industries”, Fifth Edition, McGraw Hill, Singapore, 1984.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand the various unit operations and processes with their symbols.	3	2	3	2	1	1	-	-	-	-	-	1	2	3	2
CO2	Understand the various chemical reactions involved in the process	2	2	3	3	2	1	-	1	1	1	1	-	2	2	2
CO3	Understand the manufacturing process involved	3	2	2	2	2	1	-	1	1	1	-	1	1	1	1
CO4	Students will know to draw the process Flow sheet and understand the major engineering problems encountered in the processes	2	3	3	2	3	1	1	-	-	-	-	2	2	2	2
CO5	To learn manufacturing processes of organic and Inorganic Chemicals and its applications.	2	3	3	2	3	1	1	-	1	-	1	1	2	2	3
CO6	Students will understand the role of chemical Engineering in the production	2	3	3	2	3	-	1	-	1	1	1	2	3	2	2
Overall CO		3	2	3	2	3	1	-	1	1	1	1	1	2	2	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5411 FLUID MECHANICS FOR CHEMICAL ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

The course is aimed to

- Learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.

LIST OF EXPERIMENTS*

1. Viscosity measurement of non-Newtonian fluids
2. Calibration of constant and variable head meters
3. Calibration of weirs and notches
4. Open drum orifice and draining time
5. Flow through straight pipe
6. Flow through annular pipe
7. Flow through helical coil and spiral coil
8. Losses in pipe fittings and valves
9. Characteristic curves of pumps
10. Pressure drop studies in packed column
11. Hydrodynamics of fluidized bed
12. Drag coefficient of solid particle
13. Friction in straight pipes

EQUIPMENTS REQUIRED

1. Viscometer
2. Venturi meter
3. Orifice meter
4. Rotameter
5. Weir
6. Open drum with orifice
7. Pipes and fittings
8. Helical and spiral coils
9. Centrifugal pump
10. Packed column
11. Fluidized bed

*Minimum 10 experiments shall be offered

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Identify and characterize of flow patterns and regimes

CO2: Calibrate flow measurement devices

CO3: Correlate the difference between fixed and fluidized bed columns and its application.

CO4: Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties

CO5: Compare the results of theoretical analytical models to the actual behavior of real fluid flows and draw sustainable conclusions

CO6: Work effectively as a team with commitment to the professional ethics among the peer group involved.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Identify and characterize of flow patterns and regimes	3	3	-	-	-	-	-	-	-	-	-	2	3	3	-
CO2	Calibrate flow measurement devices	-	3	3	3	-	-	-	-	-	-	-	2	3	3	-
CO3	Correlate the difference between fixed and fluidized bed columns and its application.	-	3	3	3	-	-	-	-	-	-	-	2	3	3	3
CO4	Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties	3	3	3	-	2	-	-	-	-	-	-	2	3	3	3
CO5	Compare the results of theoretical analytical models to the actual behavior of real fluid flows and draw sustainable conclusions	3	3	3	3	2	-	2	-	-	3	2	3	3	3	3
CO6	Work effectively as a team with commitment to the professional ethics among the peer group involved.	1	-	-	-	-	3	2	3	3	3	3	3	3	2	3
Overall CO		3	3	3	3	2	2	2	3	3	3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5412 **MECHANICAL OPERATIONS LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVE:

The course is aimed to

- Develop sound practical knowledge for students on different types of mechanical operations equipments.

LIST OF EXPERIMENTS*

1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Batch filtration studies using a Plate and Frame Filter press
4. Characteristics of batch Sedimentation
5. Reduction ratio in Jaw Crusher
6. Reduction ratio in Ball mill
7. Separation characteristics of Cyclone separator
8. Reduction ratio of Roll Crusher
9. Separation characterics of Elutraitor
10. Reduction ratio of Drop weight crusher
11. Size separation using Sub-Sieving

EQUIPMENTS REQUIRED

1. Sieve shaker
2. Leaf filter
3. Plate and Frame Filter Press
4. Sedimentation Jar
5. Jaw Crusher
6. Ball Mill
7. Cyclone Separator
8. Roll Crusher
9. Elutriator
10. Drop Weight Crusher
11. Sieves.

*Minimum 10 experiments shall be offered

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Determine the size analysis in solid- solid separation systems
CO2: Capability to select different solid - fluid separation equipments.
CO3: Evaluate the size reduction and various crushing parameters
CO4: Estimate the separation characteristics
CO5: Understand the technical methods related to unit operations in process plant
CO6: Apply and understand fluid particle systems and equipment

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Determine the size analysis in solid- solid separation systems	3	3	2	2	1	3	3	1	3	2	1	2	3	2	1
CO2	Capability to select different solid - fluid separation equipments.	3	3	2	3	1	2	3	2	2	1	2	1	3	3	2
CO3	Evaluate the size reduction and various crushing parameters	3	3	2	2	1	2	2	1	2	1	1	1	3	2	1
CO4	Estimate the separation characteristics	3	2	2	1	1	1	1	1	2	2	2	2	3	2	1
CO5	Understand the technical methods related to unit operations in process plant	3	3	2	3	3	2	3	3	3	3	2	3	3	3	2
CO6	Apply and understand fluid particle systems and equipment	2	3	2	2	3	2	2	3	2	2	2	2	2	3	2
Overall CO		3	3	2	2	2	2	3	2	3	2	2	2	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectivel

SEMESTER V

MG5451 PRINCIPLES OF MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers-managerial roles and skills – Evolution of Management –Scientific, human relations , system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT IV CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling .
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓					✓			✓	✓	✓	
CO2						✓			✓		✓	
CO3						✓			✓		✓	
CO4						✓			✓		✓	
CO5						✓			✓		✓	

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, “ Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and MamataMohapatra, “ Management”, Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999

CH5501	CHEMICAL ENGINEERING THERMODYNAMICS II	L	T	P	C
OBJECTIVE:		**2**	**1**	**0**	**3**

The course is aimed to

- Understand the phase Behavior of fluids under different PVT conditions and apply them for practical purposes. The course will render a comprehensive understanding of theory and application of solution thermodynamics.

UNIT I SOLUTION THERMODYNAMICS 6

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures, pure species and liquids.

UNIT II PHASE EQUILIBRIA 12

Phase equilibrium in ideal solution, excess Gibbs free energy models, Henry's law, fugacity, Phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.

UNIT III CORRELATION AND PREDICTION OF PHASE EQUILIBRIA 12

Vapor-Liquid Equilibrium at low, moderate and high pressures; bubble and dew point calculation, thermodynamic consistency test of VLE data

UNIT IV CHEMICAL REACTION EQUILIBRIA 9

Chemical Reaction Equilibrium of single and multiple reactions, Standard Gibbs free change, equilibrium constant-effect of temperature; homogeneous gas and liquid phase reactions.

UNIT V REFRIGERATION 6

Principles of refrigeration, methods of producing refrigeration, liquefaction process, coefficient of performance, Evaluation and performance of vapor compression and gas refrigeration cycles.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the systematic development of new class of properties to describe real mixtures

CO2: Develop the idea of chemical potential to derive the idea of phase equilibria

CO3: Understand the relationship connecting T, P and composition originating from the concept of chemical potential and fugacity coefficient

CO4: Understand the principle of chemical reaction thermodynamics for the prediction of equilibrium conversion.

CO5: Understand the concept of equilibrium between combination of two co existing phases other than liquid and vapor

CO6: Derive the relationship that connects the composition of two co existing phases as function of temperature and pressure.

CO7: Analyze the ideal and actual vapor-compression refrigeration cycle and Evaluate the performance of innovative vapor compression refrigeration systems

TEXT BOOKS:

1. Smith J.M., Van Ness, H.C., &Abbot M.C," Introduction to Chemical Engineering thermodynamics", McGraw Hill VII Edition 2004
2. Kyle B.G.," Chemical and Process Thermodynamics", Pearson International third Edition 1999.
3. Rao Y.V.C.," Chemical Engineering Thermodynamics" Universities Press,2005

REFERENCES

1. Sandler,S.I.,"Chemical and Engineering Thermodynamics", II Edition,Wiley,1989.
2. Narayanan K.V"A Text Book of Chemical Engineering Thermodynamics"Prentice Hall of India Pvt.Ltd.2001

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	Understand the systematic development of new class of properties to describe real mixtures	3	3	3	3	3	-	-	-	-	-	-	3	3	3	-
CO2	Develop the idea of chemical potential to derive the idea of phase equilibria	3	3	3	3	2	-	-	-	-	-	-	3	3	3	-
CO3	Understand the relationship connecting T, P and composition originating from the concept of chemical potential and fugacity coefficient	3	3	3	2	3	-	-	-	-	-	-	3	3	3	-
CO4	Understand the principle of chemical reaction thermodynamics for the prediction of equilibrium conversion.	3	3	3	3	3	-	-	-	-	-	- -	3	3	3	-
CO5	Understand the concept of equilibrium between combination of two co existing phases other than liquid and vapor	3	3	3	3	3	-	-	-	-	-	-	3	3	3	-
CO6	Derive the relationship that connect the composition of two co existing phases as function of temperature and pressure.	3	3	3	2	3	-	-	-	-	-	-	3	3	3	-
CO7	Analyze the ideal and actual vapor-compression refrigeration cycle and Evaluate the performance of innovative vapor compression refrigeration systems	3	3	3	3	3	-	-	-	-	-	-	3	3	3	
Overall CO		3	3	3	3	3	-	-	-	-	-	-	3	3	3	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial High) respectively

CH5502 **MASS TRANSFER I**

L	T	P	C
2	1	0	3

OBJECTIVE:

The course is aimed to

- Learn and determine mass transfer rates under laminar and turbulent conditions and apply these concepts in the design of humidification columns, dryers and crystallisers.

UNIT I MOLECULAR DIFFUSION **9**

Introduction to mass transfer operations. Molecular diffusion in gases, liquids and solids. Diffusivity measurement and prediction; multi-component diffusion.

UNIT II CONVECTIVE TRANSFER AND INTERPHASE MASS TRANSFER **9**

Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.

UNIT III HUMIDIFICATION OPERATIONS **9**

Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT IV DRYING **9**

Drying – Equilibrium. Classification of dryers, batch drying – Mechanism and time of cross through circulation drying, theoretical estimation of drying rate and time. Continuous dryers – material and energy balance. Advance drying techniques such as freeze drying, microwave drying

UNIT V CRYSTALLIZATION **9**

Crystal geometry. Equilibrium, yield and purity of products, theory of super saturation, nucleation and crystal growth, classification of crystallizers, design of batch crystallizers and continuous crystallizers.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamentals, types and mechanism of mass transfer operations

CO2: Understand the theories of mass transfer and the concept of inter-phase mass transfer

CO3: Understand the basics of humidification process and its application

CO4: Understand the concept and mechanism of drying operations

CO5: Understand the concept of crystallization process and identification of suitable crystallizer

CO6: Formulate and solve material balances for unit operations such as humidification, drying and crystallization operations.

TEXT BOOKS:

1. Treybal, R. E., “Mass Transfer Operations”, 3rd Edition, McGraw-Hill,1981.
2. Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice HallInc., NewJersey, 2003.
3. Narayanan K.V. and Lakshmikutty, B “Mass Transfer – Theory and Applications”, 1st Edition, CBS Publishers & Distributors Pvt Ltd, New Delhi, 2014.

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edition., McGraw-Hill, 2005.
2. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I and II, 4th Edition, Asian Books Pvt. Ltd., India, 1998.
3. Seader J.D. and Henley E.J., “Separation Process Principles”, 2nd Ed., John Wiley, 2006

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	Understand the fundamentals, types and mechanism of mass transfer operations	3	3	3	-	-	-	-	-	-	-	-	3	1	-	-
CO2	Understand the theories of mass transfer and the concept of inter-phase mass transfer	3	3	3	-	-	-	-	-	-	-	-	3	1	-	-
CO3	Understand the basics of humidification process and its application	3	3	3	-	-	-	-	-	-	-	-	3	1	-	-
CO4	Understand the concept and mechanism of drying operations	3	3	3	-	-	1	1	1	-	-	- -	3	1	1	-
CO5	Understand the concept of crystallization process and identification of suitable crystallizer	3	3	3	-	-	1	-	1	-	-	-	3	1	1	-
CO6	Formulate and solve material balances for unit operations such as humidification, drying and crystallization operations.	3	3	3	-	-	1	1	1	-	-	-	3	1	-	-
Overall CO		3	3	3	-	-	1	1	1	-	-	-	3	2	1	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5503 **CHEMICAL REACTION ENGINEERING I**

	L	T	P	C
OBJECTIVE:	**2**	**1**	**0**	**3**

The course is aimed to

- Learn reaction kinetics, types of reactors, design of reactors, understand the isothermal, non-isothermal operation of reactors and gain knowledge about non ideal reactors.

UNIT I **9**

Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis. Half-life calculation.

UNIT II **9**

Ideal reactor classification. Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, combination of reactors, and size comparison of reactors.

UNIT III **9**

Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.

UNIT IV **9**

Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.

UNIT V **9**

The residence time distribution for chemical reactors, residence time functions and relationship between them in reactor; Models for non-ideal reactors, conversion in non-ideal reactors.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the kinetics of homogenous reaction.

CO2: Develop performance equation and determine the conversion for different reactors.

CO3: Understand the reactor arrangement in series and parallel configuration.

CO4: Understand the design of reactor for multiple reactions.

CO5: Understand the non-isotherm operation of the reactor

CO6: Understand the residence time distribution function and analyze the non-ideality in the reactor.

TEXT BOOKS:

1. O. Levenspiel, Chemical Reaction Engineering , Third Edition, John Wiley 1999
2. H.S. Fogler, Elements of Chemical Reaction Engineering, Third Edition, Prentice Hall of India, 1999
3. Lanny D. Schmidth The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2005

REFERENCES:

1. L.K Doraiswamy, DenizUner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press , 2014
2. G.Fronment, K.B.Bischoff Chemical Reactor Analysis and Design , John Wiley and Sons, 1979
3. J.M.Smith Chemical Engineering Kinetics, Third Edition, Mc Graw Hill New York 1981

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO 1	PSO2	PSO3
CO1	Understand the kinetics of homogenous reaction.	3	3	3	2	2	-	-	-	-	-	-	-	3	3	-
CO2	Develop performance equation and determine the conversion for different reactors.	3	3	3	2	2	-	-	-	-	-	-	-	3	3	-
CO3	Understand the reactor arrangement in series and parallel configuration.	3	3	3	2	-	1	1	-	-	-	-	-	3	3	-
CO4	Understand the design of reactor for multiple reactions.	3	3	3	2	2	1	1	-	-	-	-	-	3	3	-
CO5	Understand the non-isotherm operation of the reactor	3	2	3	2	2	1	1	-	-	-	-	-	3	3	-
CO6	Understand the residence time distribution function and analyze the non-ideality in the reactor.	3	3	3	2	2	2	2	-	-	-	-	-	3	3	-
Overall CO		3	3	3	2	2	2	2	-	-	-	-	-	3	3	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5511 **HEAT TRANSFER LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVE:

The course is aimed to

- Develop sound practical knowledge for students on different types of heat transfer equipments

LIST OF EXPERIMENTS*

1. Measurement of Thermal Conductivity of metal rod
2. Performance studies on Cooling Tower
3. Batch drying kinetics using Tray Dryer
4. Heat transfer in Open Pan Evaporator
5. Boiling Heat Transfer
6. Heat Transfer through Packed Bed
7. Heat Transfer in a Double Pipe Heat Exchanger
8. Heat Transfer in a Bare and Finned Tube Heat Exchanger
9. Heat Transfer in a Vertical and Horizontal Condenser
10. Heat Transfer in Helical Coils
11. Heat Transfer in Agitated Vessels
12. Heat transfer studies in Stefan - Boltzmann apparatus

EQUIPMENTS REQUIRED

1. Thermal Conductivity Apparatus
2. Cooling Tower
3. Tray Dryer
4. Open Pan Evaporator
5. Packed Bed
6. Double Pipe Heat Exchanger
7. Bare and Finned Tube Heat Exchanger
8. Vertical and Horizontal Condenser
9. Agitated Vessels and Helical Coils
10. Stefan - Boltzmann apparatus

*Minimum 10 experiments shall be offered.

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipments.

CO2: Estimate the heat transfer rate and heat transfer co-efficient

CO3: To perform heat transfer operation and to compare observed with predicted performance.

CO4: Evaluate the performance/calculate the parameters in heat transfer equipments.

CO5: Collect and analyse the heat transfer data practically.

CO6: Conduct experiments to solve complex engineering problems effectively as an individual as well as team work

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipments.	3	3	3	3	2	1	1	1	2	3	2	2	3	3	-
CO2	Estimate the heat transfer rate and heat transfer co-efficient	3	3	3	2	2	1	1	1	2	3	2	2	3	3	-
CO3	To perform heat transfer operation and to compare observed with predicted performance.	3	3	3	2	2	1	1	1	2	3	2	2	3	3	-
CO4	Evaluate the performance/calculate the parameters in heat transfer equipments.	3	3	3	2	2	1	1	1	2	3	2	2	3	3	-
CO5	Collect and analyse the heat transfer data practically.	3	3	3	3	2	1	1	1	2	3	2	2	3	3	-
CO6	Conduct experiments to solve complex engineering problems effectively as an individual as well as team work	3	3	3	3	2	1	1	1	2	3	2	2	3	3	-
Overall CO		3	3	3	3	2	1	1	1	2	3	2	2	3	3	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5512 COMPUTATIONAL CHEMICAL ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

The course is aimed to

- Solve chemical engineering problems form core courses using Excel, Matlab, Polymath and process simulation using Aspen Plus.

MICROSOFT EXCEL SOFTWARE

Excel used to solve chemical engineering problems. Use goal seek, regression, solver to solve the problem. Solve differential equation using RengaKutta method, matrix methods.

POLYMATH

Solving simultaneous equation and differential equation using Polymath. Specific examples with Chemical Reaction Engineering problems , Process control problem.

MATLAB

Solving chemical engineering Problem using Matlab. Simultaneous equation, Differential equation and Partial differential Equation. Simulink tool for chemical process and process control.

ASPEN SOFTWARE

Simulation of simple unit operations equipments Distillation, extraction and absorption. Reactors simulation. Simulation of simple process flow sheets.

Evaluation

This Lab course will have two or three online assessment tests and an online end semester examination in Process simulation laboratory and assignments in all the above four units.

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Solving chemical engineering problems using different tools available in the excel software.
CO2: Solving simultaneous equation and differential equation using polymath
CO3: Solving simultaneous equation and differential equation using Matlab
CO4: Simulation of simple chemical process with controller using simulink tool
CO5: Estimation of fluid property and understand the unit operation simulation using Aspen Plus
CO6: Dynamic simulation of chemical process using aspen plus

TEXT BOOKS

1. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.
2. Michael B. Cutlip, Mordechai ShachamProblem Solving in Chemical and Biochemical Engineering with POLYMATH, Excel, and MATLAB, 2nd Edition, Prentice Hall, 2008

REFERENCES

1. Pradeep Ahuja Introduction to Numerical Methods in Chemical Engineering PHI New delhi, 2010
2. Amiya K.Jana, Process Simulation and Control using Aspen , PHI New delhi, 2012
3. H.S. Fogler, Elements of Chemical Reaction Engineering, Third Edition, Prentice Hall of India, 1999

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Solving chemical engineering problems using different tools available in the excel software.	3	3	3	3	3	-	-	-	1	-	-	-	3	3	-
CO2	Solving simultaneous equation and differential equation using polymath	3	3	3	3	3	-	-	-	1	-	-	-	3	3	-
CO3	Solving simultaneous equation and differential equation using Matlab	3	3	3	3	3	-	1	-	1	-	-	-	3	3	-
CO4	Simulation of simple chemical process with controller using simulink tool	3	3	3	3	3	-	1	1	1	-	- -	- -	3	3	-
CO5	Estimation of fluid property and understand the unit operation simulation using Aspen Plus	3	2	3	3	3	-	1	1	1	-	-	-	3	3	-
CO6	Dynamic simulation of chemical process using aspen plus	3	3	3	3	3	-	2	-	1	-	-	-	3	3	-
Overall CO		3	3	3	3	3	-	2	1	1	-	-	-	3	3	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

SEMESTER VI

CH5601 CHEMICAL REACTION ENGINEERING II

	L	T	P	C
OBJECTIVE:	**2**	**1**	**0**	**3**

The course is aimed to

- Learn gas solid non catalytic, gas solid catalytic and fluid- fluid reaction and apply the knowledge for the reactor design.

UNIT I **9**

Gas solid non catalytic reaction. Reaction kinetics, Shrinking Core Model and Progressive conversion model, Controlling resistances (diffusion through gas film, ash layer and chemical reaction controlling), rate controlling steps; time for Complete Conversion for Single and Mixed Sizes, design of fluid –particle reactors.

UNIT II **9**

Catalysis and adsorption: physical properties of catalyst, surface area, void volume, solid density, volume determination, catalyst classification and preparation, catalyst promoters, catalyst inhibitors, catalyst poisons. Adsorption Isotherms Freundlich and Langumir isotherms.

UNIT III **9**

Gas solid catalytic reaction: steps in catalytic reaction, Single site, dual site mechanisms, Langmuir Hinshelwood, EleyRideal, Rate controlling steps. Experimental methods for determining rate, differential , integral reactor and reactor deign.

UNIT IV **9**

Diffusion Within Catalyst Particle, Mass and Heat Transfer Within Catalyst Pellets, Effectiveness Factor, Thiele Modulus, Effectiveness factor for non isothermal condition.

UNIT V **9**

Fluid Fluid reaction. Kinetics and design of Fluid- Fluid Reactions. Rate equation, Kinetic regimes for absorption combined with chemical reaction. Various cases of mass transfer with chemical reaction , Factors to select the contactor, Tower Reactor Design.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the gas solid non catalytic reaction and different models for non catalytic reaction.

CO2: Understand catalyst, catalyst preparation, property estimation and isotherm study.

CO3: Understand the gas solid catalytic reaction and their mechanism

CO4: Design of catalytic reactor for gas solid reaction.

CO5: Understand the concepts of effectiveness factor, Thiele modulus.

CO6: Understand the concept of Mass Transfer and Mass transfer with reaction for fluid fluid reaction and tower design.

TEXT BOOKS:

1. J.M.Smith Chemical Engineering Kinetics, Third Edition, Mc Graw Hill New York 1981
2. O. Levenspiel, Chemical Reaction Engineering , Third Edition, John Wiley 1999
   H.S. Fogler, Elements of Chemical Reaction Engineering, Third Edition, Prentice Hall of India, 1999

REFERENCES:

1. Lanny D. Schmidt The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2005
2. L.K Doraiswamy, DenizUner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press , 2014
3. G.F. Froment, K.B.Bischoff Chemical Reactor Analysis and Design , John Wiley and Sons, 1979

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO 1	PSO2	PSO3
CO1	Understand the gas solid non catalytic reaction and different models for non catalytic reaction.	3	3	3	2	-	-	2	-	-	-	-	3	3	3	-
CO2	Understand catalyst, catalyst preparation, property estimation and isotherm study.	3	1	3	2	2	-	-	-	-	-	-	3	3	3	-
CO3	Understand the gas solid catalytic reaction and their mechanism	3	3	3	2	-	1	1	-	-	-	-	3	3	3	-
CO4	Design of catalytic reactor for gas solid reaction.	3	3	3	2	2	2	1	-	-	-	- -	3	3	3	-
CO5	Understand the concepts of effectiveness factor, Thiele modulus.	3	2	3	2	-	1	1	-	-	-	-	3	3	3	-
CO6	Understand the concept of Mass Transfer and Mass transfer with reaction for fluid fluid reaction and tower design.	3	3	3	2	2	2	2	-	-	-	-	3	3	3	-
Overall CO		3	3	3	3	2	2	2	-	-	-	-	3	3	3	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5602 **MASS TRANSFER II**

L	T	P	C
2	1	0	3

OBJECTIVE:

The course is aimed to

- Impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit their properties according to the changed environment. Also, to design absorber and stripper, distillation column, extraction and leaching equipment and adsorber.

UNIT I ABSORPTION **9**

Equilibrium and operating line concept in absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stage wise and differential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients; multicomponent absorption; mechanism and model of absorption with chemical reaction; thermal effects in absorption process.

UNIT II DISTILLATION **9**

Vapour liquid equilibria - Raoult's law, vapor-liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method and Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. Introduction to multi-component distillation, azeotropic and extractive distillation

UNIT III LIQUID-LIQUID EXTRACTION **9**

Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for batch and continuous extractors- differential contact equipment-spray, packed and mechanically agitated contactors and their design calculations-packed bed extraction with reflux. Pulsed extractors, centrifugal extractors-Supercritical extraction

UNIT IV LEACHING **9**

Solid-liquid equilibria- leaching equipment for batch and continuous operations, calculation of number of stages - Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments for leaching operation, multi stage continuous cross current and countercurrent leaching, stage calculations, stage efficiency.

UNIT V ADSORPTION, ION EXCHANGE AND MEMBRANE SEPARATION PROCESSES **9**

Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, steady state moving bed and unsteady state fixed bed adsorbers, break through curves. Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand concept and determine the theoretical stages, number of transfer units and height requirements for a gas absorption process

CO2: Identify the suitable distillation techniques, determine the number of trays for stage wise contact and determine the height of the packed tower.

CO3: Apply the ternary equilibrium diagram concepts to determine the number of stages required for separation of liquid-liquid extraction process.

CO4: Describe core principles of leaching, setting up mass balances, use graphical methods to estimate the number of ideal stages in leaching operation.

CO5: Understand the concept of adsorption techniques, various isotherms and ion exchange process.

CO6: Formulate and solve mass and energy balances for unit operations such as absorption, distillation, extraction, leaching, adsorption and other separation processes.

TEXT BOOKS:

1. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.
2. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.
3. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition, McGraw-Hill, 2005.
2. Seader J.D. and Henley E.J., "Separation Process Principles", 2nd Ed., John Wiley, 2006.
3. King,C.J.,"SeparationProcesses",2ndEdn.,TataMcGraw-Hill1980

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Understand concept and determine the theoretical stages, number of transfer units and height requirements for a gas absorption process	3	2	2	-	-	1	1	1	-	1	-	3	3	2	2
CO2	Identify the suitable distillation techniques, determine the number of trays for stage wise contact and determine the height of the packed tower.	3	3	3	-	-	1	1	1	-	1	-	3	3	2	2
CO3	Apply the ternary equilibrium diagram concepts to determine the number of stages required for separation of liquid-liquid extraction process.	3	3	3	-	-	1	1	1	-	1	-	3	3	2	2
CO4	Describe core principles of leaching, setting up mass balances, use graphical methods to estimate the number of ideal stages in leaching operation.	3	3	1	-	-	1	1	1	-	1	-	3	3	2	2
CO5	Understand the concept of adsorption techniques, various isotherms and ion exchange process.	3	2	1	-	-	1	1	1	-	1	-	3	3	2	2
CO6	Formulate and solve mass and energy balances for unit operations such as absorption, distillation, extraction, leaching, adsorption and other separation processes.	3	3	1	-	-	1	1	1	-	1	-	3	3	2	2
Overall CO		3	3	2	-	-	1	1	1	-	1	-	3	3	2	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5603 **PROCESS DYNAMICS AND CONTROL**

L	T	P	C
2	1	0	3

OBJECTIVE:

The course is aimed to

- Determine possible control objectives, input variables (manipulated variables and disturbances), model the dynamic behavior of a process, design PID controllers, frequency response and analyze stability of closed loop and open loop systems.

UNIT I **9**

Introduction to Chemical Process Control, Mathematical description of chemical processes, Formulating Process Models, Laplace Transforms, Properties of Laplace Transforms, Solution of ODE using Laplace Transforms, Standard input forcing functions, State – Space representation, transform domain models, Impulse response models, Inter relationship between process model forms

UNIT II **9**

Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag, FOPDT Model, Skogestaad's rule for FOPDT and SOPDT, Lead-Lag systems

UNIT III **9**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, control valves, transient response of closed-loop control systems and their stability, Root locus diagram.

UNIT IV **9**

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings, Nyquist Stability Criterion

UNIT V **9**

Introduction to advanced control systems, cascade control, feed forward control, Controllers for Inverse response Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the need to develop mathematical description of a chemical process as a prerequisite to process design and to control the process.

CO2: Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.

CO3: Represent a physical system using FOPDT model and estimate parameters in FOPDT model.

CO4: Convert a process and instrumentation diagram to a control block diagram

CO5: Understand Frequency response of control systems and tune the PID controllers

CO6: Appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feed forward, Dead time compensation.

TEXT BOOKS:

1. Stephanopoulos, G. (1984). *Chemical process control* (Vol. 2). New Jersey: Prentice hall.
2. Ogunnaike, B. A., & Ray, W. H. (1994). *Process dynamics, modeling, and control* (Vol. 1). New York: Oxford University Press.
3. Coughanowr, D. R., & Leblanc, S. E. (2008). Introductory concepts. *Process Systems* Analysis and Control*, 3rd Ed*, 1-6.

REFERENCES:

1. Seborg, D. E., Mellichamp, D. A., Edgar, T. F., & Doyle III, F. J. (2010). Process dynamics and control. John Wiley & Sons.
2. Bequette, B. W. (2003). Process control: modeling, design, and simulation. Prentice Hall Professional.
3. Riggs, J. B., & Karim, M. N. (2006). Chemical and Bio-process Control: James B. Riggs, M. Nazmul Karim. Prentice Hall.
4. Luyben, W. L., Tyréus, B. D., &Luyben, M. L. (1998). Plantwide process control (Vol. 43). New York: McGraw-Hill.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understand the need to develop mathematical description of a chemical process as a prerequisite to process design and to control the process.	3	3	3	2	2	3	3	-	2	2	2	2	3	3	2
CO2	Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.	3	3	3	2	2	3	3	-	-	-	2	2	3	3	-
CO3	Represent a physical system using FOPDT model and estimate parameters in FOPDT model.	3	3	3	2	2	-	-	-	-	-	2	2	3	3	-
CO4	Convert a process and instrumentation diagram to a control block diagram	3	3	3	2	2	-	-	-	-	-	2	2	3	3	-
CO5	Understand Frequency response of control systems and tune the PID controllers	3	3	3	2	2	2	-	-	-	-	2	2	3	3	-
CO6	Appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feed forward,Dead time compensation.	3	3	3	2	2	2	-	-	2	2	2	2	3	3	-
Overall CO		3	3	3	3	3	2	2	3	-	2	2	2	2	3	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5611 PROCESS CONTROL LABORATORY FOR CHEMICAL ENGINEERS

	L	T	P	C
OBJECTIVE:	**0**	**0**	**4**	**2**

The course is aimed to

- Gain the hands-on training about the control systems

LIST OF EXPERIMENTS*

1. Response of first order system
2. Response of second order system
3. Response of Non-Interacting level System
4. Response of Interacting level System
5. Open loop study on a level system
6. Open loop study on a flow system
7. Open loop study on a thermal system
8. Closed loop study on a level system
9. Closed loop study on a flow system
10. Closed loop study on a thermal system
11. Tuning of a level system
12. Tuning of a flow system
13. Tuning of a thermal system
14. Flow co-efficient of control valves
13. Characteristics of different types of control valves

EQUIPMENTS REQUIRED

1. Thermometer and Thermo well setup
2. U tube manometer (mercury and water) setup
3. Non- interacting System
4. Interacting System
5. Closed loop Level system
6. Closed loop flow system
7. Closed loop thermal system
8. Control valve setup

*Minimum 10 experiments shall be offered.

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Able to determine the response of a first order and second order system for various input

CO2: Able to determine the response of an interacting and non- interacting system for various input

CO3: Understand the difference between an open loop and closed loop system

CO4: Understand the concept of three classical controller P, PI, PID controller

CO5: Understand the concept of stability and tuning of a system

CO6: Understand about the different type of control valves

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO 1	PSO2	PSO3
CO1	Able to determine the response of a first order and second order system for various input	3	3	2	3	3	2	1	1	1	1	1	1	2	3	1
CO2	Able to determine the response of a interacting and non- interacting system for various input	3	3	2	3	3	2	1	1	1	1	1	1	2	3	1
CO3	Understand the difference between an open loop and closed loop system	3	3	2	3	3	2	1	1	1	1	1	1	2	3	1
CO4	Understand the concept of three classical controller P, PI, PID controller	3	3	2	3	3	2	1	1	1	1	1	1	2	3	1
CO5	Understand the concept of stability and tuning of a system	3	3	2	3	3	2	1	1	1	1	1	1	2	3	1
CO6	Understand about the different type of control valves	2	2	2	3	2	2	1	1	1	1	1	1	2	3	1
Overall CO		3	3	2	3	3	2	1	1	1	1	1	1	2	3	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5612 **MASS TRANSFER LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVE:

The course is aimed to

- Develop sound practical knowledge for students on different types of mass transfer equipments

LIST OF EXPERIMENTS*

1. Separation of binary mixture using Simple distillation
2. Separation of binary mixture using Steam distillation
3. Separation of binary mixture using Packed column distillation
4. Measurement of diffusivity
5. Liquid-liquid extraction
6. Drying characteristics of forced draft dryer
7. Adsorption studies
8. Cross current leaching studies
9. Surface evaporation
10. Wetted wall column
11. Solid Liquid mass transfer studies
12. Water purification using ion exchange columns
13. Mass transfer characteristics of Rotating disc contactor
14. Estimation of mass/heat transfer coefficient for cooling tower
15. Demonstration of Gas – Liquid absorption

EQUIPMENTS REQUIRED

1. Simple distillation setup
2. Steam distillation setup
3. Packed column
4. Liquid-liquid extractor
5. Forced draft dryer
6. Wetted wall column
7. Rotating disc contactor
8. Cooling tower
9. Absorption column

*Minimum 10 experiments shall be offered.

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Determine the diffusivity practically and compare the results with the empirical correlations.
CO2: Estimate the mass transfer rate and mass transfer co-efficient
CO3: Evaluate the performance/calculate the parameters in different distillation processes
CO4: Evaluate the performance/calculate the parameters in leaching and extraction operations
CO5: Estimate the drying characteristics
CO6: Collect and analyse the mass transfer data practically

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Determine the diffusivity practically and compare the results with the empirical correlations.	3	3	-	3	-	-	-	-	2	-	-	2	3	3	-
CO2	Estimate the mass transfer rate and mass transfer co-efficient	3	3	-	2	-	-	-	-	2	-	-	2	3	3	-
CO3	Evaluate the performance/calculate the parameters in different distillation processes	3	3	-	2	-	-	-	-	2	-	-	2	3	3	-
CO4	Evaluate the performance/calculate the parameters in leaching and extraction operations	3	3	-	2	-	-	-	-	2	-	-	2	3	3	-
CO5	Estimate the drying characteristics	3	3	-	3	-	-	-	-	2	-	-	2	3	3	-
CO6	Collect and analyse the mass transfer data practically	3	3	-	3	-		-	-	2	-	-	2	3	3	-
Overall CO		3	3	-	3	-	-	-	-	2	-	-	2	3	3	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

SEMESTER VII

CH5751 TRANSPORT PHENOMENA

	L	T	P	C
OBJECTIVE:	**3**	**1**	**0**	**4**

The course is aimed to

- Describe mass, momentum and energy transport at molecular, microscopic and macroscopic level to determine velocity, temperature and concentration profiles.

UNIT I MOMENTUM TRANSPORT 12

Viscosity, temperature and pressure effect on viscosity of gases and liquids, Newton's law, mechanism of momentum transport, shell momentum balance method, Shear stress and velocity distributions in falling film, circular tube, annulus, slit.

UNIT II ENERGY TRANSPORT 12

Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance method, Energy flux and temperature distribution in solids and laminar flow with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.

UNIT III MASS TRANSPORT 12

Diffusivity, temperature and pressure effect on diffusivity, Fick's law, mechanism of mass transport, shell mass balance method, Mass flux and concentration distribution in solids and in laminar flow: stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst.

UNIT IV EQUATIONS OF CHANGE AND THEIR APPLICATIONS 12

Momentum: Equations of continuity, motion and mechanical energy (Isothermal), Energy: Equation of energy (non-isothermal). Mass: Equations of change (multi-component), equations of continuity for each species, equation of energy (multi-component). Solutions of momentum, heat and mass transfer problems discussed under shell balance by applications of equation of change, dimensional analysis of equations of change.

UNIT V TRANSPORT IN TURBULENT FLOWS AND ANALOGIES 12

Comparison of laminar and turbulent flows, time-smoothed equations of change, empirical expressions. Comparison of laminar and turbulent hydrodynamics, thermal and concentration boundary layer and their thicknesses. Development and applications of analogies between momentum, heat and mass transfer.

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the mechanisms of momentum, heat and mass transfer each at molecular, micro and macro levels.

CO2: Develop mathematical models to determine transfer fluxes and velocity, temperature and concentration distribution for flow channels, heat sources and systems involving diffusion and reactions.

CO3: Determine the interrelationship between the molecular, microscopic and macroscopic descriptions of transport processes and compare the various coordinate systems to formulate equations of change.

CO4: Apply the equation of change for different coordinate systems and solve of momentum, mass and heat transport problems.

CO5: Apply the concepts of dimensional analysis and scale factors for equation of change for

different coordinate systems.

CO6: Analyze the analogy between the transports and understand the turbulence and boundary layer concept in heat and mass transport.

TEXT BOOKS:

1. Bird, R. B., Stewart, W. E. and Lighfoot, E. W., “Transport Phenomena”, 2nd Edn., John Wiley, 2002
2. Brodkey, R. S., and Hershey, H. C., “Transport Phenomena”, McGraw-Hill, 1988

REFERENCES:

1. Welty, J. R., Wilson, R. W., and Wicks, C. W., “Fundamentals of Momentum Heat and Mass Transfer”, 3rd Edition. John Wiley, New York, 1984.
2. Slattery, J. S., “Advanced Transport Phenomena”, Cambridge University Press, London, 1999.
3. C. J. Geankopolis, "Transport Processes in Chemical Operations", 3rd Edn., Prentice Hall of India, New Delhi, 1996.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Understand the mechanisms of momentum, heat and mass transfer each at molecular, micro and macro levels.	3	2	1	-	-	-	-	-	-	-	-	1	3	3	-
CO2	Develop mathematical models to determine transfer fluxes and velocity, temperature and concentration distribution for flow channels, heat sources and systems involving diffusion and reactions.	3	3	3	2	2	-	-	-	1	-	-	1	3	3	-
CO3	Determine the interrelationship between the molecular, microscopic and macroscopic descriptions of transport processes and compare the various coordinate systems to formulate equations of change.	3	3	3	1	1	-	-	-	1	-	-	1	3	3	-
CO4	Apply the equation of change for different coordinate systems and solve of momentum, mass and heat transport problems.	3	3	3	2	1	-	-	-	1	-	-	1	3	3	-
CO5	Apply the concepts of dimensional analysis and scale factors for equation of change for different coordinate systems.	3	3	3	2	1	-	-	-	1	-	-	1	3	3	-
CO6	Analyze the analogy between the transports and understand the turbulence and boundary layer concept in heat and mass transport.	3	3	3	2	1	-	-	-	1	-	-	1	3	3	-
Overall CO		3	3	3	2	1	-	-	-	1	-	-	1	3	3	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5701 **PROCESS EQUIPMENT DESIGN**

L	T	P	C
1	2	0	3

OBJECTIVE:

The course is aimed to

- Obtain process and equipment design of the equipments that are used in process industries and to select appropriate equipment for the process and to adhere to standard specifications like BIS and ASTM.

UNIT I **9**

Double Pipe Heat Exchangers, Shell and Tube Heat Exchangers, Reboilers and Condensors.

UNIT II **9**

Cooling Towers, Dryers, Evaporators, Crystallizers

UNIT III **9**

Absorption Column, Distillation column, Extraction Column.

UNIT IV **9**

Packed Bed Reactors, Vertical and Horizontal Pressure Vessels, Storage vessels for solids, liquids and gases, Horton spheres.

UNIT V **9**

Design of Plant Layout, Process physical properties data and their sources (nomographs), BIS and ASTM standards & Codes, P & ID, Pipe Line design and piping layout, Pumps and their performance curves and selection, Materials of construction and selection of process equipments.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Design double pipe and shell and tube heat exchangers according to standards such as BIS, TEMA

CO2: Design Cooling towers and evaporators and design evaporators and crystallizer

CO3: Process and Equipment Design of separation equipments such as absorbers, distillation column, extractors

CO4: Calculate the design specifications of packed bed reactor and storage vessels, bins and silos

CO5: Determine sizes, materials, and capital and operating costs of equipment commonly used in the chemical processing industries

CO6: Design the essential elements of a chemical engineering process (equipment sizes, material & energy balances, economics, environmental, safety)

TEXT BOOKS:

1. Sinnott, R. K., &Towler, G. (2009). Chemical engineering design: SI Edition. Elsevier.
2. Sinnott, R. K. (1999). Coulson & Richardson's Chemical Enginering: Volume 6/Chemical Engineering Design. Elsevier Butterworth Heinemann.
3. Couper, J. R., Penney, W. R., & Fair, J. R. (2009). Chemical Process Equipment-Selection and Design (Revised 2nd Edition). Gulf Professional Publishing.

REFERENCES:

1. Kern, D. Q. (1950). *Process heat transfer*. Tata McGraw-Hill Education.
2. Hewitt, G. F., Shires, G. L., &Bott, T. R. (1994). *Process heat transfer* (Vol. 113). Boca Raton, FL: CRC press.
3. Treybal, R. E. (1980). Mass transfer operations. *New York*.
4. Froment, G. F., Bischoff, K. B., & De Wilde, J. (1990). *Chemical reactor analysis and design* (Vol. 2). New York: Wiley.
5. Moss, D. R. (2004). *Pressure vessel design manual*. Elsevier.
6. Crane, C. (1982). Flow of Fluids through Valves, Fittings, and Pipe. Technical Paper No. 410

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Design double pipe and shell and tube heat exchangers according to standards such as BIS, TEMA	3	3	3	2	2	3	3	-	2	2	2	2	3	3	2
CO2	Design Cooling towers and evaporators and design evaporators and crystallizer	3	3	3	2	2	3	3	-	-	-	2	2	3	3	-
CO3	Process and Equipment Design of separation equipments such as absorbers, distillation column, extractors	3	3	3	2	2	-	-	-	-	-	2	2	3	3	-
CO4	Calculate the design specifications of packed bed reactor and storage vessels, bins and silos	3	3	3	2	2	-	-	-	-	-	2	2	3	3	-
CO5	Determine sizes, materials, and capital and operating costs of equipment commonly used in the chemical processing industries	3	3	3	2	2	3	3	-	2	2	2	2	3	3	2
CO6	Design the essential elements of a chemical engineering process (equipment sizes, material & energy balances, economics, environmental, safety)	3	3	3	2	2	3	3	-	2	2	2	2	3	3	2
Overall CO		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

GE5451 TOTAL QUALITY MANAGEMENT

L T P C
3 0 0 3

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-Specific 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

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. Bester field,MaryB.Sacre,HemantUrdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.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.

CH5711 CHEMICAL REACTION ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

The course is aimed to

- Develop sound practical knowledge for students on different types of reactors.

LIST OF EXPERIMENTS*

1. Kinetic studies in a Batch reactor
2. Kinetic studies in a Plug flow reactor
3. Kinetic studies in a CSTR
4. Kinetic studies in a Packed bed reactor
5. Kinetic studies in a PFR followed by a CSTR
6. RTD studies in a PFR
7. RTD studies in a Packed bed reactor
8. RTD studies in a CSTR
9. Studies on micellar catalysis
10. Study of temperature dependence of rate constant using CSTR.
11. Kinetic studies in Sono chemical reactor
12. Studies on Cascade CSTR
13. Kinetics of photochemical reaction
14. Demonstration of heterogeneous catalytic reaction
15. Demonstration of gas-liquid reaction
16. Kinetics study in Adiabatic reactor
17. Determination of Activation Energy of a reaction
18. Kinetic study in semi batch reactor

EQUIPMENTS REQUIRED

1. Batch reactor
2. Plug flow reactor
3. Continuous Stirred Tank Reactor
4. Sono chemical reactor
5. Photo chemical reactor
6. Packed bed reactor

*Minimum 10 experiments shall be offered.

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Determine the rate constant experimentally in a batch reactor.
CO2: Determine the conversion of a reaction in different reactors (batch, CSTR, PFR)
CO3: Study of temperature dependence of rate constant.
CO4: Determine the non-ideal behaviour and residence time distribution in PFR and CSTR.
CO5: Determine the conversion of reactor arranged in series.
CO6: Determine the rate constant using sono and photo chemical reactors.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Determine the rate constant experimentally in a batch reactor.	3	3	3	3	2	1	1	1	2	3	2	2	3	3	-
CO2	Determine the conversion of a reaction in different reactors (batch, CSTR, PFR)	3	3	3	2	2	1	1	1	2	3	2	2	3	3	-
CO3	Study of temperature dependence of rate constant.	3	3	3	2	2	1	1	1	2	3	2	2	3	3	-
CO4	Determine the non-ideal behaviour and residence time distribution in PFR and CSTR.	3	3	3	2	2	1	1	1	2	3	2	2	3	3	-
CO5	Determine the conversion of reactor arranged in series.	3	3	3	3	2	1	1	1	2	3	2	2	3	3	-
CO6	Determine the rate constant using sono and photo chemical reactors.	3	3	3	3	2	1	1	1	2	3	2	2	3	3	-
Overall CO		3	3	3	3	2	1	1	1	2	3	2	2	3	3	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5712 **COMPREHENSION**

L	T	P	C
0	0	4	2

OBJECTIVE:

The course is aimed to

- Evaluate a student's competency and mastery of concepts in the field of Chemical Engineering.

The students will be evaluated in the following area of subjects

Process Calculation – Fluid Mechanics – Heat Transfer – Chemical Engineering Thermodynamics – Mechanical Operations – Chemical Technology – Mass Transfer – Chemical Reaction Engineering – Process Dynamics and Control – Transport Phenomena

TOTAL: 60 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand various unit operations and unit processes and their role in a engineering industry

CO2: Acquire knowledge on fluid properties and performance characteristics of fluid machineries

CO3: Understand the fundamental concepts of heat and mass transfer and their applications.

CO4: Learn about thermodynamic property relations and their application to fluid flow.

CO5: Learn reaction kinetics, design and operation of reactors

CO6: Make an original contribution in their area of research in the dissertation phase.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understand various unit operations and unit processes and their role in a engineering industry	3	-	3	1	-	-	-	-	-	-	1	3	2	3	2
CO2	Acquire knowledge on fluid properties and performance characteristics of fluid machineries	3	-	3	1	-	-	-	-	-	-	1	2	3	3	2
CO3	Understand the fundamental concepts of heat and mass transfer and their applications.	3	1	1	2	-	-	-	-	-	-	2	3	3	2	1
CO4	Learn about thermodynamic property relations and their application to fluid flow.	2	-	2	1	2	-	-	-	-	-	2	2	3	3	-
CO5	Learn reaction kinetics, design and operation of reactors	2	1	2	2	1	-	-	-	-	1	2	3	2	3	-
CO6	Make an original contribution in their area of research in the dissertation phase.	2	-	2	2	1	-	-	-	-	1	1	3	3	2	1
Overall CO		3	1	3	2	1	-	-	-	-	-1	2	3	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5713 **INTERNSHIP/ INDUSTRIAL TRAINING**

L	T	P	C
0	0	0	2

OBJECTIVE:

The course is aimed to

- Make use of the knowledge gained by the student at various stages of the degree course in industries to acquire the practical knowledge and experience.

OUTCOMES:

On the completion of the course students are expected to

CO1: Provides real work experience
CO2: Opportunity to explore students' interest
CO3: Students will be able to integrate classroom knowledge and theory with practical application
CO4: Provides a nice learning curve for students with little experience
CO5: Develops professional skills and competencies
CO6: Assists in building up the career of students

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Provides real work experience	3	2	2	2	1	1	1	2	2	2	2	1	3	2	1
CO2	Opportunity to explore students' interest	3	2	2	2	2	-	-	1	2	2	1	2	2	2	1
CO3	Students will be able to integrate classroom knowledge and theory with practical application	3	2	2	2	2	1	1	-	-	-	1	1	1	1	1
CO4	Provides a nice learning curve for students with little experience	3	1	1	2	2	1	1	1	2	2	1	2	2	2	1
CO5	Develops professional skills and competencies	3	1	1	2	2	1	1	-	1	2	1	1	3	3	1
CO6	Assists in building up the career of students	3	1	1	2	2	1	1	-	1	2	1	3	3	3	1
Overall CO		3	2	2	2	2	1	1	1	2	2	1	2	3	3	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5714 **PROJECT – I**

L	T	P	C
0	0	6	3

OBJECTIVE:

The course is aimed to

- Make use of the knowledge gained by the student at various stages of the degree course.

OUTCOMES:

On the completion of the course students are expected to

CO1: Apply the fundamental concept learnt during the theory courses to solve industrial problems

CO2: Review the current status based on the information available in the literature or data obtained in the laboratory/ industry

CO3: Carry out material and energy balance for process calculations

CO4: Design equipment for chemical process industries

CO5: Evaluate the economics of a process through cost estimation

CO6: Identify industrial problem, design process to carry out the process in an economically feasible way

TOTAL: 90 PERIODS

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Apply the fundamental concept learnt during the theory courses to solve industrial problems	3	3	2	2	3	3	3	3	3	3	2	2	2	2	2
CO2	Review the current status based on the information available in the literature or data obtained in the laboratory/ industry	2	2	3	3	3	2	3	2	3	3	3	3	2	2	3
CO3	Carry out material and energy balance for process calculations	3	3	3	2	3	3	2	3	3	2	3	3	3	3	3
CO4	Design equipment for chemical process industries	3	3	3	3	3	2	2	3	3	3	2	2	3	3	3
CO5	Evaluate the economics of a process through cost estimation	3	3	3	3	3	3	3	3	2	2	3	3	2	3	3
CO6	Identify industrial problem, design process to carry out the process in an economically feasible way	2	2	3	2	2	2	2	2	2	3	2	3	3	3	3
Overall CO			3	3	3	3	3	3	3	3	3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5811 **PROJECT – II**

	L	T	P	C
OBJECTIVE:	**0**	**0**	**16**	**8**

The course is aimed to

- Make use of the knowledge gained by the student at various stages of the degree course.

OUTCOMES:

On the completion of the course students are expected to

CO1: Apply the fundamental concept learnt during the theory courses to solve industrial problems

CO2: Review the current status based on the information available in the literature or data obtained in the laboratory/ industry

CO3: Carry out material and energy balance for process calculations

CO4: Design equipment for chemical process industries

CO5: Evaluate the economics of a process through cost estimation

CO6: Identify industrial problem, design process to carry out the process in an economically feasible way

TOTAL: 240 PERIODS

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO7	Apply the fundamental concept learnt during the theory courses to solve industrial problems	3	3	2	2	3	3	3	3	3	3	2	2	2	2	2
CO8	Review the current status based on the information available in the literature or data obtained in the laboratory/ industry	2	2	3	3	3	2	3	2	3	3	3	3	2	2	3
CO9	Carry out material and energy balance for process calculations	3	3	3	2	3	3	2	3	3	2	3	3	3	3	3
CO10	Design equipment for chemical process industries	3	3	3	3	3	2	2	3	3	3	2	2	3	3	3
CO11	Evaluate the economics of a process through cost estimation	3	3	3	3	3	3	3	3	2	2	3	3	2	3	3
CO12	Identify industrial problem, design process to carry out the process in an economically feasible way	2	2	3	2	2	2	2	2	2	3	2	3	3	3	3
Overall CO			3	3	3	3	3	3	3	3	3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5001 DRUGS AND PHARMACEUTICAL TECHNOLOGY

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Gain fundamental knowledge about drugs and pharmaceutical and their manufacturing process

UNIT I INTRODUCTION 9

Development of drugs and pharmaceutical industry; organic therapeutic agents' uses and economics.

UNIT II DRUG ACTION, METABOLISM AND PHARMACOKINETICS 9

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; Pharmacokinetics, Pharmacodynamics, Factors modifying drug action, adverse drug reaction, drug interactions, Bioassay of drugs, drug discovery and development

UNIT III MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS 9

Types of reaction process and special requirements for bulk drug manufacture

UNIT IV PRINCIPLES OF DRUG MANUFACTURE 9

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids, parental solutions, oral liquids; injections; ointments

UNIT V PHARMACEUTICAL ANALYSIS AND QUALITY CONTROL 9

Analytical methods and other tests used in drug manufacture; packing techniques; quality management.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understanding the drug metabolism, pharmaco-dynamic and pharmaco-kinetic principles

CO2: Understanding knowledge of various drugs on different disease

CO3: Demonstrate statistical quality control procedure and quality assurance programmes in various stages of pharmaceutical process

CO4: Understand and learn the strategies to improve the same during dosage from development

CO5: Understanding analytical methods to develop new process and product formulations.

CO6: Apply the knowledge on choosing active ingredients for finished product

TEXT BOOKS

1. Shayne Cox Gad. Pharmaceutical Manufacturing Handbook, Published by John Wiley & Sons, Inc., 2008.
2. Bernd Meibohm. Pharmacokinetics and Pharmacodynamics of biotech drugs, Published by Wiley-VCH, 2006.
3. Rawlines, E.A.; "Bentleys Text book of Pharmaceutics ", III Edition, Bailliere Tindall, London, 1977.

REFERENCES

1. Yalkonsky, S.H.; Swarbick. J.; "Drug and Pharmaceutical Sciences ", Vol. I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	Understanding the drug metabolism, pharmaco-dynamic and pharmaco-kinetic principles	-	-	-	2	-	1	-	1	-	-	-	2	2	-	-
CO2	Understanding knowledge of various drugs on different disease	-	-	-	-	-	-	-	1	-	-	-	3	2	1	-
CO3	Demonstrate statistical quality control procedure and quality assurance programmes in various stages of pharmaceutical process	-	-	-	2	-	-	2	1	-	2	-	1	-	-	2
CO4	Understand and learn the strategies to improve the same during dosage from development	-	-	2	3	-	1	2	1	-	-	- -	-	-	-	1
CO5	Understanding analytical methods to develop new process and product formulations.	-	-	3	3	-	-	3	-	-	3	-	1	3	-	1
CO6	Apply the knowledge on choosing active ingredients for finished product	-	-	3	1	-	3	2	-	-	-	-	1	-	-	-
Overall CO		-	-	3	2	-	1	2	1	-	2	-	1	2	1	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5002 **ELECTROCHEMICAL ENGINEERING**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Gain knowledge about electrochemical process and its application

UNIT I **9**

Review basics of electrochemistry: Faraday's law -Nernst potential –Galvanic cells – Polarography, The electrical double layer: 94It's role in electrochemical processes – Electrocapillary curve – Helmholtz layer –Guoy –Steven's layer –fields at the interface.

UNIT II **9**

Mass transfer in electrochemical systems: diffusion controlled electrochemical reaction –the importance of convention and the concept of limiting current. over potential, primary-secondary current distribution –rotating disc electrode

UNIT III **9**

Introduction to corrosion, series, corrosion theories derivation of potential-current relations of activities controlled and diffusion-controlled corrosion process. Potential-pH diagram, Forms of corrosion- definition, factors and control methods of various forms of corrosion-corrosion control measures- industrial boiler water corrosion control – protective coatings –Vapor phase inhibitors – cathodic protection, sacrificial anodes – Paint removers.

UNIT IV **9**

Electro deposition –electro refining –electroforming –electro polishing –anodizing – Selective solar coatings, Primary and secondary batteries –types of batteries, Fuel cells.

UNIT V **9**

Electrodes used in different electrochemical industries: Metals-Graphite –Lead dioxide – Titanium substrate insoluble electrodes –Iron oxide –semi conducting type etc. Metal finishing-cell design. types of electrochemical reactors, batch cell, fluidized bed electrochemical reactor, filter press cell, Swiss roll cell, plug flow cell, design equation, figures of merits of different type of electrochemical reactors.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understanding on aspects of electrochemistry -

CO2: Understanding on the electrochemical kinetics,

CO3: Understanding on electrochemical reaction, concept of limiting current. Over potential

CO4: Understanding the causes of and the mechanisms of various types of corrosion,

CO5: Apply the concepts involved in electro process and design of batteries, fuel cell and electrochemical reactors

CO6: Understanding on the mechanism of corrosion.

TEXT BOOKS

1. Picket, " Electrochemical Engineering ", Prentice Hall. 1977.
2. Newman, J. S., " Electrochemical systems ", Prentice Hall, 1973.

REFERENCES

1. Barak, M. and Stevenge, U. K., " Electrochemical Power Sources - Primary and Secondary Batteries" 1980
2. Mantell, C.," Electrochemical Engineering ", McGraw Hill, 1972.R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	Understanding on aspects of electrochemistry -	3	3	3	2	1	1	1	1	-	1	-	2	3	3	2
CO2	Understanding on the electrochemical kinetics,	3	3	3	2	1	1	1	1	-	1	-	2	3	3	2
CO3	Understanding on electrochemical reaction, concept of limiting current. Over potential	3	3	3	2	1	1	1	1	-	1	-	2	3	3	2
CO4	Understanding the causes of and the mechanisms of various types of corrosion,	3	3	3	1	1	1	1	1	-	1	-	2	3	2	2
CO5	Apply the concepts involved in electro process and design of batteries, fuel cell and electrochemical reactors	3	3	3	2	1	1	1	1	-	1	-	2	3	2	2
CO6	Understanding on the mechanism of corrosion.	3	3	3	1	1	1	1	1	-	1	-	2	3	3	2
Overall CO		3	3	3	2	1	1	1	1	-	1	-	2	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5003 **ENERGY TECHNOLOGY**

L	T	P	C
3	0	0	3

OBJECTIVE:

The course is aimed to

- Provide a survey of the most important renewable energy resources, and the technologies for harnessing these energies from simple to advanced energy systems

UNIT I **9**

Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives

UNIT II **9**

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 **9**

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 **9**

Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.

UNIT V **9**

Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected 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

CO6: To develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS

1.Picket, " Electrochemical Engineering ", Prentice Hall. 1977.
2.Newman, J. S., " Electrochemical systems ", Prentice Hall, 1973.

REFERENCES

1. Barak, M. and Stevenge, U. K., " Electrochemical Power Sources - Primary and Secondary Batteries" 1980

2. Mantell, C.," Electrochemical Engineering ", McGraw Hill, 1972.R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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 the field of renewable energy technologies	2	2	1	3	3	1	1	1	1	-	1	3	2	1	3
CO6	To develop in-depth technical understanding of energy problems at an advanced level.	2	2	1	3	3	2	2	1	1	-	1	3	2	1	3
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

CH5004 **FRONTIERS OF CHEMICAL ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVE:

The course is aimed to

- Know the latest trends to be followed in the process industries

UNIT I PROCESS INTENSIFICATION **9**

Novel reactor configurations; combination of reaction and separation; use of different energy fields, lab on a chip.

UNIT II CHEMICAL PRODUCT DESIGN **9**

Scope and importance; identification of needs and specifications; sources of ideas and screening ideas; selection of product idea; process development for product manufacture; specialty chemical manufacture; economic aspects.

UNIT III RENEWABLE ENERGY **9**

Hydrogen production, Hydrogen economy, Fuel Cell Technology, biofuel cells and biohydrogen, solar energy

UNIT IV MATERIALS ENGINEERING **9**

Polymers and composites, ceramics and glasses, colloidal dispersions and nanoparticles, thin films and electronic materials

UNIT V BIOENGINEERING **9**

Biomechanics, biotransport and biomaterials, biomolecular and cellular engineering, drug discovery and development.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understanding on the Chemical Engineering concepts,
CO2: Understanding on the renewable energy, energy economy
CO3: Understanding on Fuel Cell, biohydrogen
CO4: Understanding on the Polymers and composites, colloid particles
CO5: Understanding on the solar energy, biohydrogen
CO6: Understanding on cellular engineering, drug discovery

REFERENCES:

1. Keil, F. J., Modeling of Process Intensification Wiley-VCH Verlag GmbH & Co. KGaA 2007
2. Cussler, E.l. and Moggridge, G.D., “Chemical product design” Cambridge University Press, Cambridge, 2001
3. Hoffmann,P, Tomorrow’s energy: hydrogen, fuel cells, and the prospects for a cleaner planet, MIT Press, Sabon, 2002
3. Mitchell, B.S., An introduction to materials engineering and science for chemical and materials engineers, John Wiley and Sons Inc., New Jersey, 2004

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	Understanding on the Chemical Engineering concepts,	3	3	2	2	1		1	1	-	1	-	3	3	3	2
CO2	Understanding on the renewable energy, energy economy	3	3	2	2	1	1	1	1	-	1	-	3	3	3	2
CO3	Understanding on Fuel Cell, biohydrogen	3	3	2	2	1	1	1	1	-	1	-	3	3	3	2
CO4	Understanding on the Polymers and composites, colloid particles	3	3	2	2	1	2	1	1	-	1	-	3	3	3	2
CO5	Understanding on the solar energy, biohydrogen	3	3	2	2	1	2	1	1	-	1	-	3	3	3	2
CO6	Understanding on cellular engineering, drug discovery	3	3	2	2	1	2	1	1	-	1	-	3	3	3	2
Overall CO		3	3	2	2	1	2	1	1	-	1	-	3	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5005 **MODERN SEPARATION TECHNIQUES**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Gain knowledge about advanced separation process. Also, to learn conceptual design of separation processes and design of equipment involved

UNIT I BASICS OF SEPARATION PROCESS **9**

Review of Conventional Processes, Recent advances in Separation Techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process concept, Theory and Equipment used in cross flow Filtration, cross flow Electro Filtration, Surface based solid – liquid separations involving a second liquid.

UNIT II MEMBRANE SEPARATIONS **9**

Types and choice of Membranes, Plate and Frame, tubular, spiral wound and hollowfiber Membrane Reactors and their relative merits, commercial, Pilot Plant and Laboratory Membrane permeators involving Dialysis, Reverse Osmosis, Nano-filtration, Ultra filtration and Micro filtration, Ceramic membranes, Hybrid process and Biological Membranes.

UNIT III SEPARATION BY ADSORPTION TECHNIQUES **9**

Types and choice of Adsorbents, Adsorption Techniques, Dehumidification Techniques, Affinity Chromatography and Immuno Chromatography, Recent Trends in Adsorption.

UNIT IV INORGANIC SEPARATIONS **9**

Controlling factors, Applications, Types of Equipment employed for Electrophoresis, Dielectrophoresis, Ion Exchange Chromatography and Electrodialysis, EDR, Bipolar Membranes.

UNIT V OTHER TECHNIQUES **9**

Separation involving Lyophilisation, Pervaporation and Permeation Techniques for solids, liquids and gases, zone melting, Adductive Crystallization, other Separation Processes, Supercritical fluid Extraction, Oil spill Management, Industrial Effluent Treatment by Modern Techniques.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the key concepts of conventional and advanced aspects of separation processes, and the selection of separation processes.

CO2: Understand the concepts and develop design equations for membrane separation processes.

CO3: Understand the principles and processes of adsorption and chromatographic techniques and to design an absorber to achieve specific separation.

CO4: Analyze the separation system for multi-component mixtures, design separation process based on electrical properties.

CO5: Apply the latest concepts like super critical fluid extraction, pervaporation, lyophilisation etc., also to understand Innovative techniques for controlling and managing oil spills in Chemical process industries.

CO6: Understand and select appropriate separation technique for intended problem.

TEXT BOOK:

1. Ronald W.Roussel - " Handbook of Separation Process Technology ", John Wiley,New York, 1987
2. Seader J.D. and Henley E.J., “Separation Process Principles”, 2nd Ed., John Wiley, 2006.
3. Schoew, H.M. - " New Chemical Engineering Separation Techniques ",Interscience Publishers, 1972.

REFERENCES:

1. Lacey, R.E. and S.Loaeb - "Industrial Processing with Membranes", Wiley –InterScience, New York, 1972.
2. King, C.J. " Separation Processes ", Tata McGraw - Hill Publishing Co., Ltd.,1982.
3. Osadar, Varid Nakagawa I - " Membrance Science and Technology ", MarcelDekkar (1992).
4. Wankat, P., “Equilibrium Stage Separations”, Prentice Hall, 1993.
5. Wankat, P., “Rate Controlled Separations”, Prentice Hall, 1993.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO 1	PSO2	PSO3
CO1	Understand the key concepts of conventional and advanced aspects of separation processes, and the selection of separation processes.	1	-	1	-	1	1	-	-	-	-	1	1	3	3	-
CO2	Understand the concepts and develop design equations for membrane separation processes.	2	-	3	-	1	-	1	-	-	-	1	2	2	2	-
CO3	Understand the principles and processes of adsorption and chromatographic techniques and to design an absorber to achieve specific separation.	2	2	3	1	-	1	-	-	-	-	2	2	3	2	-
CO4	Analyze the separation system for multi-component mixtures, design separation process based on electrical properties.	1	1	3	2	3	2	1	-	-	-	1	2	3	2	1
CO5	Apply the latest concepts like super critical fluid extraction, pervaporation, lyophilisation etc., also to understand Innovative techniques for controlling and managing oil spills in Chemical process industries.	3	3	1	3	1	2	2	2	-	-	1	3	2	2	2
CO6	Understand and select appropriate separation technique for intended problem.	1	1	1	1	-	1	1	1	-	-	1	1	2	2	-
Overall CO		2	2	2	2	2	2	2	1	-	-	1	2	3	3	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5006 **OPTIMIZATION OF CHEMICAL PROCESSES**

L	T	P	C
3	0	0	3

OBJECTIVE:

The course is aimed to

- Develop objective functions and use linear programming, geometric, dynamic and integer programming and genetic algorithms for solution to chemical engineering problems.

UNIT I **9**

Introduction to optimization; applications of optimization in chemical engineering; classification of optimization problems; Developing models for optimization

UNIT II **9**

Continuity of Functions; NLP Problem Statement Convexity and Its Applications Interpretation of the Objective Function in Terms of its Quadratic Approximation Necessary and Sufficient Conditions for an Extremum of an Unconstrained Function; region elimination methods; interpolation methods; direct root methods.

UNIT III **9**

Methods Using Function Values Only -Random Search -Grid Search – Univariate Search - Simplex Search Method - Conjugate Search Directions; Methods That Use First Derivatives - Steepest Descent - Conjugate gradient Methods; Newton's Method and Quasi Newton's Method

UNIT IV **9**

Introduction to geometric, dynamic and integer programming and genetic algorithms. Linear Programming – Solution of Problems using Excel SOLVER

UNIT V **9**

Formulation of objective functions; fitting models to data; applications in fluid mechanics, heat transfer, mass transfer, reaction engineering, equipment design, reaction engineering, resource allocation and inventory control.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Frame mathematical models and formulate optimization models for chemical processes / equipment**.**

CO2: Understand the concept of optimum and extremum and the necessary and sufficient conditions for extremum and solve single and multivariable optimization problems through various techniques.

CO3: Apply various search methods to solve unconstrained single variable optimization and unconstrained multi variable optimization

CO4: Apply higher order techniques like geometric programming, dynamic and integer programming and genetic algorithms

CO5: Able to use the principles of engineering and in particular chemical engineering to develop equality and inequality constraints for an optimization problem

CO6: Apply optimization techniques for real world problems and be knowledgeable to use software packages for their solution

TEXT BOOKS:

1. Rao, S. S., Engineering Optimization - Theory and Practice, Third Edition, John Wiley & Sons, New York, 1996.
2. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes ", McGraw-Hill Book Co., New York, 2003.
3. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. "Engineering Optimisation ", John Wiley, New York, 1980

REFERENCES:

1. Venkataraman, P. (2009). *Applied optimization with MATLAB programming*. John Wiley & Sons.
2. Ferris, M. C., Mangasarian, O. L., & Wright, S. J. (2007). *Linear programming with MATLAB* (Vol. 7). SIAM.
3. J Nocedal and S J Wright (2006). Numerical Optimization. Springer Verlag.
4. Joshi, M. C., &Moudgalya, K. M. (2004). *Optimization: theory and practice*. Alpha Science Int'l Ltd..

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	Frame mathematical models and formulate optimization models for chemical processes / equipment**.**	3	3	3	3	2	-	-	-	3	2	3	2	2	3	-
CO2	Understand the concept of optimum and extremum and the necessary and sufficient conditions for extremum and solve single and multivariable optimization problems through various techniques.	3	3	3	1	2	-	-	-	3	2	1	-	3	3	-
CO3	Apply various search methods to solve unconstrained single variable optimization and unconstrained multi variable optimization	3	3	3	3	3	-	1	-	3	3	3	3	3	3	-
CO4	Apply higher order techniques like geometric programming, dynamic and integer programming and genetic algorithms	3	3	3	3	3	-	-	-	3	3	3	2	3	-	-
CO5	Able to use the principles of engineering and in particular chemical engineering to develop equality and inequality constraints for an optimization problem	3	3	3	3	3	-	-	-	3	3	-	-	1	1	-
CO6	Apply optimization techniques for real world problems and be knowledgeable to use software packages for their solution	3	3	3	3	3	3	3	-	3	3	3	3	3	3	2
Overall CO		3	3	3	3	3	1	1	-	3	3	2	2	3	3	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectivel

CH5007 PETROLEUM REFINING AND PETROCHEMICALS

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Gain knowledge about petroleum refining process and production of petrochemical products.

UNIT I **9**

Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum - Atmospheric and Vacuum Distillation.

UNIT II **9**

Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen

UNIT III **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 **9**

Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.

UNIT V **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

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, New Delhi, 1987.
3. H. Steiner, "Introduction to petrochemicals ", Pergamon Press, New York, 1961.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.	3	2	3	-	-	3	3	3	3	3	3	2	3	3	3
CO2	Understand the insights of primary treatment processes to produce the precursors.	3	2	3	-	-	3	3	3	3	3	3	2	3	3	3
CO3	Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.	3	2	3	-	-	3	3	3	3	3	3	2	3	3	3
CO4	Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.	3	2	3	-	-	3	3	3	3	3	3	2	3	3	3
CO5	Understand the societal impact of petrochemicals and learn their manufacturing processes.	3	2	3	-	-	3	3	3	3	3	3	2	3	3	3
CO6	Learn the importance of optimization of process parameters for the high yield of petroleum products.	3	2	3	-	-	3	3	3	3	3	3	2	3	3	3
Overall CO		3	3	3	-	-	3	3	3	3	3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5008 **POLYMER TECHNOLOGY**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Gain knowledge about mechanism of polymer process and its application

UNIT I GENERAL ASPECTS OF POLYMERS **9**

Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization, Functionality-degree of polymerization. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT II MIXING AND MOULDING DEVICES **9**

Additives and Mixing process, different types of mixing devices, Types of moulds – ejector system – ejection techniques – mould cooling – CAD / CAM, Extrusion Moulding, Injection Moulding, Special Moulding Techniques.

UNIT III ELASTOMERS AND APPLICATION ORIENTED POLYMERS **9**

Natural Rubber, Styrene – butadiene, Polyisopropane – Neoprene, Silicone rubber, Thermoplastic elastomers, Resins – PVC, Silicon Oil and resins, fibrous Polymers – Nylon 66, Polyacrylonitrile.

UNIT IV PROPERTIES OF POLYMER MATERIALS **9**

Molecular weight-weight average, mechanical properties, thermal properties, electrical properties, rheological properties, and optical properties.

UNIT V POLYMER COMPOSITES **9**

Fibrous and Laminated Composites - Hybrid Composites - Matrix Resins - Unsaturated Polyester - Vinyl Ester - Epoxy- Phenol Formaldehyde - Urea Formaldehyde, Catalysts, Fillers, Reinforcements, Additives for Composites.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamentals of polymers and mechanism of polymerization techniques.

CO2: Apply the mechanism and effectiveness of polymerization in making finished materials.

CO3: Understand the knowledge of developing new formulations and products from elastomers

CO4: Understand the knowledge of polymer stability and unique definition of the product by evaluating molecular weight

CO5: Understand the manufacture and properties of application oriented industrial polymers.

CO6: Acquire knowledge on different tests for characterization of polymer for applications in R & D work

TEXT BOOKS:

1. Birley, Haworth, Batchelor, Physics of Plastics – Processing Properties and Materials Engineering, Hamer Publication, 1992.
2. F.W. Billmayer, Text Book of Polymer Science, 3rd edition, John Wiley and sons, New York, 2002.
3. Richard G.Griskey, Polymer Process Engineering, Chapman and Hall, 1995.
4. Vishu Shah, Hand book of Plastics Testing and Failure Analysis, 3rd Edition, John-Willey &Sons, New York, 2007.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understand the fundamentals of polymers and mechanism of polymerization techniques.	3	2	2	1	2	-	-	-	3	3	3	1	2	-	-
CO2	Apply the mechanism and effectiveness of polymerization in making finished materials.	3	3	3	2	3	-	-	-	3	3	3	2	1	2	1
CO3	Understand the knowledge of developing new formulations and products from elastomers	3	3	3	1	-	-	2	-	3	3	3	2	2	2	1
CO4	Understand the knowledge of polymer stability and unique definition of the product by evaluating molecular weight	3	3	3	1	3	-	2	-	3	3	3	3	-	2	-
CO5	Understand the manufacture and properties of application oriented industrial polymers.	3	3	2	1	-	-	1	-	3	3	3	3	-	-	-
CO6	Acquire knowledge on different tests for characterization of polymer for applications in R & D work	3	3	2	2	-	-	1	-	3	3	3	3	-	1	-
Overall CO		3	3	2	1	1	-	1	-	3	3	3	2	1	1	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5009 **PROCESS MODELING AND SIMULATION**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Develop steady state and transient models for processes and unit operations and to understand lumped and distributed parameter models and to seek solution of models using analytic and numerical techniques and to construct data driven models and estimate the parameters.

UNIT I **9**

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II **9**

Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations using Matrices and Numerical techniques. Error estimates.

UNIT III **9**

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems – Solution of ODE using Eigen values – Jordan Canonical Form – Stiff equations – Gear's algorithm -Perturbation Methods

UNIT IV **9**

Analysis of compressible flow, heat exchanger, packed columns, Monolith Reactor Modeling – Pseudo-homogeneous and Heterogeneous models for catalytic reactors – plug flow reactor, solution of ODE boundary value problems – shooting Method

UNIT V **9**

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor, - hierarchy in model development, classification and solution of partial differential equations – Characteristic curves for parabolic, Elliptic and Hyperbolic equations - Empirical modeling, parameter estimation, population balance and stochastic modelling - Principal Component Analysis

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamentals of modeling and their applications to transport/energy equations, chemical and phase equilibria kinetics

CO2: Associate the model with constitutive relations such as phenomenological laws, rate equations, equations of state, property estimation methods

CO3: Create the mathematical models for different unit operations equipments such as stirred tank heaters, Heat exchangers, Evaporators, Reactors, distillation columns

CO4: Analyze the principles of steady state/unsteady state lumped systems and steady state/ unsteady state distributed systems

CO5: Apply relevant solution methods for the mathematical models with relevant initial and/or boundary conditions

CO6: Appreciate the applicability of stochastic, population balance model and data driven models

TEXT BOOKS

1. Bequette, B.W., “Process Dynamics: Modelling, Analysis and Simulation,” Prentice Hall (1998)
2. Himmelblau D.M. and Bischoff K.B., *Process Analysis and Simulation*, Wiley, 1988
3. Varma A. and Morbidelli M., *Mathematical Methods in Chemical Engineering*, Oxford University Press, 1997

REFERENCES:

1. Golub G.H. and van Loan C.F., *Matrix Computations*, Johns Hopkins University Press, 3rd Edition, 1996
2. Ogunnaike B. and W. Harmon Ray. *Process Dynamics, Modeling, and Control*, Oxford University Press, 1995
3. Chapra S.C. and Canale R.P. *Numerical Methods for Engineers*, McGraw Hill, 2001
4. Press W.H., Teukolsky S.A., Vetterling W.T. and Flannery B.P., *Numerical Recipes: The Art of Scientific Computing*, Cambridge University Press, 3rd Edition, 2007
5. Ramirez, W.; “ Computational Methods in Process Simulation “, 2nd Edn., Butterworths Publishers, New York, 2000.
   Luyben, W.L., “ Process Modelling Simulation and Control “,2nd Edn, McGraw-Hill Book Co., 1990

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Understand the fundamentals of modeling and their applications to transport/energy equations, chemical and phase equilibria kinetics	3	3	3	1	-	-	-	-	3	3	3	3	3	3	-
CO2	Associate the model with constitutive relations such as phenomenological laws, rate equations, equations of state, property estimation methods	3	3	3	3	3	-	-	-	3	3	-	3	3	3	1
CO3	Create the mathematical models for different unit operations equipments such as stirred tank heaters, Heat exchangers, Evaporators, Reactors, distillation columns	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-
CO4	Analyze the principles of steady state/unsteady state lumped systems and steady state/ unsteady state distributed systems	3	3	3	3	3	-	-	-	3	3	1	3	3	3	1
CO5	Apply relevant solution methods for the mathematical models with relevant initial and/or boundary conditions	3	3	3	3	3	-	-	-	3	3	2	3	3	3	1
CO6	Appreciate the applicability of stochastic, population balance model and data driven models	3	3	3	3	3	-	-	-	3	3	1	3	3	3	-
Overall CO		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

AS5073 **PROCESS PLANT UTILITIES**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Enable the students to gain knowledge about various process plant utilities essentially required for the working of any chemical or related industry plants

UNIT I INDUSTRIAL WATER **9**

Hard and Soft water, Requisites of Industrial Water and its uses. Methods of Water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening, Reverse Osmosis.

UNIT II STEAM GENERATION **9**

Properties of Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Corrosion in boilerand Trouble Shooting. Steam Traps and Accessories

UNIT III REFRIGERATION **9**

Refrigeration Cycles, Methods of Refrigeration used in Industry, Old and Modern refrigerants, Refrigerating Effects and Liquefaction Processes.

UNIT IV COMPRESSED AIR **9**

Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Slip Factor. Properties of Air – Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.

UNIT V FUEL AND PUMPS **9**

Types of Fuel used in Chemical Process Industries for Power Generation, Internal Combustion Engine, Petrol and Diesel Engine. Combustion calculations ,various types of pumps used in industries

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the importance of process plant utilities
CO2: Understand the Requisites of Industrial Water and treatment methodologies
CO3: Understand various types of steam generators and boiler corrosion
CO4: Understand the concept of refrigeration used in industries
CO5: Understand the classification of compressors and humidification equipments
CO6: Understand the types of engines and fuels used for power generation and pumps used in chemical industries.

TEXT BOOKS:

1. Industrial Chemistry by Shashi Chawla, Dhanpat Rai and Sons Publication
2. P. L. Ballaney, “Thermal Engineering”, Khanna Publisher New Delhi, 1986
3. Heat Transfer by D.S. Kumar
4. Fuel Furances and Refractories by O.P. Gupta, Khanna Publishers

REFERENCES:

1. P. N. Ananthanarayan, “Basic Refrigeration & Air conditioning”, Tata McGraw Hill, New Delhi, 2007.
2. Plant Utilities by D.B. Dhone, NiraliPrakshan Publication

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understand the importance of process plant utilities	3	1	1	-	1	3	3	2	-	-	3	2	3	2	1
CO2	Understand the Requisites of Industrial Water and treatment methodologies	3	3	1	1	2	-	1	1	-	-	2	2	3	1	1
CO3	Understand various types of steam generators and boiler corrosion	3	2	1	1	2	-	1	-	-	-	1	2	3	3	1
CO4	Understand the concept of refrigeration used in industries	3	2	1	1	2	-	-	-	-	-	1	2	3	3	1
CO5	Understand the classification of compressors and humidification equipments	3	2	1	1	2	-	-	-	-	-	1	1	3	3	1
CO6	Understand the types of engines and fuels used for power generation and pumps used in chemical industries.	3	2	1	1	2	-	-	-	-	-	1	3	3	3	1
Overall CO		3	2	1	1	2	1	2	1	-	-	2	3	3	3	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5010 **CHEMICAL PROCESS DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVE:

The course is aimed to

- Design and sequence chemical processes based on hierarchical modeling and be able to critically choose reactors, separation trains and heat exchanger networks for optimal performance.

UNIT I **9**

Process Design and Development: General Design Considerations; The Hierarchy of Chemical Process Design; The Nature of Process Synthesis and Analysis

UNIT II **9**

Choice of reactor based on reactor performance, reactor conditions and reactor configuration. Reactor networks in process flow sheets

UNIT III **9**

Choice of separation of heterogeneous and homogeneous mixtures – Attainable region Separation systems in process flowsheets: multicomponent distillation for ideal and non-ideal systems, distillation column sequences

UNIT IV **9**

Heat exchange networks synthesis and utilities: Energy targets, Integration in distillation columns

UNIT V **9**

Introduction to optimization approaches to optimal design, role of simulations in process design, Design under uncertainty and failure tolerance, Engineering around variations, Introduction to process integration

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand different codes, standards, design factors and system of units used in design process**.**

CO2: Understand the importance of process diagrams, design of reactors

CO3: Evaluate the choice of reactors and configure reactors for process design

CO4: Map attainable regions in separation systems

CO5: Apply the skill in thermal design of heat transfer equipment and assessing thermal efficiency of the above equipment in practice.

CO6: Apply optimization techniques for chemical engineering processes and use software packages for their solution

TEXT BOOKS:

1. Smith, R. (2005). *Chemical process: design and integration*. John Wiley & Sons.
2. Douglas, J. M. (1988). *Conceptual design of chemical processes* (Vol. 1110). New York: McGraw-Hill.

REFERENCES:

1. Rudd, D. F., & Watson, C. C. (1968). Strategy of process engineering. Wiley.
2. Sinnott, R. K. (1999). Coulson & Richardson's Chemical Enginering: Volume 6/Chemical Engineering Design. Elsevier Butterworth Heinemann.
3. Silla, H. (2003). Chemical process engineering: design and economics. CRC Press.
4. Seider, W. D., Seader, J. D., & Lewin, D. R. (2009). PRODUCT & PROCESS DESIGN PRINCIPLES: SYNTHESIS, ANALYSIS AND EVALUATION, (With CD). John Wiley & Sons.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO 1	PSO2	PSO3
CO1	Understand different codes, standards, design factors and system of units used in design process**.**	3	3	3	3	2	-	-	-	3	2	3	2	2	3	-
CO2	Understand the importance of process diagrams, design of reactors	3	3	3	1	2	-	-	-	3	2	1	-	3	3	-
CO3	Evaluate the choice of reactors and configure reactors for process design	3	3	3	3	3	-	1	-	3	3	3	3	3	3	-
CO4	Map attainable regions in separation systems	3	3	3	3	3	-	-	-	3	3	3	2	3	-	-
CO5	Apply the skill in thermal design of heat transfer equipment and assessing thermal efficiency of the above equipment in practice.	3	3	3	3	3	-	-	-	3	3	-	-	1	1	-
CO6	Apply optimization techniques for chemical engineering processes and use software packages for their solution	3	3	3	3	3	3	3	-	3	3	3	3	3	3	2
Overall CO		3	3	3	3	3	1	1	-	3	3	2	2	3	3	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5011 **MATERIALS OF CONSTRUCTION**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Understand various material and its properties and manufacturing methods

UNIT I INTRODUCTION **10**

Structure – Property relationship - Selection criteria and processes: General criteria of selection of materials in process industries. Properties: Mechanical, Thermal, Physical, Chemical, Electrical, Magnetic and Technological properties. Processing of Metals and Alloys- Casting, Hot and cold rolling, Forging, Extrusion, Deep drawing.

UNIT II MECHANICAL BEHAVIOUR **8**

Elastic, Anelastic and Viscoelastic Behaviour – Introduction to Slip, Slip planes, Plastic Deformation by Slip: Critical resolved shear stress, Mechanism of Creep, Creep Resistant Materials – Fracture: Ductile and Brittle, Fatigue fracture, Griffith's theory, S-N curves, Fracture toughness.

UNIT III PHASE DIAGRAMS AND PHASE TRANSFORMATIONS **8**

Gibb's Phase rule : Unary and Binary phase diagrams , Al CO - Cr O , Pb-Sn, Ag-Pt and Iron- Iron Carbide Phase Diagram – Lever rule – Invariant reactions- TTT diagrams – Micro structural changes – Nucleation and growth – Martensitic transformations – Solidification and Crystallization – Glass transition – Recrystallization and Grain growth

UNIT IV FERROUS, NON-FERROUS METALS AND COMPOSITES **10**

Pig iron, Cast iron, Mild Steel-Manufacturing process, properties &, Applications Stainless steels, Special Alloy steels-properties and uses; Heat treatment of plain-carbon steels. Manufacturing methods of Lead, Tin and Magnesium. Properties and applications in process industries. FRP-Fiber Reinforced Plastics (FRP), manufacturing methods; Asphalt and Asphalt mixtures; Wood.

UNIT V NANOMATERIALS **9**

Introduction to Nanotechnology- Zero Dimensional Nano Structures – Nano particles – One Dimensional Nano Structures- Nano wires and Nano rods – Two Dimensional Nano Structures, Films – Special Nano Materials - Nano Structures fabricated by Physical Techniques – Characterisation and Properties of Nano Materials – Applications of Nano Structures.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the basics knowledge such as internal structure, properties and processing of metals.

CO2: Understand basic and the mechanical behavior of the metals.

CO3: Understand phase diagrams and phase transformations of metals.

CO4: Understand the manufacturing process of ferrous, non-ferrous metals and composites.

CO5: Understand the basic concepts of nano materials.

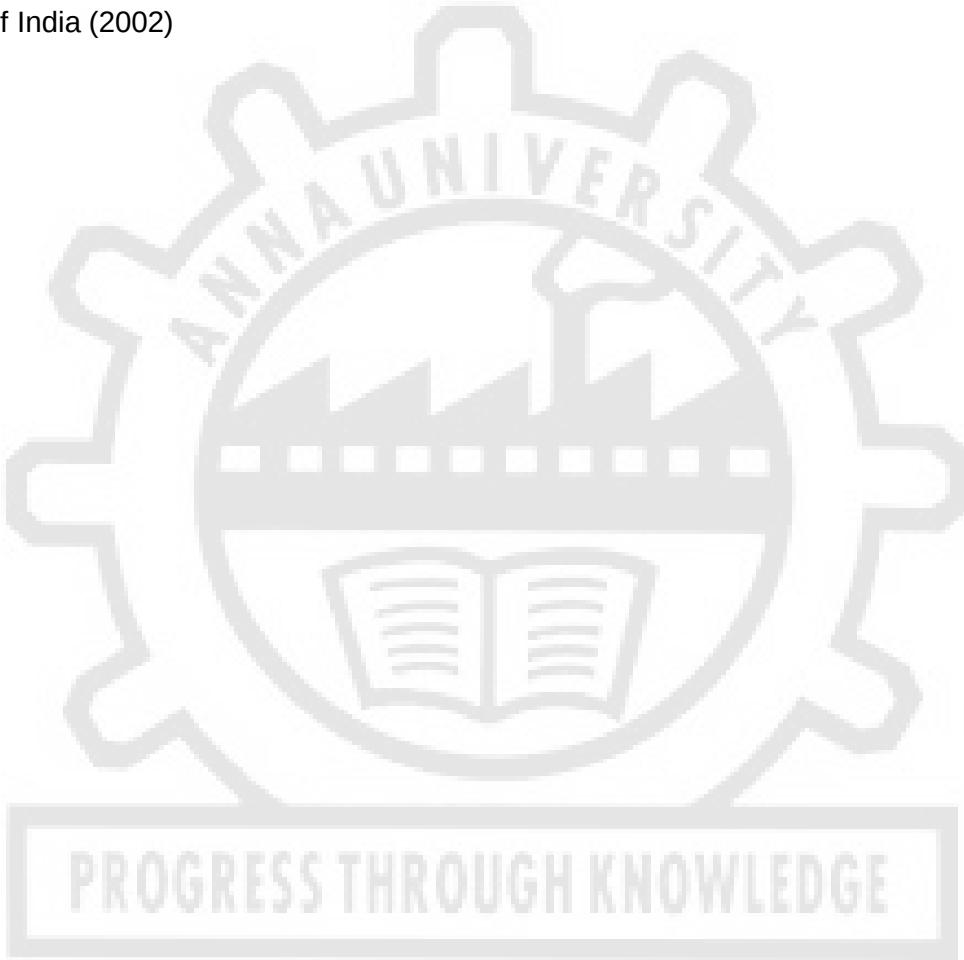
CO6: Apply knowledge of various materials properties and processing methods in chemical industry.

TEXT BOOKS:

1. William D. Callister, “Materials Science and Engineering”,7th edn, John Wiley & Sons, Inc.
2. V. Raghavan, Materials Science and Engineering, Prentice Hall
3. S. K. Hajra Choudhury, "Material Science and processes", 1stEdn. , 1977. Indian Book Distribution Co., Calcutta.
4. Brenner D, “Hand book of Nanoscience and technology” (2002)

REFERENCES:

1. Henry R Clauster, “Industrial and Engineering Materials” McGraw Hill Book Co. (1975)
2. Kingery W D and Bowen H K and Unimann D R, “Introduction to Ceramics” John Wiley and Sons, Second edition (1991)
3. Fahrner W R, “Nanotechnology and Nanoeletronics” Springer International edition(2005)
4. Budinsky K G and Budinsky K M “ Engineering Materials- Properties and Selection” Prentice Hall of India (2002)



Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the basics knowledge such as internal structure, properties and processing of metals.	3	3	-	-	-	2	3	3	2	3	2	3	3	3	2
CO2	Understand basic and the mechanical behavior of the metals.	3	3	3	2	2	3	2	3	-	-	3	3	3	3	3
CO3	Understand phase diagrams and phase transformations of metals.	3	3	3	2	3	3	2	2	-	-	2	3	3	3	2
CO4	Understand the manufacturing process of ferrous, non-ferrous metals and composites.	3	3	3	2	2	3	2	2	-	-	3	3	3	3	2
CO5	Understand the basic concepts of nano materials.	3	3	3	2	3	3	3	2	-	-	2	3	3	3	2
CO6	Apply knowledge of various materials properties and processing methods in chemical industry.	3	3	3	2	3	2	2	2	3	2	2	3	3	3	2
Overall CO		3	3	3	2	3	3	2	2	2	2	2	3	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5012 **BIOCHEMICAL ENGINEERING**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Introduce fundamental concept of Bioprocesses to Chemical Engineers to deal with the design and construction of unit processes that involve biological organisms or molecules

UNIT I INTRODUCTION TO BIOPROCESS **9**

Overview of traditional and modern application of bioprocesses, unit operations in bioprocesses, Microbiology overview- microbial taxonomy, prokaryotic cell, eukaryotic cell; Introduction to biochemistry- fats, lipids, proteins, carbohydrates, nucleic acids, vitamins.

UNIT II ENZYME TECHNOLOGY **9**

Classification of enzymes, Kinetics of enzyme catalyzed reaction: enzyme substrate complex and enzyme action, types of inhibition, Immobilization-methods, properties, Diffusional limitations, enzyme reactors.

UNIT III KINETICS OF MICROBIAL GROWTH **9**

Stoichiometry of microbial growth and product formation, Medium formulation, operating conditions of suspended and immobilized cells in bioreactors-Batch, fed batch; operation and control of bioreactors.

UNIT IV MASS TRANSFER IN BIOPROCESSES **9**

Stoichiometry of microbial growth and product formation, Medium formulation, operating conditions of suspended and immobilized cells in bioreactors-Batch, fed batch; operation and control of bioreactors.

UNIT V DOWN STREAM PROCESSING **9**

Product recovery: Filtration, sedimentation, centrifugation, cell disruption, extraction, crystallization, drying, Design and analysis of bioreactors.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand basics of microbiology to engineer them

CO2: To apply the reaction kinetics to enzyme catalyzed reactions

CO3: Understand basics of cell growth and apply to scale up reactors

CO4: Understand mass transport mechanisms in bioprocesses

CO5: Understand the downstream processing and industrial bioreactors

CO6: Application of chemical concepts in bio-based industries

TEXT BOOKS

1. Biochemical engineering fundamentals by J.E.Bailey and D.F.Ollis, 2nd ed, 1986, McGraw Hill.
2. Bioprocess Engineering by Michael L. Shuler and FikretKargi, 2nd edition, Pearson education.

REFERENCES

1. Biochemical engineering by James M.Lee – Prentice-Hall-1992.
2. Shigeo Katoh, Jun-ichiHoriuchi and Fumitake Yoshida, “Biochemical Engineering”, Wiley, 2015.
3. Bioprocess engineering principles, Pauline M. Doran, Academic Press.
4. Biochemical Engineering, H.W. Blanch and D.S. Clark, Marcel Dekker, 1997

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12	PSO 1	PSO2	PSO3
CO1	Understand basics of microbiology to engineer them	1	2	-	-	-	2	2	-	1	-	-	1	1	-	2
CO2	To apply the reaction kinetics to enzyme catalyzed reactions	3	3	3	3	2	2	2	-	3	-	2	3	3	3	2
CO3	Understand basics of cell growth and apply to scale up reactors	1	2	2	2	1	2	2	1	1	-	2	3	3	3	2
CO4	Understand mass transport mechanisms in bioprocesses	3	3	2	1	2	1	-	-	3	-	1	3	3	3	1
CO5	Understand the downstream processing and industrial bioreactors	1	1	2	2	1	2	1	-	2	1	2	3	3	3	2
CO6	Application of chemical concepts in bio-based industries	2	2	3	3	3	2	1	1	3	1	3	3	3	3	3
Overall CO		2	3	2	2	2	2	2	1	3	1	2	3	3	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

GE5071 **DISASTER MANAGEMENT**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Educate students about the basic knowledge on various types of Disasters and Disaster Management

UNIT I INTRODUCTION TO DISASTERS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of Disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts Including Social, Economic, Political, Environmental, Health, Psychosocial, etc.- Differential Impacts- In Terms of Caste, Class, Gender, Age, Location, Disability - Global Trends In Disasters: Urban Disasters, Pandemics, Complex Emergencies, Climate Change- Dos and Don'ts During Various Types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) **9**

Disaster cycle - Phases, Culture of Safety, Prevention, Mitigation And Preparedness Community based DRR, Structural- nonstructural Measures, Roles and responsibilities ofcommunity, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT **9**

Factors Affecting Vulnerabilities, Differential Impacts, Impact of Development Projects such as Dams, Embankments, and Changes in Land-use etc. - Climate Change Adaptation- IPCC Scenario and Scenarios in the Context of India - Relevance of Indigenous Knowledge, Appropriate Technology and Local Resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other Related Policies, Plans, Programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, 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.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand foundations of hazards, disasters and associated natural/social phenomena and to provide knowledge on response during different types of Disasters

CO2: Gain Preliminary understanding of DRR approaches

CO3: Manage the Public Health aspects and Humanitarian Assistance of the disasters and Capacity to describe analyse various aspects influencing vulnerabilities and capacities.

CO4: Understand the Technological innovations and their usage during various phases of Disaster

CO5: To enhance awareness of institutional process, vulnerability profile, Policies, Law, and methods of assessment in the country

CO6: Gain the capacity to obtain, analyse, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios

TEXT BOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010.
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill, 2012.
3. Gupta Anil K, Sreeja S. Nair, “Environmental Knowledge for Disaster Risk Management”, 2011
4. 4. KapurAnu, “ Vulnerable India: A Geographical Study of Disasters”, IIAS and Sage Publishers, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, 2005
2. Government of India, National Disaster Management Policy,2009.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand foundations of hazards, disasters and associated natural/social phenomena and to provide knowledge on response during different types of Disasters	1	3	1	1	1	3	3	3	3	3	2	3	-	-	-
CO2	Gain Preliminary understanding of DRR approaches	-	1	1	1	2	3	3	2	3	2	1	3	-	-	-
CO3	Manage the Public Health aspects and Humanitarian Assistance of the disasters and Capacity to describe analyse various aspects influencing vulnerabilities and capacities.	1	3	3	3	1	3	3	3	3	3	3	3	-	-	-
CO4	Understand the Technological innovations and their usage during various phases of Disaster	2	2	3	3	3	3	2	2	3	3	1	3	-	-	-
CO5	To enhance awareness of institutional process, vulnerability profile, Policies, Law, and methods of assessment in the country	2	2	1	1	1	3	3	3	3	3	1	3	-	-	-
CO6	Gain the capacity to obtain, analyse, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios	1	3	3	3	2	3	3	3	3	3	3	3	-	-	-
Overall CO		2	3	3	3	2	3	3	3	3	3	2	3	-	-	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5013 **INDUSTRIAL PROCESS PLANT SAFETY**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Educate Students about implementation of safety procedures, risk analysis and assessment, hazard identification

UNIT I **9**

Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling.

UNIT II **9**

Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety.

UNIT III **9**

Overall risk analysis--emergency planning-on site &off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV **9**

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-VizagBopal analysis

UNIT V **9**

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understanding the chemical process safety, plant layout , safety codes
CO2: Plant inspection, safe handling of chemicals
CO3: Understanding on risk management iso 14000, ems
CO4: Hazard identification safety audits, checklist, what if analysis
CO5: Vulnerability models event tree analysis fault tree analysis, hazan, hazop
CO6: Past accident analysis fixborough-mexico-madras-vizagbopal analysis

TEXT BOOKS:

1. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.
2. Fawatt, H.H. and Wood, W.S., “Safety and Accident Prevention in Chemical Operation“, Wiley Interscience, 1965.
3. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004.

REFERENCES:

1. Handley, W., “Industrial Safety Hand Book “, 2nd Edn., McGraw-Hill Book Company, 1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., “ Industrial Accident Prevention“, McGraw-Hill Book Co., 1980.
3. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understanding the chemical process safety, plant layout , safety codes	3	3	2	2	2	-	2	1	2	2	1	2	2	2	2
CO2	Plant inspection, safe handling of chemicals	3	3	2	2	2	-	2	1	2	2	1	2	2	2	2
CO3	Understanding on risk management iso 14000, ems	3	3	2	2	3	-	2	1	2	2	1	2	2	2	2
CO4	Hazard identification safety audits, checklist, what if analysis	3	3	3	3	3	-	2	1	2	2	1	2	2	2	2
CO5	Vulnerability models event tree analysis fault tree analysis, hazan, hazop	3	3	3	2	3	-	2	1	2	2	1	2	2	2	2
CO6	Past accident analysis fixborough-mexico-madras-vizagbopal analysis	3	3	2	2	3	-	2	1	2	2	1	2	2	2	2
Overall CO		3	3	2	2	2	-	2	1	2	2	1	2	2	2	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5014 **INSTRUMENTAL METHODS OF ANALYSIS**

	L	T	P	C
OBJECTIVE:	**3**	**0**	**0**	**3**

The course is aimed to

- Know the principle and importance of various analytical instruments used for the characterization of various materials.

UNIT I INTRODUCTION TO SPECTROSCOPICAL METHODS OF ANALYSIS 9

Electromagnetic radiation: Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance & transmittance and their relationship, Color and complementary colours-Orbital overlap- MO diagrams of O_2, N_2 and H_2. Permitted energy levels for the electrons of an atom and simple molecules, HOMO and LUMO levels of simple organic compounds and polyenes-Various electronic transitions in organic and inorganic compounds effected by UV, and Visible radiations, Various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations, Choice of solvents, cut off wavelengths for solvents

UNIT II QUALITATIVE ANALYSIS BY UV AND VISIBLE SPECTROCOPY 9

Lamda max and epsilon max rules, Woodward -Fieser rules for the calculation of absorption maxima (Lamda max) for dienes and carbonyl compounds, Fieser and Kuhn rules, Effects of auxo chromes and effects of conjugation on the absorption maxima, Different shifts of absorption peaks (Batho chromic, hypsochromic, hypochromic), Difference in the absorption spectra of organic and inorganic compounds and complexes, Instrumentation for single beam and double beam UV and VISIBLE spectrophotometers (source, optical parts and detectors), Applications of UV and VISIBLE spectroscopies.

UNIT III QUANTITATIVEANALYSIS BY UV AND VISIBLE SPECTROCOPY 9

Beer -Lambert's law, Limitations, Deviations (Real, Chemical, Instrumental), problems based on Beer- Lambert's Equation-Estimation of inorganic ions such as Fe^{2+}, Fe^{3+}, Ni^{2+} ions and estimation of Nitrite (NO_2^-) using Beer -Lambert's Law, Multicomponent analysis (no overlap, single way overlap and two-way overlap), Photometric titration (Experimental set -up and various types of titrations and their corresponding curves).

UNIT IV IR SPECTROSCOPY 9

Theory of IR spectroscopy, Various stretching and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR (Near, Mid, Finger print and Far) and their usefulness, Instrumentation (Only the sources and detectors used in different regions), sample preparation techniques (Gas, Liquid and solid), Qualitative analysis of alkanes, alkenes and carbonyl compounds

UNIT V CHROMATOGRAPHIC METHODS 9

Classification of chromatographic methods, Column, Thin layer, Paper, Gas, High Performance Liquid Chromatographical methods (Principle, mode of separation, Technique and applications).

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamentals, concepts and mechanisms involved in spectral analysis.
CO2: Understand the purpose and theories in qualitative analysis.
CO3: Understand the purpose and theories in quantitative analysis.
CO4: Understand the purpose and theories in IR spectral analysis.
CO5: Understand the purpose and theories of chromatographic methods.
CO6: Understand the importance of analytical instrumentation during the purification, compounding and formulating the finished product.

TEXT BOOKS:

1. B. Sivasankar, Instrumental methods of Analysis" Oxford University Press, 2012

REFERENCES:

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Instrumental Analysis, CENGAGE Learning, India, 7th Edition, 2007.
2. Willard H.H, Merritt L.L, Dean J.A and Settle F.A, Instrumental method of analysis, 7th edition, Wadsworth Publishing Company, 1988.
3. Sharma, B.K., Instrumental Methods of Analysis, Goel publishing House, 24th Edition.
4. William Kemp, Organic Spectroscopy, 3rd Edition, Palgrave publishers, 2007.
5. Gurdeep R. Chatwal, Sharma K. Anand, Instrumental methods of Chemical Analysis, Himalaya Publishers, New Delhi, 2014
6. John R Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prentice-hall of India Pvt. Ltd., 2012
7. Robert M. Silverstein, Francis X. Webstrer, David Kiemle, David L. Bryce, Spectrometric Identification of Organic Compounds, Wiley, 8th Edition

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome													
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**	**PSO3**
CO1	Understand the fundamentals, concepts and mechanisms involved in spectral analysis.	3	1	-	3	1	1	-	3	2	1	1	3	3	3	-
CO2	Understand the purpose and theories in qualitative analysis.	2	-	-	3	-	1	-	3	2	1	-	2	3	2	-
CO3	Understand the purpose and theories in quantitative analysis.	2	-	-	3	-	1	-	2	2	1	-	2	3	2	-
CO4	Understand the purpose and theories in IR spectral analysis.	2	-	-	3	-	1	-	2	2	1	-	2	3	2	-
CO5	Understand the purpose and theories of chromatographic methods.	2	-	-	3	-	1	-	2	2	1	-	2	3	2	-
CO6	Understand the importance of analytical instrumentation during the purification,compounding and formulating the finished product.	2	2	-	3	-	1	-	3	2	1	-	2	2	2	-
Overall CO		2	2	-	3	-	1	-	3	2	1	1	2	3	2	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

CH5015 **PROCESS ENGINEERING ECONOMICS**

L	T	P	C
3	0	0	3

OBJECTIVE:

The course is aimed to

- Understand the various concepts of economics, process development, design consideration and cost estimation in chemical industry.

UNIT I INTEREST AND PLANT COST **9**

Economics-Engineering economics-Financial efficiency, human factors, capital, accounting. Time value of money – Interest, present worth, annuities, Depreciation-methods, capital investment, estimation of capital cost, elements of cost, break even analysis (BEA)

UNIT II PROFITABILTY AND FINANCIAL RATIOS **9**

Profitability - methods to estimate profitability, Alternative investments, Balance sheet-Preparation, Income statement (Profit and loss account) and financial ratio analysis.

UNIT III ECONOMIC BALANCE IN EQUIPMENTS **9**

Essentials of economic balance, economic balance in batch operations, cyclic operations, economic balance for insulation, evaporation, heat transfer equipment.

UNIT IV PRINCIPLES OF MANAGEMENT **9**

Principles of management, planning and organizing, staffing, process of directing-communication and types of communication, coordinating and controlling, Types of organizations, Management information systems (MIS).

UNIT V PRODUCTION PLANNING CONTROL **9**

Work measurement techniques, motion study(Work sampling)-procedure and application , time study-procedure-performance rating-types of performance rating- learning curve, elements of production control, forecasting, planning, routing, scheduling, dispatching, inventory and control, role of control charts in quality control.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the concept of economics in a process plant, time value of money and cost indices

CO2: Able to integrate knowledge about financial statements, Depreciation and Accounting.

CO3: Able develop economic balance for chemical engineering equipment's and determine the optimum cost for operation

CO4: Understand the basics of principles of management, types of organization and MIS

CO5: Understand the theory behind Work measurement technique, Production planning and elements of production control

CO6: Understand the concept of inventory control and the role of control charts in quality control

TEXT BOOKS

1. Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 5th Edition, 2004.
2. Ahuja K.K, Industrial management, Khanna publishers, New Delhi, 1985.
3. Schweyer. H.E, "Process Engineering Economics", Mc Graw Hill, 1969

REFERENCES

1. F.C. Jelen and J.H. Black, "Cost and Optimization Engineering", McGraw Hill, 3rd Edn., 1992

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	Understand the fundamentals, concepts and mechanisms involved in spectral analysis.	1	1	-	-	-	1	1	1	-	-	1	-	-	-	1
CO2	Understand the purpose and theories in qualitative analysis.	1	1	-	-	-	1	1	1	-	-	1	-	-	-	1
CO3	Understand the purpose and theories in quantitative analysis.	2	2	1	1	1	-	-	-	-	-	1	-	1	1	-
CO4	Understand the purpose and theories in IR spectral analysis.	-	-	-	-	-	1	1	2	2	2	2	1	-	-	2
CO5	Understand the purpose and theories of chromatographic methods.	-	-	-	-	-	1	1	2	2	2	2	1	-	-	2
CO6	Understand the importance of analytical instrumentation during the purification,compounding and formulating the finished product.	1	-	-	-	-	1	1	2	2	2	2	1	-	-	2
Overall CO		1	1	1	1	1	1	1	2	2	2	2	1	1	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

AUDIT COURSE (AC)

AD5091 **CONSTITUTION OF INDIA** **L T P C**
3 0 0 0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I INTRODUCTION **9**

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties

UNIT III ORGANS OF GOVERNANCE **9**

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV EMERGENCY PROVISIONS **9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V LOCAL ADMINISTRATION **9**

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

TEXTBOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

AD5092 **VALUE EDUCATION** **L T P C**
3 0 0 0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I INTRODUCTION TO VALUE EDUCATION 9

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

UNIT II IMPORTANCE OF VALUES 9

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III INFLUENCE OF VALUE EDUCATION 9

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendshipHappiness Vs suffering, love for truth.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9

Equality, Non violence, Humility, Role of Women, All religions and same message,Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓	✓			✓
CO3							✓	✓	✓			✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

AD5093 **PEDAGOGY STUDIES** **L T P C**
3 0 0 0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I INTRODUCTION AND METHODOLOGY: 9

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW 9

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT 9

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS 9

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												✓
CO2												✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

AD5094 **STRESS MANAGEMENT BY YOGA**

L T P C
3 0 0 0

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog.(Ashtanga)

UNIT II YAM **9**

Do`s and Don't's in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM **9**

Do`s and Don't's in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN **9**

Various yog poses and their benefits for mind & body

UNIT V PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do's and Don't's in life through Yam
CO3 – Learn Do's and Don't's in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓				✓
CO3							✓	✓				✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS L T P C
3 0 0 0

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I 9

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45PERIODS

OUTCOMES:

CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016

AD5097 ESSENCE OF INDIAN KNOWLEDGE TRADITION L T P C

3 0 0 0

COURSE OBJECTIVES

The course will introduce the students to

- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I INTRODUCTION TO CULTURE 9

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II INDIAN LANGUAGES AND LITERATURE 9

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY 9

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA 9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45PERIODS

COURSE OUTCOMES

After successful completion of the course the students will be able to

- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

AD5098 SANGA TAMIL LITERATURE APPRECIATION L T P C
3 0 0 0

Course Objectives: The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. 'Agathinai' and'Purathinai' in SangaTamil Literature.
3. 'Attruppadai' in SangaTamil Literature.
4. 'Puranaanuru' in SangaTamil Literature.
5. 'Pathitrupaththu' in SangaTamil Literature.

UNIT I SANGA TAMIL LITERATUREANINTRODUCTION 9

Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar-Tamil Sangam Literature's parables.

UNIT II 'AGATHINAI'AND'PURATHINAI' 9

Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History of Culturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.

UNIT III 'ATTRUPPADAI'. 9

AttruppadaiLiterature–Attruppadaiin'Puranaanuru'-Attruppadaiin'Pathitrupaththu'-Attruppadai in 'Paththupaattu'.

UNIT IV 'PURANAANURU' 9

Puranaanuru on Good Administration, Rulerand Subjects–Emotion & its Effectin Puranaanuru.

UNIT V 'PATHITRUPATHTHU' 9

Pathitrupaththuin'Ettuthogai'–Pathitrupaththu'sParables–Tamildynasty:Valor,Administration, Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.

Total (L:45) = 45 PERIODS

COURSE OUTCOMES:

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

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate'Agathinai' and'Purathinai'in their personal and societallife.
3. Appreciate and apply the messages in' Attruppadai' in their personal and societalife.
4. Appreciate and apply the messages in' Puranaanuru' in their personal and societallife.
5. Appreciate and apply the messages in' Pathitrupaththu' in their personal and societallife.

REFERENCES:

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: Ancient Poems of Love and War, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1									0.9						0.6
2									0.9						0.6
3									0.9						0.6
4									0.9						0.6
5									0.9						0.6

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171	**LANGUAGE AND COMMUNICATION**	**LT P C**
		3 0 0 3

COURSE DESCRIPTION

This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives

- ✓ To familiarize students with the concept of communication using linguistic and non linguistic resources.
- ✓ To help students ask critical questions regarding facts and opinions.
- ✓ To provide students with the material to discuss issues such as language and power structures.
- ✓ To help students think critically about false propaganda and fake news.

Learning Outcomes

- ➢ Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
- ➢ Students will be able to analyse communication in terms of facts and opinions.
- ➢ Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9

a) Writing and Speech

b) Distinction between language structure and language use, form and function, acceptability and grammaticality

c) Gestures and Body language, pictures and symbols, cultural appropriacy

d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II STRUCTURE OF WRITING/CONVERSATION: 9

a) Language skills and the communication cycle; speaking and listening, writing and reading

b) Initiating and closing conversations, intervention, turn taking

c) Writing for target reader, rhetorical devices and strategies

d) Coherence and Cohesion in speech and writing

UNIT III POWER STRUCTURE AND LANGUAGE USE: 9

a) Gender and language use

b) Politeness expressions and their use

c) Ethical dimensions of language use

d) Language rights as part of human rights

UNIT IV MEDIA COMMUNICATION: 9

a) Print media, electronic media, social media

b) Power of media

c) Manufacturing of opinion, fake news and hidden agendas

UNIT V PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9

a) Fundamentals of persuasive communication

b) Persuasive strategies

c) Communication barriers

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Austin, 1962, J.L. How to do things with words. Oxford: Clarendon Press. Grice, P.1989. Studies in the way of words. Cambridge, M.A: Harvard University Press.
2. Chomsky, N.1966. Aspects of the theory of syntax, The MIT press, Cambridge. Chomsky, N.2006. Language and Mind, Cambridge University Press.
3. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
4. Gilbert, H.Harman, 1976. Psychological aspect of the theory of syntax in Journal of Philosophy, page 75-87.
5. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University press.
6. Stangley, J. 2007. Language in Context. Clarendon press, Oxford. 7. Shannon, 1942. A Mathematical Theory of Communication. 8. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge University Press.

HU5172 **VALUES AND ETHICS** **L T P C**

3 0 0 3

OBJECTIVES:

- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic-Social-Aesthetic-Moral and Religious values

UNIT II CONCEPTS RELATED TO VALUES 9

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III IDEOLOGY OF SARVODAYA 9

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV SUSTENANCE OF LIFE 9

The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V VIEWS ON HIERARCHY OF VALUES 9

The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand definition and classification of values.
CO2: Able to understand purusartha.
CO3: Able to understand sarvodaya idea.
CO4: Able to understand sustenance of life.
CO5: Able to understand views of hierarchy of values.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓	✓			✓
CO2								✓	✓			✓
CO3								✓	✓			✓
CO4								✓	✓			✓
CO5								✓	✓			✓

TEXTBOOKS:

1. AwadeshPradhan :MahamanakeVichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
3. William, K Frankena : Ethics (Prentice Hall of India, 1988)

HU5173 **HUMAN RELATIONS AT WORK** **L T P C**

3 0 0 3

OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9

Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9

Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9

Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY 9

Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓		✓	✓			✓
CO2									✓	✓		✓
CO3						✓		✓	✓			✓
CO4								✓				✓
CO5								✓	✓	✓		✓

TEXT BOOK:

1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

REFERENCES:

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

HU5174 **PSYCHOLOGICAL PROCESSES** **L T P C**
3 0 0 3

COURSE DESCRIPTION

Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people's psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES

The major objectives of this course is

- To develop students' awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION

What is psychology? - Why study psychology? - Psychology as science – Behavior and its role in human communication – socio-cultural bases of behaviour – Biological bases of behavior - Brain and its functions – Principles of Heredity – Cognition and its functions Fields of psychology – Cognitve and Perceptual – Industrial and Organizational.

UNIT 2: SENSORY & PERCEPTUAL PROCESSES

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal-external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

UNIT 3: COGNITION & AFFECT

Learning and memory – philosophy of mind – concepts - words – images – semantic features – Association of words – Repetition – Retrieval – Chunking - Schemata - Emotion and motivation – nature and types of motivation – Biological & Psychosocial motivation – nature and types of emotions – physiological & cognitive bases of emotions – expressions of emotions – managing negative emotions - enhancing positive emotions.

UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING

Thinking skills – Types of thinking skills – Concrete & Abstract thinking – Convergent & Divergent - Analytical & Creative thinking – Problem & Possibility thinking – Vertical & Lateral thinking – Problem solving skills – stages of problem solving skills – Decision making - intuition and reasoning skills - Thinking and language - The thinking process- concepts, problem solving, decision-making, creative thinking; language communication.

UNIT 5: PERSONALITY & INTELLIGENCE

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

References

1. Morgan, C.T.and King, R.A (1994) Introduction to Psychology, Tata McGraw Hill Co Ltd, New Delhi.
2. Robert A. Baron (2002), Psychology, 5th Edition, Prentice Hall, India.
3. Michael W.Passer, Ronald E.smith (2007), Psychology: The science of mind and Behavior,3rd Edition Tata McGraw-Hill Edition.
4. Robert S.Feldman (2004) Understanding Psychology 6th Edition Tata McGraw – Hill.
5. Endler, N. S., & Summerfeldt, L. J. (1995). Intelligence. personality. psychopathology. and adjustment. In D. H. Saklofske & M. Zeidner (Eds.). International handbook of personality and intelligence (pp. 249-284). New York: Plenum Press.
6. Ford, M. E. (1994). A living systems approach to the integration of personality and intelligence. In R. J. Sternberg. & P. Ruzgis (Eds.). Personality and intelligence (pp. 188-21 7). New York: Cambridge University Press.

- De Bono, E (1990) Lateral Thinking, Harper Perennial, New York.

HU5175 EDUCATION, TECHNOLOGY AND SOCIETY L T P C

3 0 0 3

COURSE DESCRIPTION

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:

The course aims

- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES

By the end of the course, learners will be able to

- Understand the various apps of technology apps and use them to access, generate and present information effectively.
- Apply technology based resources and other media formats equitably, ethically and legally.
- Integrate their technical education for betterment of society as well as their personal life.

UNIT I INDIAN EDUCATION SYSTEM

Gurukul to ICT education – Teacher as facilitator – Macaulay's Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II LEARNING THEORIES

Learning Theories – Behaviorism – Cognitivism – Social Constuctivism – Humanism Learning Styles – Multiple Intelligences – Emotional Intelligence – Blooms Taxonomy

UNIT III TECHNOLOGICAL ADVANCEMENTS

Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV EDUCATIONAL TECHNOLOGY

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V ETHICAL IMPLICATIONS

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL:45 PERIODS

TEACHING METHODS

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)

(a) Written Test (40 marks)
(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)
(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)
(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)
(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington

HU5176 **PHILOSOPHY** **L T P C**

3 0 0 3

OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To Fosters critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one's self and others.

UNIT I KNOWLEDGE 9

Knowledge (Vidya) Versus Ignorance (Avidya)- Brihadaranyaka Upanishad. Unity and Multiplicity – Isha Upanishad. What is True Knowledge? Ways to True Knowledge. Introduction to Philosophy of Yoga, Socratic Debate, Plato's Views. Asking and Answering Questions to Stimulate Critical Thinking and to Draw Ideas. Argumentative Dialogues. Dialectical Methods to Arrive at Conclusions.

UNIT II ORIGIN 9

Origin of Universe And Creation – 'Nasidiya Sukta' in Relation With Big Bang Theory. Greek Concept of Chaos. The Concept of Space – Space as the Final Goal – Udgitha. Relationship Between Teacher And Student – The Knowledge Of Combinations, Body And Speech – Siksha Valli – Taittriya Upanishad.

UNIT III WORD 9

Aum- Speech and Breath as Pair – Chandogya Upanishad and Brihadaryanaka Upanishad. Significance of Chants, Structure of Language and Cosmic Correspondences. The Non-Dual Word – Bhartrihari's Vakyapadiyam. Sphota-Ultimate Reality Expressed Through Language. Intention. Thought 'Sabdanaor' and Speaking.

UNIT IV KNOWLEDGE AS POWER/OPPRESSION 9

Power- as Self-Realization in Gita. Krishna's Advice to Arjuna on How to Conquer Mind. Francis Bacon – Four Idols – What Prevents One From Gaining Knowledge? Michel Foucault- Knowledge as Oppression. Panopticon. Rtam (Truth) and Satyam (Eternal Truth).

UNIT V SELF KNOWLEDGE/BRAHMAN 9

Knowledge about Self, Transcendental Self. The Different Chakras and the Stages of Sublimation. Philosophy of Yoga and Siva for Union of Mind and Body. Concept of Yin/Yang. Aspects of the Feminine / Masculine.

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:

1. Swami Nikhilananda: The Upanishads, Swami Nikhilananda, Advaita Ashrama, Kolkata.
2. Swamy Tapasyananda: Srimad Bhagavad Gita, The Scripture of Mankind, Sri Ramakrishna Math, Chennai.
3. Subrahmanyam, Korada: Vakyapadiyam of Bhartrhari Brahmakanda, Sri Garib Dass series.
4. Swami Lokeswarananda: Chandogya Upanishad, Swami Lokeswarananda, Ramakrishna Mission Institute of Culture, Kolkata.
5. Brahma, Apuruseya: The Four Vedas: Translated in English.
6. Haich, Elizabeth: Sexual Energy and Yoga.
7. Bacon, Francis: Power as Knowledge
8. Vlastos, Gregory: Socrates Ironist and Moral Philosopher.
9. Plato: The Republic, Penguin.
10. Gutting, Garry: Foucault A Very Short Introduction, Oxford.

HU5177 APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE L T P C
3 0 0 3

UNIT I INTRODUCTION 7

Nature and fields.

UNIT II PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS 9

Job analysis; fatigue and accidents; consumer behavior.

UNIT III PSYCHOLOGY AND MENTAL HEALTH 11

Abnormality, symptoms and causes psychological disorders

UNIT IV PSYCHOLOGY AND COUNSELING 7

Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V PSYCHOLOGY AND SOCIAL BEHAVIOUR 11

Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New Jersey:Pearson/Prentice Hall
2. Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.). New York: Pearson
3. Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson Education
4. Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7th Ed.). Upper Saddle River, NJ: Prentice Hall

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

HU5271 GENDER, CULTURE AND DEVELOPMENT L T P C
3 0 0 3

COURSE DESCRIPTION

This course offers an introduction to Gender Studies that asks critical questions about the meanings of sex and gender in Indian society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary drawing from Indian literature and media studies, to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with class, caste and other social identities. This course also seeks to build an understanding of the concepts of gender, gender-based violence, sexuality, and rights and their impact on development through a number of discussions, exercises and reflective activities.

Objectives

- ✓ To familiarize students with the concepts of sex and gender through literary and media texts.
- ✓ To help students ask critical questions regarding gender roles in society.
- ✓ To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
- ✓ To help students think critically about gender based problems and solutions.

Learning Outcomes

- ➢ Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
- ➢ Students will be able to analyse current social events in the light of gender perspectives.
- ➢ Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.

UNIT I: Introduction to Gender

- Definition of Gender
- Basic Gender Concepts and Terminology
- Exploring Attitudes towards Gender
- Social Construction of Gender

Texts:

1. Sukhu and Dukhu (Amar Chitra Katha)
2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

UNIT II: Gender Roles and Relations

- Types of Gender Roles
- Gender Roles and Relationships Matrix
- Gender-based Division and Valuation of Labour

Texts:

1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)
2. Video: Witness: Freeing Women From Cleaning Human Waste (2014, HRW, Manual Scavenging, India)

UNIT III: Gender Development Issues

- Identifying Gender Issues
- Gender Sensitive Language
- Gender, Governance and Sustainable Development
- Gender and Human Rights
- Gender and Mainstreaming

Texts:

1. The Many Faces of Gender Inequality (Essay, Amartya Sen, Frontline, Volume 18 - Issue 22, Oct. 27 - Nov. 09, 2001)
2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)

UNIT IV: Gender-based Violence

- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
- Gender-based violence from a human rights perspective

Texts:

1. Lights Out (Play, Manjula Padmanabhan)

2. Lights Out (Video of play enacted)

UNIT V: Gender and Culture

- Gender and Film
- Gender, Media and Advertisement

Texts:

1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements

READINGS: Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

ASSESSMENT AND GRADING:

Discussion & Classroom Participation: 20%

Project/Assignment: 30%

End Term Exam: 50%

HU5272 **ETHICS AND HOLISTIC LIFE** **L T P C**
3 0 0 3

OBJECTIVES:

- To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.
- To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
- To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

UNIT I HUMAN LIFE, ITS AIM AND SIGNIFICANCE

The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

UNIT II CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT

Intellectual, Emotional, Creative, Ethico - spiritual development, Aesthetic sense, Self-dependency, Activeness, Development of positive attitude.

UNIT III HARMONY IN PERSONAL AND SOCIAL LIFE:

Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

UNIT IV CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE

Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE

Science, Technology, Consumerism, Relation with Nature and Environment, New dimension of Global Harmony: Democracy, Equality, Social Justice

TOTAL:45 PERIODS

OUTCOMES:

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

1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and integrate them in their personality after cross examination.
3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.

HU5273 LAW AND ENGINEERING L T P C
3 0 0 3

UNIT I THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURT STRUCTURE 9

Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court) Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

UNIT II LAWS 9

Basic principles of contract law, sale of goods law, laws relating to industrial pollution, accident, environmental protection, health and safety at work, patent law, constitutional law: the supreme law of the land, Information technology law and cyber crimes.

UNIT III BUSINESS ORGANISATIONS 9

Sole traders (Business has no separate identity from you, all business property belongs to you).

Partnerships: Types of Partnerships - Limited Liability Partnership, General Partnership, Limited Partnerships. Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, Carrying on business, Directors– Their Powers and Responsibilities/Liabilities.

UNIT IV LAW AND SOCIETY 9

Interdisciplinary nature of law, legal ideologies/philosophy/ schools of jurisprudence**.**

UNIT V CASE STUDIES 9

Important legal disputes and judicial litigations

TOTAL: 45 PERIODS

HU5274 FILM APPRECIATION L T P C
3 0 0 3

COURSE DESCRIPTION

This is an intensive course designed to promote comprehensive understanding and insights into the nature of cinema and other related forms and practices. Movies, though at times are used more as escapism, they are also a true art form and expressive tool used by writers, directors and actors. This course will explore the aesthetics of cinema, the concepts behind storytelling and various other elements of a film. It will also explore the impact of movies in our society and in our lives. It also encourages students to use films as a medium to analyse visual texts and read underlying messages.

OBJECTIVES:

- To help learners understand the various movie genres and its types.
- To understand various elements that contributes to film making.
- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

UNIT I THE COMPONENTS OF FILMS 9

Story, Screenplay & Script – Actors – Director – Crew Members – Mis En Scene – Structure of A Film – Narrative Elements – Linear & Non-Linear – Types of Movie Genres: Mysteries, Romantic Comedies, Horror Etc.

UNIT II EVOLUTION OF FILM 9

History of Films – Early Cinema – Silent Movies – Talkies – Film Language, Form, Movement – Film Theories – Realist, Auteurists, Feminist, Psychonalyic, Idealogical Theories.

UNIT III FILMS ACROSS THE WORLD 9

European Films – Russian Films – Japanese Films – Korean Films – Hollywood Film – Studio Culture – All Time Great Movies.

UNIT IV INDIAN FILMS 9

The Early Era – History Of Indian Cinema – Movies for Social Change – Hindi Movies that Created Impact – Regional Movies – Documentaries – Cultural Identity.

UNIT V INTERPRETING FILMS 9

Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

TOTAL: 45 PERIODS

OUTCOMES

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

- Recognize types of films, their impact on society and their roles in our lives.
- Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
- Interpret the underlying messages in the movies.

Teaching Methods

- Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

Evaluation

- As this is course is critical appreciation course on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

Internal (100 % weightage)

- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment2 : Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)

- Group discussion : Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971
4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983
5. The Encyclopedia of Indian Cinema Edited by Ashish Rajadhyaksha and Paul Willemen, BFI, 1994.

HU5275 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS L T P C

3 0 0 3

OBJECTIVES

- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

CONTENTS : -

UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW 9

Language and Linguistics-Linguistic Knowledge-Knowledge of Sound Systems & Words – Creativity of Language – Relationship of form and meaning. Grammar – descriptive, prescriptive,universal-Human Language – Animal Language – Sign Language- Computers and Language.

UNIT II MORPHOLOGY - WORDS OF LANGUAGE 9

Content and function words – morphemes -free & bound –prefixes – suffixes – roots and stems – inflectional and derivational morphology-compound words and their formation – malapropisms – slips of the tongue.

UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE 9

Syntax : Rules of Syntax- Sentence Structure-Structural Ambiguity-Syntactic Categories. Semantics: Lexical Semantics – Anomaly-Metaphors- Idioms- Synonyms – Antonyms – Homonyms -Pragmatics– Speech Acts

UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE 9

Speech sounds- Introduction to branches of Phonetics- The Phonetic Alphabet – IPA – Consonants - Vowels – Diphthongs- Tone and Intonation.

UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE 9

Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

TOTAL : 45 PERIODS

Teaching Methods :

Lectures, discussion.

Evaluation Internal and External :

Internal: 2 written tests + assignments, seminars, project (50+15+15+20).

External: A 3 hour written exam (50 marks)

REFERENCES :

1.Victoria Fromkin, Robert Rodman, Nina Hyams.2019.An Introduction to Language.USA.CENGAGE.11th edition

2. Cook. G,2003. Applied linguistics.UK: Oxford University Press.

HU5276 UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE L T P C

3 0 0 3

OBJECTIVES

- To internalize the importance of language by understanding its role in the transformation of man.
- To look at language, literature and culture as locus of identity and change.
- To extract meaning from existing literatures and cultures.
- To identify meanings in modern life by reconnecting with lost cultures.

Unit 1 Introduction

Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral -Logography. Reading out literature to young children- Edmund J Farrell.

Unit 2. Reading Culture

Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel's ' The night of the Scorpion' . 'Nothing's Changed'- Tatamkhulu Afrika- Apartheid. Ruskin Bond- 'Night train at Deoli'- How real life is different from movies.

Unit 3. Identifying Meaning

Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar's 'Jagat Mithya'- the world as an illusion. The Indian version as 'meaninglesss meaning'.

Unit 4. Post Modernism

'If on a winter's night a traveler'- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.

Unit 5. Returning to Pictures

Literature of the present- Emphasis on the visual world. Twitterature. SMS. Whatsapp language. Consumer culture. Change in fixed gender notions. Interactive sessions. Introspection.

Reading list

1. Bond, Ruskin: 'Night train at Deoli'
2. Ezekiel, Nissim: ' The Night of the Scorpion'
3. Afrika,Tatamkhulu: 'Nothing's Changed'
4. Barthes, Roland: *Mythologies*
5. Shankaracharya: *Viveka Chudamani*
6. Camus, Albert- *The Myth of Sisyphus*
7. Calvino, Italo: *If on a winter's night a traveler*
8. Farrell, Edmund J: 'Listen, my children, and you shall read'

Outcome

- Can identify the connections among language, literature and culture.
- Is able to relate between seemingly different aspects of life.
- Understands the fractions in modern life and can assimilate meanings.