DEPARTMENT OF BIOTECHNOLOGY

ANNA UNIVERSITY, CHENNAI

VISION:

The Department of Biotechnology is committed to evolve as a world class science and technology centre by integrating quality and ethics in teaching and research.

MISSION:

The mission of the department is

- To provide students a unique and multidisciplinary learning experience that will foster the young minds to develop as a researcher, entrepreneur etc.
- To enhance academic and industrial collaborative research initiatives for the development of biotechnological, food and therapeutic products.
- To emphasise and equip the students towards innovative industrial and research updates.
- To serve the society with utmost commitment, integrity, enthusiasm, and dedication.

ANNA UNIVERSITY, CHENNAI: 600 025

UNIVERSITY DEPARTMENTS

B. TECH. PHARMACEUTICAL TECHNOLOGY
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM (CBCS)

1. PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

The primary objective of the Bachelor of Pharmaceutical Technology program is to prepare professionals with the basic skills required to work in the pharmaceutical industry (bulk and formulation) with emphasis on the engineering, regulatory, quality control and research aspects of drug manufacturing, pharmaceutical production, pharmaceutical development, and pharmaceutical operations. The program objective also tends to focus on imparting fundamental knowledge on drug chemistry, mechanism and allied disciples that will be relevant in upholding and supporting the primary objectives and aims to train them for the following goals,

I. To generate trained undergraduates with state of the art knowledge in pharmaceutical technology and allied subjects in an ambience of motivation that could stimulate growth and excellence

II. To create undergraduates who are trained and synchronized with the requirements of the pharmaceutical industry and adapt readily to national healthcare programmes.

III. To create professionals with outstanding caliber who would be an asset in various areas including education, research, industry and government

IV. To mould students to emerge as future leaders of the pharmaceutical industry and as an entrepreneur.

V. To sensitize students to local and global needs of environment protection and sustainability

2. PROGRAM OUTCOMES (POs):

After going through the four years of study, our Pharmaceutical Technology Undergraduates will exhibit ability to

	Graduate Attribute	Program Outcome
PO1	Pharmaceutical Technology Knowledge	Acquaint and apply the knowledge of mathematics, basic sciences, chemical engineering, and formulation sciences in pharmaceutical technology.
PO2	Problem Analysis	Explore, identify, formulate and analyze problems in pharmaceutical technology for reaching substantiated conclusions using principles of mathematics, natural sciences, and pharmaceutical engineering/sciences.
PO3	Design/development of solutions	Derive solutions for pharmaceutical technology problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, 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, to provide valid conclusions.

PO5	Modern tool usage	Create, select, and apply appropriate techniques, resources, modern engineering and IT tools including prediction and modeling to complex pharmaceutical technology activities with an understanding of the limitations.
PO6	The engineer and society	Apply reasoning formed by the knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice of Pharmaceutical technology.
PO7	Environment and sustainability	Understand the impact of the professional pharmaceutical technology solutions in societal and environmental contexts, and demonstrate the knowledge needed for sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional responsibilities and norms in the practice of pharmaceutical technology.
PO9	Individual and team work	Function effectively as an individual/ member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication	Communicate effectively on complex Pharmaceutical technology activities with the Pharmaceutical community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, give and receive clear instructions.
PO11	Project management and finance	Apply these to one's own work, as a member/leader in a team, to manage projects in cost-effective manner and also extend the same in multidisciplinary environments.
PO12	Life-long learning	Recognize the need for, 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 Pharmaceutical Technology Undergraduates Program the student will have following Program Specific outcomes

I. Foundations of Pharmaceutical Chemistry: Ability to understand the basics in the general chemistry, organic chemistry and inorganic chemistry pertaining to pharmaceutical bulk and formulation industries and provide relevant theoretical background.

II. Foundations of Medicinal Chemistry and Pharmacology & chemotherapy: Ability to encompass drug design, drug synthesis, and the evaluation of drug efficacy and drug safety.

III. Applications of Dosage Form technology: Ability to use knowledge in various domains of Dosage Form Technology to develop new Dosage Form which will provide solution to the current problem of drug delivery. To provide fundamental understanding on various unit processes and chemical engineering principles that will have relevance in pharmaceutical bulk and formulation industries and make the students ready for industrial employment.

IV. Applying the knowledge and training in Pharmaceutical technology to pursue higher studies and research. Develop as entrepreneurs and technocrats to furnish policies related to pharmaceutical industries.

4. MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

PROGRAMED UCATIONAL O BJECTIVES (P EOS)	PROGRAMME OUTCOMES											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
I	✓	✓	✓				✓	✓				
II						✓		✓	✓	✓	✓	✓
III		✓	✓	✓	✓		✓	✓	✓	✓		
IV			✓	✓	✓					✓	✓	✓
V	✓	✓	✓						✓	✓	✓	✓

5. MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1st Year	1st SEM	Technical English												
		Engineering Mathematics – I												
		Engineering Physics												
		Engineering Chemistry												
		Problem solving and Python programming												
		தமிழர் மரபு /Heritage of Tamils												
		Basic Sciences Laboratory												
		Problem solving and Python programming Laboratory												
		English Laboratory$												
		Professional Communication												
		Engineering Mathematics – II												

	2nd SEM	Applied Thermodynamics of Pharmaceutical Systems	-	1	2	-	2	2	-	2	3	2	-	2
		Basics of Electrical and Electronics engineering												
		Microbiology	1	2	2	3	2	2	-	3	3	3	-	3
		Biochemistry for Pharmaceutical Technology	2	3	3	3	2	1	-	-	-	-	-	3
		தமிழரும் தொழில்நுட்பமும் / Tamils and Technology												
		Microbiology Laboratory	3	-	-	2	-	3	2	3	3	3	-	3
		Biochemistry	2	3	3	3	2	1	-	-	-	-	-	3
		Communication Laboratory / Foreign Language												
		Transform Techniques and Partial Differential Equations												
2nd YEAR	3rd SEM	Physical Pharmaceutics	2	1	1	1	-	1	1	-	-	1	-	1
		Chemical Process Calculations	3	3	2	2	2	3	1	-	3	1	3	3
		Human Anatomy and Physiology	2	1	1	-	-	-	-	-	-	-	-	2
		Pharmaceutical Chemistry	2	-	1	1	1	-	-	-	-	-	-	2
		Elective - Humanities I												
		Physical Pharmaceutics Laboratory	2	2	1	1	-	-	-	-	-	-	-	2
		Physiology Laboratory	2	1	1	-	-	-	-	-	-	-	-	1
		Professional Development$												
		Elective - Humanities II												
		Environmental Sciences	2	3	2	2	2	1	2	2	-	-	-	1
		Audit Course I												
		Probability and statistics												

	4th SEM	Fluid mechanics and heat transfer operations	2	2	1	2	-	-	1	2	-	-	3	1
		Cell and Molecular Biology	2	3	2	3	2	1	-	-	-	-	-	3
		Pharmaceutical Analysis	3	2	1	1	2	1	1	1	-	1	-	3
		Pharmaceutical Analysis Laboratory	2	1	1	1	-	-	-	-	-	-	-	2
		Cell and Molecular Biology Laboratory	3	3	2	3	3	2	2	1	-	-	-	-
3rd YEAR	**5th SEM**	Total Quality management												
		Audit Course II												
		Medicinal Chemistry	3	2	2	2	2	2	-	-	-	-	-	2
		Unit Operations in Pharmaceutical Industries	3	3	3	3	3	3	3	1	3	1	2	3
		Professional Elective I												
		Professional Elective II												
		Medicinal Chemistry Laboratory	3	2	1	2	2	3	1	2	1	2	2	-
		Chemical engineering Laboratory	3	3	2	2	1	3	2	1	2	3	3	3
3rd YEAR	**6th SEM**	Technology of Solid and Semi solid Dosage Forms	3	2	2	2	2	3	2	3	2	3	2	2
		Mass Transfer operations in Pharmaceutical Technology	3	3	3	3	1	1	1	-	-	-	2	3
		Pharmacology and chemotherapy	3	2	2	1	2	2	2	2	3	2	2	2
		Open Elective I												
		Professional Elective III												
		Professional Elective IV												
		Pharmacology Laboratory	2	2	2	1	2	2	2	2	3	2	3	1
		Dosage Forms Laboratory	2	2	2	3	3	3	2	2	1	2	1	1

4th YEAR	**7th SEM**	Biopharmaceutics and Pharmacokinetics	2	2	1	2	2	-	1	-	-	-	-	2
		Drug delivery systems	2	1	1	2	2	-	1	-	-	-	-	2
		Open Elective - II												
		Professional Elective V												
		Professional Elective VI												
		Professional Elective VII												
		Project I	2	2	1	1	1	2	-	2	2	2	-	2
		Novel Drug Delivery Systems Laboratory	2	2	2	2	-	1	-	-	-	-	2	2
		Biopharmaceutics and Pharmacokinetics laboratory	2	2	1	1	2	1	3	-	-	2	3	2
		Internship / Training (Minimum 4 Weeks)	1	1	2	1	1	-	-	2	2	1	1	2
	8th SEM	Project II	2	2	3	3	2	1	2	3	3	2	2	3

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

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B. TECH. PHARMACEUTICAL TECHNOLOGY

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM CURRICULUM AND

SYLLABI FOR I TO VIII SEMESTERS

(Applicable to students admitted from the Academic Year 2022-2023 onwards)

SEMESTER I

SI. NO.	CODE NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	HS5151	Technical English	HSMC	3	0	0	3	3
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	GE5153	Problem solving and Python programming	ESC	3	0	0	3	3
6..	GE5154	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
6	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
7	GE5161	Problem solving and Python programming Laboratory	ESC	0	0	4	4	2
8	GE5163	English Laboratory[$]	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

[$] Skill Based Course

SEMESTER II

Sl. NO	CODE NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS5251	Professional communication	HSMC	2	0	0	2	2
2.	MA5252	Engineering Mathematics – II	BSC	3	1	0	4	4
3.	PM5201	Applied Thermodynamics of Pharmaceutical Systems	ESC	2	1	0	3	3
4.	EE5251	Basics of Electrical and Electronics engineering	ESC	3	0	0	3	3
5.	IB5251	Microbiology	PCC	3	0	0	3	3
6.	PM5202	Biochemistry for Pharmaceutical Technology	PCC	3	0	0	3	3
7.	GE5252	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	1	1
PRACTICALS								
8.	IB5261	Microbiology Laboratory	PCC	0	0	4	4	2
9.	IB5361	Biochemistry Laboratory	PCC	0	0	4	4	2
10.	GE5262	Communication Laboratory / Foreign Language	EEC	0	0	4	4	2
			TOTAL	**11**	**2**	**12**	**31**	**25**

SEMESTER III

Sl. No.	CODE NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MA5355	Transform Techniques and Partial Differential Equations	BSC	3	1	0	4	4
2	PM5301	Physical Pharmaceutics	ESC	3	0	0	3	3
3	PM5302	Chemical Process Calculations	ESC	2	1	0	3	3
4	PM5303	Human Anatomy and Physiology	PCC	3	0	0	3	3
5	PM5304	Pharmaceutical Chemistry	PCC	3	0	0	3	3
6		Elective - Humanities I	HSMC	3	0	0	3	3
PRACTICALS								
7	PM5311	Physical Pharmaceutics Laboratory	ESC	0	0	4	4	2
8	PM5312	Physiology Laboratory	PCC	0	0	4	4	2
9.	GE5361	Professional Development[$]	EEC	0	0	2	2	1
			TOTAL	**17**	**2**	**10**	**29**	**24**

[$] Skill Based Course

SEMESTER IV

Sl. No.	CODE NO	COURSE TITLE	CATEGORY	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	MA5354	Probability and Statistics	BSC	3	1	0	4	4
5	IB5452	Fluid mechanics and heat transfer operations	ESC	3	1	0	4	4
6	PM5401	Cell and Molecular Biology	PCC	3	0	0	3	3
7	PM5402	Pharmaceutical Analysis	PCC	3	0	0	3	3
PRACTICALS								
8	PM5411	Pharmaceutical Analysis Laboratory	PCC	0	0	4	4	2
9	PM5412	Cell and Molecular Biology Laboratory	PCC	0	0	4	4	2
			TOTAL	**21**	**2**	**8**	**31**	**24**

***** Audit Course is optional

SEMESTER V

Sl. No.	CODE NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL ONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	GE5451	Total Quality Management	HSMC	3	0	0	3	3
2		Audit Course -II*	AC	3	0	0	3	0
3	PM5501	Medicinal Chemistry	PCC	3	0	0	3	3
4	PM5502	Unit Operations in Pharmaceutical Industry	PCC	2	1	0	3	3
5		Professional Elective I	PEC	3	0	0	3	3
6		Professional Elective II	PEC	3	0	0	3	3
PRACTICALS								
7	PM5511	Medicinal Chemistry Laboratory	PCC	0	0	4	4	2
8	IB5451	Chemical engineering Laboratory	PCC	0	0	4	4	2
TOTAL				**17**	**1**	**8**	**26**	**19**

* Audit Course is optional

SEMESTER VI

Sl. No.	CODE NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	PM5601	Technology of Solid and Semi solid Dosage Forms	PCC	3	0	0	3	3
2	PM5602	Mass Transfer operations in Pharmaceutical Technology	PCC	2	1	0	3	3
3	PM5603	Pharmacology and chemotherapy	PCC	3	0	0	3	3
4		Open Elective I	OEC	3	0	0	3	3
5		Professional Elective III	PEC	3	0	0	3	3
6		Professional Elective IV	PEC	3	0	0	3	3
PRACTICALS								
7	PM5611	Pharmacology Laboratory	PCC	0	0	4	4	2
8	PM5612	Dosage Forms Laboratory	PCC	0	0	4	4	2
9	PM5713	Internship/ Training (Minimum 4 Weeks)*	EEC	-	-	-	-	-
TOTAL				**17**	**1**	**8**	**26**	**22**

*****Student should undergo a Internship/ Training for which assessment will be done in the seventh semester

SEMESTER VII

Sl. No.	CODE NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	PM5701	Biopharmaceutics and Pharmacokinetics	PCC	3	0	0	3	3
2	PM5702	Drug delivery systems	PCC	3	0	0	3	3
3		Open Elective - II	OEC	3	0	0	3	3
4		Professional Elective V	PEC	3	0	0	3	3
5		Professional Elective VI	PEC	3	0	0	3	3
6		Professional Elective VII	PEC	3	0	0	3	3
PRACTICALS								
7	PM5711	Novel Drug Delivery Systems Laboratory	PCC	0	0	4	4	2
8	PM5712	Biopharmaceutics and Pharmacokinetics laboratory	PCC	0	0	4	4	2
9	PM5713	Internship/ Training (Minimum 4 Weeks)*	EEC	-	-	-	-	2
10	PM5714	Project I	EEC	0	0	6	6	3
TOTAL				**18**	**0**	**14**	**32**	**27**

SEMESTER VIII

Sl. No.	CODE NO	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	PM5811	Project II	EEC	0	0	16	16	8
TOTAL				**0**	**0**	**16**	**16**	**8**

TOTAL NO. OF CREDITS: 171

PROFESSIONAL ELECTIVES (PEC)

Sl. No	CODE NO	COURSE TITLE	CATEGORY	TOTAL CONTACT PERIODS	L	T	P	CREDITS
1	PM5001	Pharmacognosy	PEC	3	2	0	2	3
2	PM5002	Clinical Research and Pharmacovigilance	PEC	3	3	0	0	3
3	PM5003	Chemistry of Natural Products	PEC	3	3	0	0	3
4	PM5004	Medicinal Chemistry of Therapeutic Agents	PEC	3	3	0	0	3
5	PM5005	Pharmacology of Therapeutic Agents	PEC	3	3	0	0	3
6	CH5751	Transport Phenomena	PEC	3	2	1	0	3
7	PM5006	Colloids and Interfacial Phenomena	PEC	3	3	0	0	3
8	PM5007	Computer Aided Drug Design	PEC	3	3	0	0	3
9	PM5008	Experimental Design and Biostatistics	PEC	3	3	0	0	3
10	PM5009	Fundamentals of Material Science and Engineering	PEC	3	3	0	0	3
11	IB5017	Fundamentals of Molecular Pathology	PEC	3	3	0	0	3
12	PM5011	Fundamentals of Polymer Science and Engineering	PEC	3	3	0	0	3
13	PM5012	Biomaterials and Tissue Engineering	PEC	3	3	0	0	3
14	PM5013	Molecular Modeling and Drug Design	PEC	3	3	0	0	3
15	PM5014	Nutraceuticals	PEC	3	3	0	0	3
16	PM5015	Principles of Bioengineering	PEC	3	3	0	0	3
17	PM5016	Vaccine Technology	PEC	3	3	0	0	3
18	GE5074	Fundamentals of Nanoscience	PEC	3	3	0	0	3
19	CH5072	Instrumentation and Process Control	PEC	3	3	0	0	3
20	IB5071	Bioconjugate Technology and Applications	PEC	3	3	0	0	3
21	IB5072	Biological Spectroscopy	PEC	3	3	0	0	3

22	IB5025	Protein Structure and Function	PEC	3	3	0	0	3
23	IB5752	Bioinformatics	PEC	3	3	0	0	3
24	IB5751	Downstream Processing	PEC	3	3	0	0	3
25	IB5075	Metabolic Engineering	PEC	3	3	0	0	3
26	PM5018	Bioprocess equipment design	PEC	3	2	1	0	3
27	IB5551	Immunology	PEC	3	3	0	0	3
28	IB5010	Developmental biology	PEC	3	3	0	0	3
29	IB5076	Biosafety	PEC	3	3	0	0	3
30	PM5019	Nutragenetics	PEC	3	3	0	0	3
31	IB5073	Chemical reaction engineering	PEC	3	2	1	0	3
32	PM5020	Technology of Sterile Dosage Forms and Dispersions	PEC	3	3	0	0	3
33	PM5021	Regulatory Issues in Pharmaceutical Industry	PEC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No	CODE NO	COURSE TITLE	L	T	P	CREDITS	SEMESTER
1.	MA5158	Engineering Mathematics – I	3	1	0	4	I
2.	PH5151	Engineering Physics	3	0	0	3	I
3.	CY5151	Engineering Chemistry	3	0	0	3	I
4.	BS5161	Basic Sciences Laboratory	0	0	4	2	I
5.	MA5252	Engineering Mathematics II	3	1	0	4	II
6.	MA5355	Transform Techniques and Partial Differential Equations	3	1	0	4	III
7	GE5251	Environmental Sciences	3	0	0	3	IV
8.	MA5354	Probability and Statistics	3	1	0	4	IV

PROFESSIONAL CORE COURSES (PCC)

Sl. No	CODE NO	COURSE TITLE	L	T	P	CREDITS	SEMESTER
1.	IB5251	Microbiology	3	0	0	3	II
2.	PM5202	Biochemistry for pharmaceutical technology	3	0	0	3	II
3.	IB5261	Microbiology Laboratory	0	0	4	2	II
4.	IB5361	Biochemistry Laboratory	0	0	4	2	II
5.	PM5303	Human Anatomy and Physiology	3	0	0	3	III
6.	PM5304	Pharmaceutical Chemistry	3	0	0	3	III
7	PM5312	Physiology Laboratory	0	0	4	2	III
8.	PM5401	Cell and Molecular Biology	3	0	0	3	IV
9.	PM5402	Pharmaceutical Analysis	3	0	0	3	IV
10.	PM5411	Pharmaceutical Analysis Laboratory	0	0	4	2	IV
11.	PM5412	Cell and Molecular Biology Laboratory	0	0	4	2	IV
12.	PM5501	Medicinal Chemistry	3	0	0	3	V
13.	PM5502	Unit Operations in Pharmaceutical Industries	2	1	0	3	V
14.	PM5511	Medicinal Chemistry Laboratory	0	0	4	2	V
15.	IB5451	Chemical engineering Laboratory	0	0	4	2	V
16.	PM5601	Technology of Solid and Semi solid Dosage Forms	3	0	0	3	VI
17.	PM5602	Mass Transfer operations in Pharmaceutical Technology	2	1	0	3	VI

18.	PM5603	Pharmacology and chemotherapy	3	0	0	3	VI
19.	PM5611	Pharmacology Laboratory	0	0	4	2	VI
20.	PM5612	Dosage Forms Laboratory	0	0	4	2	VI
21.	PM5701	Biopharmaceutics and Pharmacokinetics	3	0	0	3	VII
22.	PM5702	Drug delivery systems	3	0	0	3	VII
23.	PM5711	Novel Drug Delivery Systems Laboratory	0	0	4	2	VII
24.	PM5712	Biopharmaceutics and Pharmacokinetics laboratory	0	0	4	2	VII

ENGINEERING SCIENCE COURSES (ESC)

Sl. No	CODE NO	COURSE TITLE	L	T	P	CREDITS	SEMESTER
1.	GE5153	Problem solving and Python programming	3	0	0	3	I
2.	GE5161	Problem solving and Python programming Laboratory	0	0	4	2	I
3.	PM5201	Applied Thermodynamicsof pharmaceutical systems	2	1	0	3	II
4.	EE5251	Basics of Electrical and Electronics engineering	3	0	0	3	II
5.	PM5301	Physical Pharmaceutics	3	0	0	3	III
6.	PM5302	Chemical Process Calculations	2	1	0	3	III
7	PM5311	Physical Pharmaceutics Laboratory	0	0	4	2	III
8.	IB5452	Fluid mechanics and heat transfer operations	3	1	0	4	IV

HUMANITIES AND SOCIAL SCIENCES (HSMC) – MANAGEMENT AND OTHERS

Sl. No.	CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1	HS5151	Technical English	4	0	0	4	4	I
	GE5154	தமிழர் மரபு /Heritage of Tamils	1	0	0	1	1	i
	GE5252	தமிழரும் தொழில்நுட்பமும் /	1	0	0	1	1	II
2	HS5251	Professional Communication	4	0	0	4	4	II
5	GE5451	Total Quality Management	3	0	0	3	3	V

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

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	2/6
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	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	CODE NO	COURSE TITLE	L	T	P	CREDITS	SEMESTER
	GE5163	English Laboratory[$]	0	0	2	1	1
	GE5262	Communication Laboratory / Foreign Language[$]	0	0	4	2	2
	GE5361	Professional Development[$]	0	0	2	1	3
	TT5513	Internship / Training (Minimum 4 Weeks)	0	0	0	2	5
	PM5714	Project I	0	0	4	2	VII
	PM5811	Project II	0	0	16	8	VIII

SUMMARY

	SEM 1	SEM 2	SEM 3	SEM 4	SEM 5	SEM 6	SEM 7	SEM 8	Total
HSMC	4	3	3	3	3				16
BSC	12	4	4	7					27
PCC		10	8	10	10	13	10		61
ESC	5	6	8	4					23
PEC					6	6	9		21
AC(Non Credits)				0	0				0
OEC						3	3		6
EEC	1	2	1				5	8	17
Total Credit	22	26	22	24	19	22	27	8	**171**

SEMESTER I

HS5151 TECHNICAL ENGLISH L T P C
3 0 0 3

OBJECTIVES

- To build lexical competency and accuracy that will help learners to use language effectively.
- To learn various reading strategies that will enable learners to comprehend the different modes of reading materials of varied levels of complexity.
- To comprehend the linguistic aspects of various rhetorical structures and functions of Technical English and use them effectively in writing.

UNIT I INTRODUCING ONESELF 9

Theory:

Reading: Descriptive passages (From Newspapers / Magazines) – Writing: Writing a coherent paragraph (Native Place, School Life) – Grammar: Simple present tense, Present continuous tense – Vocabulary development: One word substitution.

UNIT II DIALOGUE WRITING 9

Theory:

Reading: Reading a print interview (Comprehension and inference questions) - Writing: Writing a checklist - Dialogue writing – Grammar: Simple past tense – Question formation (Wh-Questions, 'Yes' or 'No' Questions, Tag Questions) – Vocabulary Development: Lexical items relevant to the theme of the given unit.

UNIT III FORMAL LETTER WRITING 9

Theory:

Reading: Reading motivational essays on famous Engineers and Technologists (Answering Open – Ended and Closed Questions) – Writing: Writing formal letters/ emails – Grammar: Future tenses, Subject and verb agreement - Vocabulary Development: Collocations – Fixed expressions.

UNIT IV WRITING LETTERS OF COMPLAINT 9

Theory:

Reading: Reading Problem – Solution Articles/Essays Drawn From Various Sources – Writing: Making Recommendations – Writing a complaint Letter – Letter / email to the Editor – Note Making – Grammar: Use of modal verbs – Phrasal verbs – Cause-and-effect sentences – Vocabulary Development: Connectives, Use Of cohesive devices in writing, Technical vocabulary.

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 9

Theory:

Reading: Reading graphical material for comparison (Advertisements & Infographics) – Writing: Writing Definitions - One-line & extended definition – Compare-and-contrast paragraphs - Grammar: Adjectives – Degrees of comparison – Compound nouns – Compound words - Vocabulary Development: Use of Discourse Markers – Suffixes (Adjectival endings).

TOTAL : 45 PERIODS

LEARNING OUTCOMES:

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

- Use appropriate language structures and lexical items in authentic contexts.
- Read both general and technical texts and comprehend their denotative and connotative meanings.
- Write different kinds of formal documents with grammatical and lexical appropriacy.

Assessment Pattern

- Two written internal assessments to test learner's progress in grammar, vocabulary, reading and writing skills.
- End Semester exam to be tested in two parts: Theory exam for three hours and listening and speaking skills for two hours.

MA5158 ENGINEERING MATHEMATICS – I LT PC

(Common to all branches of B.E. / B.Tech. Programmes in I Semester) 3 1 0 4

OBJECTIVES

The course aims to,

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

UNIT I MATRICES 12

Eigenvalues and Eigenvectors of a real matrix – Characteristics equation – Properties of eigenvalues 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,

CO1 use the matrix algebra methods for solving practical problems.

CO2 apply differential calculus tools in solving various application problems.

CO3 use differential calculus ideas on several variable functions.

CO4 apply different methods of integration in solving practical problems.

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

TEXT BOOKS:

1. 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 Education, 2nd 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 LT PC
(Common to all branches of Engineering and Technology) 3 0 0 3

OBJECTIVES

The course aims to,

- make the students in understanding the importance of mechanics.
- equip the students on the knowledge of electromagnetic waves.
- introduce the basics of oscillations, optics and lasers.
- enable the students in understanding the importance of quantum physics.
- 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 the wave function - Normalization - Particle in an 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:

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

C**O1** understand the importance of mechanics.

CO2 express the knowledge of electromagnetic waves.

CO3 know the basics of oscillations, optics and lasers.

CO4 understand the importance of quantum physics**.**

CO5 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 LT PC

(Common to all branches of Engineering and Technology) 3 0 0 3

OBJECTIVES

The course aims to,

- introduce the basic concepts of polymers, their properties and some of the important applications.
- impart knowledge on the basic principles and preparatory methods of nanomaterials.
- facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- 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 photo quenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibration 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:

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

CO1 recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.

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

CO3 identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.

CO4 recognize different forms of energy resources and apply them for suitable applications in energy sectors.

CO5 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.

REFERENCES:

1. Sachdeva M V, “Basics of Nano Chemistry”, Anmol Publications Pvt Ltd, 2011
2. B.Sivasankar, “Instrumental Methods of Analysis”, Oxford University Press. 2012.
3. Friedrich Emich, “Engineering Chemistry”, Scientific International Ltd.2015
4. V RGowariker, N V Viswanathan and Jayadev Sreedhar, “Polymer Science” New AGE International Publishers, 2015

GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING LT PC

(Common to all branches of Engineering and Technology) 3 0 0 3

OBJECTIVES

The course aims to,

- know the basics of algorithmic problem solving.
- develop python programs with conditionals and loops.
- define python functions and use function calls.
- use python data structures - lists, tuples, dictionaries.
- 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 – Pseudocodes and 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:

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

CO1 develop algorithmic solutions to simple computational problems.

CO2 develop and execute simple Python programs.

CO3 write simple Python programs for solving problems.

CO4 decompose a Python program into functions.

CO5 represent compound data using Python lists, tuples, dictionaries etc.

CO6 read and write data from/to files in Python programs.

TEXT BOOKS:

1. Reema Thareja, “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.
3. 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.

GE5154 **தமிழர் மரபு** **L T P C**
1 0 0 1

அலகு I மொழி மற்றும் இலக்கியம்: **3**

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

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

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

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: **3**

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

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: **3**

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

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

GE5154 **HERITAGE OF TAMILS** **L T P C**
1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

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

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

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

UNIT III FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

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

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

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

(Common to all branches of Engineering and Technology) **0 0 4 2**

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVES

The course aims to,

- inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- induce the students to familiarize with experimental determination of the 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 wavelength 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 the 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:

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

CO1 determine various moduli of elasticity and also various thermal and optical properties of materials.

CO2 determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY (Minimum of 8 experiments to be conducted)

OBJECTIVES

The course aims to

- Inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- Induce the students to familiarize with electroanalytical techniques such aspH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- 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 polyvinyl alcohol 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

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

CO 1 analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO 2 determine the amount of metal ions through volumetric and spectroscopic techniques
CO 3 determine the molecular weight of polymers by viscometric method.
CO 4 quantitatively analyse the impurities in solution by electroanalytical techniques
CO 5 design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS

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

GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L T P C

0 0 4 2

OBJECTIVES

The course aims to,

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

LIST OF 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:

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

CO1 develop algorithmic solutions to simple computational problems

CO2 develop and execute simple Python programs.

CO3 structure simple Python programs for solving problems.

CO4 decompose a Python program into functions.

CO5 represent compound data using Python data structures.

CO6 apply Python features in developing software applications.

GE5163 **ENGLISH LABORATORY** **L T P C**
0 0 2 1

OBJECTIVES :

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

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

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

UNIT II NARRATION AND SUMMATION 6

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

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 6

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

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 6

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

UNIT V EXPRESSION 6

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

TOTAL : 30 PERIODS

LEARNING OUTCOMES:

At the end of the course, learners will be able

- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

ASSESSMENT PATTERN

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

SEMESTER II

HS5251 PROFESSIONAL COMMUNICATION L T P C
2 0 0 2

OBJECTIVES

- To comprehend various reading materials relevant to technical context and understand the main and supporting ideas of the reading materials.
- To write effective job applications along with detailed CV for internship or placements.
- To explore definitions, essay and report writing techniques and practice them in order to develop associated skills.

UNIT I TECHNICAL COMMUNICATION 6

Theory:

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

UNIT II SUMMARY WRITING 6

Theory:

Reading: Reading Technical Essays/ Articles and Answering Comprehension Questions – Writing: Summary Writing – Grammar: Participle Forms, Relative Clauses

UNIT III PROCESS DESCRIPTION 6

Theory:

Reading: Reading Instruction Manuals – Writing: Writing Process Descriptions – Writing Instructions – Grammar: Use of Imperatives, Active and Passive Voice, Sequence Words

UNIT IV REPORT WRITING 6

Theory:

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

UNIT V WRITING JOB APPLICATIONS 6

Theory:

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.

TOTAL : 30 PERIODS

LEARNING OUTCOMES

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

- Read and comprehend technical texts effortlessly.
- Write technical reports and job application for internship or placement.
- Learn to use language effectively in a professional context.

Assessment Pattern

- Two written internal assessments to test learner's progress in grammar, reading and writing skills.
- End Semester exam to be tested in two parts: Theory exam for three hours and listening and speaking skills along with vocabulary for two hours.

MA5252 **ENGINEERING MATHEMATICS – II** **LT PC**

(Common to all branches of Engineering and Technology) **3 1 0 4**

OBJECTIVES

The course aims to,

- acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- acquaint the students with Differential Equations which are significantly used in Engineering problems.
- 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 the 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 – Homogeneous 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:

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

CO1 calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.

CO2 construct analytic functions and use their conformal mapping property in application problems.

CO3 evaluate real and complex integrals using Cauchy's integral formula and the residue theorem.

CO4 apply various methods of solving differential equations which arise in many application problems.

CO5 apply Laplace transform methods for solving linear differential equations.

TEXT BOOKS:

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.

PM5201 APPLIED THERMODYNAMICS OF PHARMACEUTICAL SYSTEMS LT PC

2 1 0 3

OBJECTIVES

The course aims to,

- provide a good platform to pharmaceutical engineering students to understand, model and appreciate the concept of dynamics involved in pharmaceutical systems.
- prepare them to carry out experimental investigation and analysis at later stages of graduation

UNIT I ENERGY AND THE FIRST LAW OF THERMODYNAMICS 9

Concept of heat work and energy-forms of energy- forms of work- first law of thermodynamics-energy balance equation – batch system energy balance – internal energy and enthalpy changes-application problems – enthalpy changes in chemical and biochemical reactions -application problems- effect of temperature on chemical reactions (Kirchoff's law) Open systems-Simple applied problems

UNIT II THERMODYNAMIC PROPERTIES OF FLUIDS 8

PVT behavior of pure fluids, Equation of state of ideal gases, Equation of state for Real gases, Second law of thermodynamics, Entropy and entropy changes – Applied problems-Concept of Heat Engine – refrigeration- heat pump -fundamental equations relating first law and second law.

UNIT III FREE ENERGY 8

Helmholtz free energy, Gibbs free energy, Reversible process, Maxwell Relations for fundamental properties, Eqns for ΔG, ΔS, ΔH and Cp-Cv relationship for actual gases. Phase equilibria for single component, VLE and clausius clapeyron eqn, Latent heat of phase transformation.

UNIT IV THERMODYNAMICS OF PHYSICAL PROCESSES 10

Introduction to Physical Processes, Phase Transformations - Pure Substances, Multicomponent Systems, Solutions of Nonelectrolytes - Ideal Solutions, Non Ideal Solutions, Partitioning between Liquid Phases, Solutions of Electrolytes – Coulombic Interaction and Ionic Dissociation, Mean Ionic Activity and Activity Coefficient, The Debye–Huckel Theory, Colligative Properties and Isotonicity Calculations, Solubility - Solubility as an Equilibrium Constant, The Ideal Solubility, Temperature Dependence of the Solubility, Solubility of Slightly Soluble Salts, Solubilities of Nonelectrolytes, Surfaces and Interfaces - Thermodynamic Properties, Adsorption.

UNIT V THERMODYNAMICS OF CHEMICAL PROCESSES 10

Acid–Base Equilibria, Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions, Electrical Work – Oxidation–Reduction Reactions, Electrochemical Cells, pH Measurement, Noncovalent Binding Equilibria. Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, thermodynamics and stoichiometry of Product Formation.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the laws of thermodynamics and its pharmaceutical applications

CO2 appreciate the concepts and fundamentals of thermodynamics of fluids and chemical process

CO3 learn the concepts of free energy and physical process in thermodynamics and apply the ideas in pharmaceutics and formulation development process

TEXT BOOKS:

1. Kenneth A. Connors “Thermodynamics of pharmaceutical systems: An Introduction for Students of Pharmacy”, John Wiley & Sons, Inc., Hoboken, New Jersey, 2002.
2. Smith J.M., Van Ness H.C., And Abbot M.M. “Introduction To Chemical Engineering Thermodynamics”, VII edition. Tata Mcgraw-Hill, 2009.
3. Narayanan K.V. “A TextBook Of Chemical Engineering Thermodynamics”, II edition, PHI, 2013.
4. Christiana D. Smolke, “The Metabolic Pathway Engineering Handbook Fundamentals”, Crc Press Taylor & Francis Group, 2010.
5. Urs Von Stockar. “Biothermodynamics, The Role Of thermodynamics In Biochemical Engineering“ Crc Press Taylor & Francis Group, 2013.

REFERENCES:

1. Sandler S.I. “Chemical and BiochemicalThermodynamics”, John Wiley,1989.
2. Peter Atkins, Julio de Paula “Physical Chemistry” VII Edition, oxford university press 2002.
3. Donald T.Haynie, “Biological Thermodynamics” II Edition. Cambridge University Press 2013.
4. Sandler S.I. “Chemical, Biochemical, and Engineering Thermodynamics”, V Edition, Wiley, 2017
5. Peter Atkins, Julio de Paula and James Keeler “Atkins' Physical Chemistry: Thermodynamics and kinetics” XI Edition oxford university press 2018.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	understand the laws of thermodynamics and its pharmaceutical applications	-	-	2	-	2	3	-	3	3	2	-	3	2	2	-	3
CO 2	appreciate the concepts and fundamentals of thermodynamics of fluids and chemical process	-	2	1	-	1	1	-	2	2	-	-	2	1	1	-	2
CO 3	learn the concepts of free energy and physical process in thermodynamics and apply the ideas in pharmaceutics and formulation development process	-	1	3	-	-	-	-	-	2	1	-	2	2	3	-	3
Overall CO		-	1	2	-	2	2	-	2	3	2	-	2	2	2	-	3

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

EE5251 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

LT PC

3 0 0 3

OBJECTIVES

The course aims to,

- understand the basic concepts of electric circuits, magnetic circuits and wiring.
- understand the operation of AC and DC machines.
- 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 DEVICES 9

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.

IB5251 MICROBIOLOGY LT PC

3 0 0 3

OBJECTIVES

The course aims to,

- provide the students the knowledge of how to identify different microbes
- make them aware about the requirements for microbial growth and their lifecycle
- help them understand the different types of physical and chemical control of microbial growth
- make them realize the interaction between microbes and their hosts and also how to design antimicrobials
- make them realize the applications of microbial metabolism in various industries.

UNIT I INTRODUCTION TO MICROBIOLOGY 6

History (scientists and discoveries), classification and nomenclature of microorganisms, microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy. Stains and staining techniques – Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospores staining.

UNIT II MICROBIAL NUTRITION, GROWTH AND METABOLISM 8

Nutritional classification of microorganisms based on carbon, energy and electron sources Definition of growth, balanced and unbalanced growth, growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment,different media used for bacterial culture (defined, complex, selective, differential, enriched), Biochemical test for identification (citrate utilization, catalase, coagulase, IMViC), Mathematics of growth-generation time, specific growth rate.

UNIT III CONTROL OF MICROORGANISMS **12**

Sterilization, Physical control of microorganisms dry and moist heat, pasteurization, tyndallization; radiation, ultrasonication, filtration. and chemical control of microorganisms(phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes, sterilizing gases) Disinfection, antiseptics and fumigation. Determination of phenol coefficient of disinfectant. Host- microbe interactions (types of interaction,gnotobiotic, host defense and pathogen defense); anti-bacterial (class I, II, III), antifungal and antiviral agents; mode of action and resistance to antibiotics.

UNIT IV MICROBES- STRUCTURE AND REPRODUCTION **10**

Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (Cyanophyta), and fungi (*Streptomyces, Saccharomyces*), mycoplasma (*M. pneumoniae*) and bacteriophages (T4 phage, lambda phage)

UNIT V INDUSTRIAL MICROBIOLOGY AND MICROBIAL ECOLOGY **9**

Microbes involved in preservation (*Lactobacillus,bacteriocins*), spoilage of food and food borne pathogens (*E.coli, Clostridium*). Primary and secondary metabolites, Industrial use of microbes (production of penicillin, vitamin B-12); bioremediation (oil spillage); biofertilizers, biopesticides.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 identify different microorganisms and to design a medium for microbial growth

CO2 Control microorganisms using various physical and chemical agents

CO3 Gain knowledge of how the various drugs interact with the microbial metabolism

CO4 learn the applications of microbial metabolism and their primary, secondary metabolites in various fields

TEXT BOOKS:

1. Pelczar, M.J. “Microbiology”, 5th Edition, Tata McGraw-Hill, 2001.
2. Prescot. Harley, Klein. “ Microbiology “: Authored by Wiley, Sherwood, Woolverton, Prescot, 10th edition McGraw-Hill Higher Education, 2017.
3. Ananthanarayanan, R.and JayaramPaniker C.K., “Textbook of Microbiology”, 10th Edition, University Press, 2017.
4. Jeremy. W. Dale Understanding Microbes: An Introduction to a Small World”. February 2013 Wiley-Blackwell

REFERENCES:

1. Casida, L.E. “Industrial Microbiology”, New Age International, 2nd Edition, 2019.
2. Schlegel, H.G. “General Microbiology”, 7th Edition, Cambridge University Press, 1993.
3. Tortora J, Funke R, Case L, “Microbiology An Introduction” 11th Edition; Pearson Education India, 2016.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	identify different microorganisms and to design a medium for microbial growth	-	-	2	-	2	3	-	3	3	2	-	3	2	2	-	3
CO 2	Control of microorganisms using various physical and chemical agents	-	2	1	-	1	1	-	2	2	-	-	2	1	1	-	2
CO 3	Knowledge of how the various drugs interact with the microbial metabolism	-	1	3	-	-	-	-	-	2	1	-	2	2	3	-	3
CO 4	The applications of microbial metabolism and their primary and secondary metabolites in various fields	1	2	1	3	-	-	-	2	-	1	2	3	2	-	-	3
Overall CO		1	2	2	3	2	2	-	3	3	3	-	3	2	1	1	3

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

PM5202 BIOCHEMISTRY FOR PHARMACEUTICAL TECHNOLOGY

LT PC

3 0 0 3

OBJECTIVES

The course aims to,

- enable students learn the fundamentals of the life processes at the molecular level
- explain the structure, function and interrelationships of bio-molecules and their deviation during disease process
- introduce them to metabolic pathways of the major biomolecules in health and diseases

UNIT I PRINCIPLES OF BIOCHEMISTRY, CARBOHYDRATES AND LIPIDS 9

Basic principles of organic chemistry, role of carbon, types of functional groups, biomolecules, chemical nature of water, pH and biological buffers, component of the cell, structure and biochemical functions, membrane structure and functions, transport through biological cell membrane, the concept of free energy.

Carbohydrates – classification, mutarotation, glycosidic bond, properties. starch, glycogen, dextrin, inulin, cellulose, Proteoglycans, glycosaminoglycans. hyaluronic acid.

Lipids – Classification, properties. sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, cholesterol, lipoproteins, biosynthesis porphyrin, bile pigments, fatty acids and ketone bodies

UNIT IIPROTEINS, NUCLEIC ACIDS AND VITAMINS 9

Proteins and amino acids – Classification, properties, of amino acids, reactions - deamination, transamination and decarboxylation, Functions, biosynthesis and structure of amino acids and proteins, essential amino acids

Nucleic acids –genetic code, nucleic acids, and structure of DNA and RNA, purine biosynthesis and pyrimidine biosynthesis, Chargaff's Rules. Base pairing, A-T and G-C, mRNA, rRNA and tRNA., Watson-Crick structure of DNA. reactions, properties - Tm and hypochromicity, Measurement of DNA and RNA. Nucleoprotein complexes

vitamins – classification, coenzyme, chemical nature and properties, hormones.

UNIT III ENZYMES 5

Enzymes, introduction to biocatalysts, Nomenclature, Classification, Mechanism of action, Enzyme and substrate specificity, sensitivity, stereospecificity, Inhibitors, Enzyme kinetics.

UNIT IV INTERMEDIARY METABOLISM AND REGULATION 15

Reduction potential, general concept of oxidation and reduction, uncouplers and theories of biological oxidation and oxidative phosphorylation, metabolic pathways, primary and secondary metabolites.metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. citric acid cycle and its biological significance, role of sugar in nucleotide biosynthesis and pentose phosphate pathway. respiratory chain, glyoxylate shunt. metabolism of lipids, oxidation of fatty acids, α,β - oxidation, urea cycleand metabolism of amino acids and proteins, Nitrogen balance. Interconnection of pathways and metabolic regulation.

Bioenergetics - High energy compounds, electronegative potential of compounds, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNIT V CASE STUDIES IN THE BIOCHEMISTRY OF HUMAN DISEASES 7

Biochemical understanding of disease process – Diabetes mellitus, atherosclerosis, fatty liver, obesity, hormonal disorders, aging, inborn errors of metabolism.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 have a strong foundation in the structure and reactions of biomolecules.

CO2 introduce them to metabolic pathways of the major biomolecules and relevance to disease

CO3 correlate biochemical processes relevant with pharmaceutical and clinical applications.

TEXT BOOKS:

1. "Lehninger Principles of Biochemistry" 7th Edition by David L. Nelson, Michael M. Cox W.H.Freeman and Company, 2017.
2. Schaum's Outline Of Biochemistry, Third Edition (Schaum's Outline Series) Philip Kuchel, 2009.
3. Lippincott's Illustrated Reviews Biochemistry, 6th Edition, Denise R. Ferrier, 2013.
4. Satyanarayana, U. and U. Chakerapani, "Biochemistry" 4th Edition, Books & Allied (P) Ltd., 2013.
5. Rastogi, S.C. "Biochemistry" 4nd Edition, Tata McGraw-Hill, 2019.
6. Conn, E.E., etal., "Outlines of Biochemistry" 5th Edition, John Wiley & Sons, 1987.
7. Outlines of biochemistry, 5th Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi. pp 693. John Wiley and Sons, New York. 2006.
8. Biochemistry 9th edition by Lubert Stryer. Jeremy Berg, John Tymoczko, Gregory Gatto,.WH Freeman Publisher,2015.
9. Zubay's Principles of Biochemistry 5th edition Rastogi, Aneja. Meditech, 2019.
10. Harper's Illustrated Biochemistry, Victor W., Ph.D. Rodwell, David A., Ph.D. Bender, Kathleen M., Ph.D. Botham, Peter J., Ph.D. Kennelly, P. Anthony, Ph.D. Weil, 31st edition, McGrawHill, LANGE,2015.
11. Ambika Shanmugam's Fundamentals of Biochemistry, 8th Edition, by K. Ramadevi, Wolters Kluwer,30 th edition,2016.

REFERENCES:

1. Berg, Jeremy M. et al. "Biochemistry", 6th Edition, W.H. Freeman & Co., 2006.
2. Voet, D. and Voet, J.G., "Biochemistry", 4rd Edition, John Wiley & Sons Inc.,2011.
3. Murray, R.K., etal "Harper's Illustrated Biochemistry", 30th Edition, McGraw-Hill, 2015

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	ensure students have a strong foundation in the structure and reactions of Biomolecules	1	3	2	2	2	-	-	-	-	-	-	3	2	2	3	2
CO 2	introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions	2	3	3	3	2	-	-	-	-	-	-	3	3	3	3	2
CO 3	correlate Biochemical processes relevant with pharmaceutical and clinical applications.	2	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
Overall CO		2	3	3	3	2	1	-	-	-	-	-	3	3	3	3	2

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

GE5252 **தமிழரும் தொழில்நுட்பமும்** **L T P C**
1 0 0 1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: **3**
சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: **3**
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்: **3**
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: **3**
அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: **3**
அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

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

GE5252 TAMILS AND TECHNOLOGY L T P C
1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

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

IB5261 **MICROBIOLOGY LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES

The course aims to,

- make the students aware of the various lab protocols
- make them aware of the safety measures involved while doing experiments
- equip the students to handle microbes confidently.

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid:Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mould
6. Staining Techniques Simple, Differential- Gram's Staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient
9. Antibiotic Sensitivity Assay
10. Growth Curve in Bacteria
11. Effect of pH, Temperature, UV radiation on Growth Bacteria
12. Biochemical test for identification of E.coli, Bacillus

TOTAL: 60 PERIODS

Equipment needed for 20 Students

Autoclave 1

Hot Air Oven 1

Incubators 2

Light Microscopes 4

Incubator Shaker 1

Colorimeter 2

Laminar Flow Chamber 2

Glassware, Chemicals, Media as required

OUTCOMES:

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

CO1 know how to identify an organism by microscopic examination

CO2 quantify microbes and confirmation of the identity by biochemical tests.

CO3 know how to use the various equipment in the lab and also the importance of biosafety lab

TEXT BOOKS:

1. Cappuccino, J.G. and N. Sherman “Microbiology: A Laboratory Manual”, 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G, “Mackie & McCartney Practical Medical Microbiology” 4th Edition, Churchill Livingstone, 1996.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	identify an organism by microscopic examination	2	-	-	3	-	3	2	3	3	3	1	3	1	2	-	2
CO 2	quantify microbes and confirmation of the identity by biochemical tests.	2	-	-	2	-	2	-	3	3	2	-	3	1	2	1	2
CO 3	Know how to use the various equipment in the lab and also the importance of various biosafety measures used in lab	3	-	-	2	-	3	2	3	3	3	-	3	1	2	1	2
Overall CO		3	-	-	2	-	3	2	3	3	3	-	3	1	2	1	2

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

IB5361 **BIOCHEMISTRY LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES

The course aims to,

- learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,).
- make students to learn the basic units of measurements and standardisation of various buffer solutions

LIST OF EXPERIMENTS

1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer –titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
6. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid.
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.
12. Enzymatic assay: estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.

TOTAL: 60 PERIODS

Equipment Needed for 20 Students

Autoclave 1
Hot Air Oven 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Colorimeter 2
Laminar Flow Chamber 2
Glassware, Chemicals, Media as required

OUTCOMES:

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

CO1 learn various qualitative and quantitative techniques

CO2 describe various types of biochemical reaction

CO3 evaluate the novelty of the experiment

TEXT BOOKS:

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan. I Edition 2014.
2. Introduction of Practical Biochemistry by David T. Plummer. III Edition, 2017

REFERENCES:

1. Harpers Biochemistry Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W.Rodwell, Appleton and Lange ,Stanford ,Conneticut.24th edition 1996.
2. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers 6th edition 2015.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	learn various qualitative and quantitative techniques	1	3	2	2	2	-	-	-	-	-	-	3	2	2	3	2
CO 2	Describe various types of biochemical reaction	2	3	3	3	2	-	-	-	-	-	-	3	3	3	2	2
CO 3	Evaluate the novelty of the experiment	2	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
Overall CO		2	3	3	3	2	1	-	-	-	-	-	3	2	2	1	3

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

GE5262 COMMUNICATION LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

UNIT I **12**

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

UNIT II **12**

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

UNIT III **12**

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

UNIT IV **12**

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

UNIT V **12**

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

TOTAL: 60 PERIODS

LEARNING OUTCOMES

- Speak effectively in group discussions held in a formal/semi formal contexts.
- Write emails and effective job applications.

Assessment Pattern

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

SEMESTER III

MA5355 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS

L T P C

3 1 0 4

OBJECTIVES

The course aims to,

- introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;
- acquaint the student with Fourier transform techniques used in a wide variety of situations in which the functions used are not periodic;
- develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Classification of partial differential equations - Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 12

Method of separation of variables – Solutions of one dimensional wave equation and one dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourierseries solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM 12

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

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and final value theorems – Formation of difference equation – Solution of difference equation using Z -transform.

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1 learn about partial differential equations

CO2 learn about fourier series analysis

CO3 learn about the problems using Fourier transform and Z transform techniques

TEXT BOOKS:

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

REFERENCES:

1. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education,New Delhi, 4th edition 2011.
2. Ramana, B.V. “Higher Engineering Mathematics”,Tata McGraw Hill, NewDelhi, 11th Reprint, 2010.
3. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”,Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2012.
4. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PM5301 PHYSICAL PHARMACEUTICS L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- acquire the fundamental principles and concepts involved in pharmaceutical powders, liquid flow, dispersions, drug diffusion, dissolution, complexation and protein binding.
- provide the knowledge about kinetics and drug stability

UNIT I MICROMERITICS AND POWDER RHEOLOGY 9

Particle size and distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, Dynamic light scattering (DLS) technique, measurement of particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

UNIT II SURFACE AND INTERFACIAL PHENOMENON, VISCOSITY AND RHEOLOGY 9

Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interface, solid gas and solid-liquid interface, complex films, electrical properties of the interface. Newtonian system, Law of flow, kinematic viscosity, effect of temperature on viscosity, non-Newtonian systems, plastic, pseudoplastic, dilatant, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers.

UNIT III DISPERSION SYSTEMS 9

Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy. Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspension, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations, emulsions; types, theories, physical stability.

UNIT IV DIFFUSION, DISSOLUTION, COMPLEXATION & PROTEIN BINDING 9

Definitions, Steady state diffusion, Procedures and apparatus for diffusion, dissolution and drug release, factors affecting dissolution, Complexation and protein binding; Metal complexes, organic molecular complexes, inclusion compounds, methods of analysis of complexes, crystalline structures of complexes and thermodynamic basis of stability constants. Protein binding and drug action, protein binding studies.

UNIT V KINETICS AND DRUG STABILITY 9

General considerations and concepts of drug reaction kinetics; zero order, first order and pseudo first order, half-life determination, Influence of temperature, light, catalytic species, solvent and other factors, Stabilization of drugs, Accelerated stability study – shelf-life

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 know the fundamental properties of pharmaceutical solids

CO2 understand the surface, interfacial phenomena and the rheology of liquids

CO3 understand the principles, characteristics and applications of pharmaceutical dispersions.

TEXT BOOKS:

1. Manavalan, R. and Ramasamy. C. “Physical Pharmaceutics” 2nd Ed., Vignesh Publishers, 2015.
2. C.V.S. Subrahmanyam, “Text book of physical pharmaceutics”, 3rdEdn., Vallabhprakashan, 2015.
3. Hadkar. U. B., “Physical Pharmacy”, Nirali Prakashan, 12th edition, 2017.

REFERENCES:

1. Alfred N. Martin, Patrick J. Sinko, Martin’s Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, sixth edition, Lippincott Williams & Wilkins, 2011.
2. David B. Troy, Paul Beringer, Remington: The science and practice of pharmacy, 21st Edition, Lippincott Williams and Wilkins, 2006
3. Humphrey Moynihan and Abinacrean “Physicochemical Basis of Pharmaceuticals” Oxford University Press, 2009.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	know the fundamental properties of pharmaceutical solids	3	1	2	1	-	-	1	-	-	1	-	1	-	-	2	2
CO 2	understand the surface, interfacial phenomena and the rheology of liquids	2	-	1		-	1	-	-	-	-	-	1	-	-	2	2
CO 3	understand the principles, characteristics and applications of pharmaceutical dispersions	1	-	1	-	-	-	-	-	-	-	-	1	-	-	2	2
Overall CO		2	1	1	1	-	1	1	-	-	1	-	1	-	-	2	2

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

PM5302 **CHEMICAL PROCESS CALCULATIONS** **L T P C**
2 1 0 3

OBJECTIVES

The course aims to,

- learn about the basic calculation techniques used in process industries
- learn the laws about the behavior of gases, liquids and solids, for analysing and designing chemical processing equipment with the help of data sources containing relevant physical and chemical properties.

UNIT I UNITS AND DIMENSIONS **9**

Fundamental and derived units, conversion, dimensional consistency of equations, conversions of equations, Dimensional and dimensionless constants, mass and volume relations, Stoichiometric and composition relations.

UNIT II IDEAL GASES AND VAPOUR PRESSURE **9**

Ideal gas law, Dalton's Law, Amagat's Law and Average molecular weight of gaseous mixtures.Effect of temperature on vapour pressure, Vapour pressure plot (Cox chart), Vapour pressures of miscible and immiscible liquids and solutions, Raoult's Law and Henry's Law.

UNIT III HUMIDITY AND SOLUBILITY **9**

Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization and adiabatic saturation temperature.

UNIT IV MATERIAL BALANCE **9**

Tie substance, limiting reactant, excess reactant, General material balance equation for steady and unsteady state, Typical steady state material balances in distillation, absorption, extraction, crystallization. Combustion of coal, fuel gases and sulphur – Recycling operations – Bypassing streams – Degree of conversion – Excess reactant – Limiting reactant- Selectivity and Yield.

UNIT V ENERGY BALANCE **9**

General steady state energy balance equation, Heat capacity, Enthalpy, Heat of formation, Heat of reaction, Heat of combustion and Calorific values. Heat of solution, Heat of mixing, Heat of crystallization, determination of ΔHR at standard and elevated temperatures, Theoretical flame temperature and adiabatic flame temperature.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 have a clear idea of various types of unit systems and they will be able to convert units from one form to another.

CO2 have sound strategy for solving and developing mathematical relations for material and energy balance calculations for reaction and separation processes.

CO3 analyze the behavior of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.

TEXT BOOKS:

1. Narayanan, K.V. and Lakshmikutty, B. “Stoichiometry and Process Calculations”, 2nd Edition., PHI Learning Pvt. Ltd., 2017
2. Bhatt, B.I. and Thakore, S.M., “Stoichiometry", 5th Edition, Tata McGraw Hill, Education Pvt. Ltd, 2017.
3. Gavhane, K. A. “Introduction to Process Calculations”, Nirali Publication, 2016.

REFERENCES:

1. Venkataramani, V., Anantharaman, N. and Meera Sheriffa Begum K. M. “Process Calculations”, 2nd ed.PHI Learning Pvt. Ltd., 2011
2. Himmelblau, D. M. and Riggs, B. J. “Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall International series, 2015.
3. Sikdar, C.D., "Chemical Process Calculations", PHI Learning Pvt. Ltd., 2013.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Have a clear idea of various types of unit systems and they will be able to convert units from one form to another.	3	1	1	2	1	-	-	-	1	2	2	1	1	-	3	1
CO 2	Have sound strategy for solving and developing mathematical relations for material and energy balance calculations for reaction and separation processes.	3	3	3	2	1	3	1	-	3	1	3	3	1	2	2	2

CO 3	Analyze the behaviour of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.	3	3	3	2	3	3	1	-	3	1	3	3	1	2	2	2
Overall CO		3	3	2	2	2	3	1	-	3	1	3	3	1	2	2	2

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

PM5303 HUMAN ANATOMY AND PHYSIOLOGY L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- develop an understanding about the structure (gross and histology) and functions of various organs of the human body;
- describe the various homeostatic mechanisms and their imbalances of various systems; identify the various tissues and organs of the different systems of the human body and appreciate coordinated working pattern of different organs of each system

UNIT I FOUNDATIONS OF PHYSIOLOGY, HOMEOSTASIS 7

Organization of the Human Body, Chemical Foundations – Atoms, Ions, Molecules, Bonds, Solutions, Classes of organic molecules; Physical Foundations – Morphology of the cell (plasma membrane, nucleus, cell organelles) Elementary tissues of the human body: epithelial, connective, Muscular and nervous tissues-their sub-types and characteristics, Cellular Transport – Intracellular movement, Intercellular movement, Movement of molecules across the plasma membrane, intercellular communication.

UNIT II NERVOUS AND MUSCULO-SKELETON SYSTEM 12

Anatomy and physiology of brain, blood-brain barrier, spinal cord, structure and types of the neuron, synapses neurotransmitters, organization of spinal and cranial nerves, central and peripheral nervous system, autonomic nervous system, receptors membrane potentials – graded potentials and action potentials, physiology of vision, audition, olfaction, taste and skin; anatomy and physiology of the muscular system, types of muscle tissue – skeletal, smooth, cardiac, contraction, muscle fibre regulation, Osseous system - structure, composition and functions of the Skeleton, classification of joints, types of movements of joints and their disorders

UNIT III GASTROINTESTINAL AND RENAL SYSTEM 7

Anatomy and physiology of the gastrointestinal tract (secretion, motility, digestion and absorption), structure and function of the liver, spleen, gallbladder, pancreas; the renal system structure – Anatomy and physiology kidney; structure of the nephron and network of blood capillaries urinary tract, formation of urine, concentration of urine; regulation of acid-base balance; the chemical acid-base buffer systems of body fluids and disease conditions

UNIT IV CARDIOVASCULAR AND RESPIRATORY SYSTEM **9**

Anatomy and physiology of the heart, lungs, cardiac cycle; circulation of blood, heart rate, blood pressure, ECG and heart sounds, lymphatic vessel, systemic and portal circulation; vascular system – arteries, arterioles, capillaries, venules. Anatomy of the respiratory tract, mechanism and dynamics of respiration, lung volumes, transport of oxygen and carbon dioxide, disorders like cyanosis

UNIT V ENDOCRINE AND REPRODUCTIVE SYSTEM **10**

Anatomy and physiology of Pituitary, thyroid, parathyroid, adrenal and pancreatic hormones and disorders of these glands, endocrine control of growth and metabolism; pineal, thymus, testes, ovaries, structure and physiology of reproductive systems, sex hormones, physiology of fertilization, menstruation, menopause, spermatogenesis and oogenesis, pregnancy and parturition and clinical disorders

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 study the different physiological process in human system

CO2 study the anatomy of different bones and connective tissues

CO3 study the underlying physiological process in different organ

TEXT BOOKS:

1. Waugh, Anne and Allison Grant, “Ross and Wilson Anatomy and Physiology in Healthand Illness”, Xth Edition, Churchill – Livingstone / Elsevier), 2006.
2. Ganong, W.F., “Review of Medical Physiology”, XXIVth Edition (A Lange Medical book series) McGraw – Hill (International Ed.) 2014.
3. Khurana, Indu, “A Textbook of Medical Physiology” Elsevier, 2006.
4. Johnson, L.R., “Essential Medical Physiology”, IIIrd Edition, Academic Press / Elsevier), 2003.

REFERENCES:

1. Guyton, A.C. and Hall, J.E., “Textbook of Medical Physiology”, XI Edition, Saunders, 2006.
2. Carola, R., Harley J.P. and Noback C.R., “Human Anatomy & Physiology”, II Edition, McGraw– Hill, 1992.
3. Vander, A.J., Sherman J.H. and Luciano D.S., “Human Physiology: The Mechanisms ofBody Function”, V Edition, McGraw – Hill, 1990.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	study the different physiological process in human system	2	1	-	-	-	-	-	-	-	-	-	2	-	-	-	2
CO 2	study the anatomy of different bones and connective tissues	2	1	-	-	-	-	-	-	-	-	-	2	-	-	-	2
CO 3	study the underlying physiological process in different organ	2	1	1	-	-	-	-	-	-	-	-	2	-	-	-	3
Overall CO		2	1	1	-	-	-	-	-	-	-	-	2	-	-	-	3

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

PM5304 **PHARMACEUTICAL CHEMISTRY**

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry
- provide the basic functional group identification, chemical bonding with their mechanism and also to understand the basic principles involved in the identification and estimation of pharmaceutical substances.

UNIT I CHEMISTRY OF HETEROCYCLIC COMPOUNDS ` 12

Classification of heterocyclic compounds, nature and nomenclature, preparation and important reactions of pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole, pyridine, pyrimidine, indole, quinoline, isoquinoline, acridine, phenothiazine, azepines, diazepines, quinolones and quinazolines and structural examples of medicinal compounds and examples prototype pharmaceutical compounds

UNIT II PROTOTYPE REACTIONS 9

Friedel–Crafts and related reaction: Principle involved, alkylation and acylation, industrial applications, Fries rearrangement, Hoesch reaction, formylation reactions– Gatterman, Gatterman-Koch, Vilsmeyer, Reimer – Tiemann, Duff, chloromethylation reaction, Kolbe reaction, preparation and properties of poly aromatic compounds, naphthalene, anthracene, phenanthrene, diphenyl methane, triphenyl methane and diphenyl ethane.

UNIT III PRINCIPLES OF TEST FOR PURITY IN PHARMACEUTICAL SUBSTANCES 5

Identification and characterization of impurities in Pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals, lead and modifications with suitable examples

UNIT IV STUDY OF INORGANIC COMPOUNDS IN PHARMACOPOEIA 9

Method of preparation, assay, identification test, test for purity, official preparation, storage conditions and belonging to the following categories. Gastrointestinal agents and related compounds – Acidifiers, Antacids, Adsorbents and Protectives, Saline cathartics; Topical Agents – Protectives, Astringents, Antimicrobial topical agents.

UNIT V PHARMACEUTICAL AIDS AND COORDINATION COMPOUNDS 10

Definition, principles and properties of various agents such as – Sodium bisulphate, Sodium metabisulphite, Sulphur dioxide, Bentonite, Magnesium stearate, Zinc stearate, Aluminium sulphate, Sodium carboxymethyl cellulose, Sodium methyl paraben. Theory of coordination compounds with special reference to application in Pharmacy such as – EDTA, Dimercaprol, Penicillamine, 1, 10-Phenanthroline.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.

CO2 identify and estimate the purity of drugs and its application.

CO3 be involved in the development and synthesis of new drug molecule.

TEXT BOOKS:

1. Atherden L.M, “Bentley and Driver’s Textbook of Pharmaceutical Chemistry”, 8th Edition, Oxford University Press, 2006.
2. AB.S. Bahl and ArunBahl.A, Textbook of Organic Chemistry, S.Chand and company pvt.Ltd, New Delhi. 2016.
3. Reactions and reagents by OP Agarwal, Krishna Prakashan Media Ltd (P), 2016.
4. Chatwal, G.R. “Pharmaceutical Chemistry” Organic & Inorganic. Himalaya Publications, 2013.

REFERENCES:

1. “Indian Pharmacopoeia 2018”, Indian Pharmacopoeia Commission, VIII edition, 2018.
2. A.I. Vogel, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, and A.R. Tatchell, Vogels “Textbook of Practical Organic Chemistry”, V Edition., ELBS longman, 1994.
3. Morrison R.T., Boyd R.N., “Organic Chemistry”, Prentice- Hall of India, VI edition, 1992.
4. I.L. Finar, “Organic Chemistry” Vol. I and II, Pearson Education India, VI edition, 2012.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.	3	-	1	-	-	-	-	-	-	-	-	2	3	-	-	2
CO 2	Identify and estimate the purity of drugs and its application.	2	-	-	-	-	-	-	-	-	-	-	2	3	-	-	2
CO 3	Be involved in the development and synthesis of new drug molecule	2	-	1	1	1	-	-	-	-	-	-	2	3	2	-	2
Overall CO		2	-	1	1	1	-	-	-	-	-	-	2	3	2	-	2

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

PM5311 **PHYSICAL PHARMACEUTICS LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES

The course aims to,

- understand the principles of characterizing pharmaceutical powders.
- determine various physico-chemical properties involved in formulation design.
- learn the basics of physico-chemical characterization of pharmaceutical additives used in liquid/semi-solid dosage forms

LIST OF EXPERIMENTS

1) Determination of particle size and particle size distribution using sieving method.
2) Determination of particle size and particle size distribution using Microscopic method.
3) Determination of bulk density, true density and porosity.
4) Determine the angle of repose
5) Determine the angle of repose with effect of lubricant.
6) Determination of surface area of powders.
7) Determination of surface tension of given liquids by drop count and drop weight method.
8) Determination of critical micellar concentration (CMC) of surfactants.
9) Study of rheological properties of various types of systems using different viscometers.
10) Preparation of various types of suspensions and determination of their sedimentation parameters.
11) Preparation and stability studies of emulsions.
12) Determination of half-life, rate constant and order of reaction.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- Optical Microscope
- Sieve shaker and sieve set
- Andreasen pipette
- Stalagmometer
- Ostwald's viscometer, Brookfield viscometer
- Stability chamber
- Specific gravity bottle
- Bulk density apparatus

OUTCOMES:

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

CO1 Characterize and evaluate the properties of powders by suitable methods.

CO2 Carry out the stability studies and determines the stability of various dosage forms

CO3 Calculate the rate constants involved in the pharmaceutical systems and process

TEXT BOOKS:

1. CVS Subrahmanyam, SG Vasantharaju, Laboratory Manual of Physical Pharmacy, IInd Ed., Vallabh Publications / Prakashan, 2009.
2. Manavalan, R. and C. Ramasamy. “Physical Pharmaceutics” Vignesh Publishers, IInd Ed.,2011.

REFERENCES:

1. Eugene L. Parrott, WitoldSaski, Experimental Pharmaceutics, IVth Ed, Burgess Pub. Co., 1977.
2. Liberman H.A., RiEgor M.M, & Banker GS. Pharmaceutical dosage forms – Disperse systems, Vol 1, 2 and 3, IInd Edition, Marcel Dekker Inc, New York, 1996.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Characterize and evaluate the properties of powders by suitable methods.	2	1	-	-	-	-	-	-	-	-	-	2	-	1	2	2
CO 2	Carry out the stability studies and determine the stability of various dosage forms	2	1	-	-	-	-	-	-	-	-	-	2	-	1	2	2
CO 3	Calculate the rate constants involved in the pharmaceutical systems and process	1	2	1	2	-	-	-	-	-	-	-	2	-	1	2	2
Overall CO		2	2	1	1	-	-	-	-	-	-	-	-	2	-	1	2

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

PM5312 **PHYSIOLOGY LABORATORY**

L T P C

0 0 4 2

OBJECTIVES

The course aims to,

- learn the gross histology, structure and functions of various organs of the human body
- perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of the human body

LIST OF EXPERIMENTS

1. Study of different systems with the help of models (axial skeleton, appendicular skeleton, cardiovascular system, respiratory system, digestive system, urinary system, nervous system, special senses, reproductive system)
2. Principles of mounting tissue, examination, preservation,
3. Microscopic study of different tissues, epithelial, muscular, connective tissue, nervous tissue
4. Determination of bleeding and clotting time
5. Determination of R.B.C. count of blood
6. Estimation of Haemoglobin
7. Enumeration of W.B.C. count of blood
8. Determination of differential count of blood
9. Determination of Erythrocyte Sedimentation Rate
10. Blood group determination
11. Heart rate and blood pressure recording
12. Identification of human bones and joints, anatomic features
13. Determination of vital capacity

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Microscope
2. Pipettes and tips
3. Haemocytometer
4. Sphygmomanometer
5. Spirometer
6. Hemoglobinometer

OUTCOMES:

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

CO1 explain physiological processes in detail and to an appropriate level

CO2 analyze physiological process

CO3 interpret the underlying mechanism of disease progression

TEXT BOOKS:

1. Ramesh K. Goyal and Natvar M. Patel, “Practical Anatomy and Physiology”, seventeenth edition, B.S Shah Prakashan, Ahmedabad, 2017.
2. Tortora Gerard J, Grabowski Sandra R and Anagnostakos Nicholas P. “Principles of anatomy and physiology”, John Wiley & Sons Inc., 1996.

REFERENCES:

1. Tandon O.P & Tripathi Y, “Best & Taylor’s Physiological Basis of Medical Practice”, Wolters Kluwer India Pvt. Ltd., Thirteenth edition, 2011.
2. John E. Hall, “Guyton and Hall Textbook of Medical Physiology”, Elsevier, Thirteenth edition, 2016.
3. Nitin ashok john, “CC Chatterjee’s Human Physiology: volume I & II”, CBS publishers & distributors pvt. Ltd., XII edition, 2018.
4. Cyril A. Keele, Eric Neil and Norman Joels, “Samson Wright’s Applied Physiology”, Thirteenth edition, Oxford University Press, 2015.
5. Park K, “Park’s Textbook of Preventive and Social Medicine”, Banarsidas Bhanot Publishers, 2019.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	explain physiological processes in detail and to an appropriate level	2	1	-	-	-	-	-	-	-	-	-	2	-	-	-	2
CO 2	analyze physiological process	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-	2
CO 3	interpret the underlying mechanism of disease progression	2	1	1	-	-	-	-	-	-	-	-	1	-	-	-	2
Overall CO		2	1	1	-	-	-	-	-	-	-	-	1	-	-	-	2

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

GE5361 **PROFESSIONAL DEVELOPMENT** **L T P C**
0 0 2 1

OBJECTIVES:

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize,interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD: **10 Hours**

Create and format a document
Working with tables
Working with Bullets and Lists
Working with styles, shapes, smart art, charts
Inserting objects, charts and importing objects from other office tools
Creating and Using document templates
Inserting equations, symbols and special characters
Working with Table of contents and References, citations
Insert and review comments
Create bookmarks, hyperlinks, endnotes footnote
Viewing document in different modes
Working with document protection and security
Inspect document for accessibility

MS EXCEL: **10 Hours**

Create worksheets, insert and format data
Work with different types of data: text, currency, date, numeric etc.
Split, validate, consolidate, Convert data
Sort and filter data
Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)
Work with Lookup and reference formulae
Create and Work with different types of charts
Use pivot tables to summarize and analyse data
Perform data analysis using own formulae and functions
Combine data from multiple worksheets using own formulae and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

MS POWERPOINT: **10 Hours**

Select slide templates, layout and themes
Formatting slide content and using bullets and numbering
Insert and format images, smart art, tables, charts
Using Slide master, notes and handout master
Working with animation and transitions
Organize and Group slides
Import or create and use media objects: audio, video, animation
Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion the students will be able to

- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects

SEMESTER IV

GE5251 ENVIRONMENTAL SCIENCES L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- 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.
- inculcate the effect of population dynamics on human and environmental health and inform about human rights, value education and the 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:

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

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

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

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

CO4 recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development

CO5 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 the effect of population dynamics on human value education, consumerism and the 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).

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 2012.
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. ErachBharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient BlackswanPvt. Ltd.2013.

MA5354 **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 design.

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

CO1 To analyze the performance in terms of probabilities and distributions achieved by the determined solutions

CO2 To be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis

CO3 To apply the basic principles underlying statistical inference(estimation and hypothesis testing)

CO4 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.

IB5452 FLUID MECHANICS AND HEAT TRANSFER OPERATIONS

L T P C

3 1 0 4

OBJECTIVES

The course aims to,

- make the students understand and impart knowledge on the fluid statics and dynamics
- incorporate different expressions involved in fluid flow and fluid flowing over immersed solids
- learn the concepts involved in heat transfer by conduction, convection and radiation

UNIT I FLUID PROPERTIES & FLUID MECHANICS 11

Fluid definition- compressible, incompressible fluids – Density, specific gravity, specific weight, surface tension, vapour pressure and viscosity. Newtonian and Non-newtonian fluids. Fluid statics – Barometric equation – application for incompressible and compressible fluids. Pressure changes in atmospheric air – Gauge and absolute pressure – pressure measurement with Bourdon gauge & manometers. Fluid Dynamics – equation of continuity – Bernoulli's equation – pressure loss in straight pipes – in fittings – expansion and contraction losses (applied to Newtonian Fluids only) Fluid flow measurement, Orifice, venture & Rotameter for Newtonian fluids.

UNIT II FLOW OF FLUID THROUGH PACKINGS 12

Fluid transport for Industrial application - fluid flow through packing- characteristics of packed bed-Bed surface area-void fraction-Laminar flow through packed bed and turbulent flow-pressure drop experienced by the fluid-equations and application - problems. Fluidization phenomena-Industrial application and minimum fluidization velocity. Fluid moving machinery-pumps: centrifugal, Reciprocating-gear, lobe, Peristaltic pumps and gas moving machinery-Fans, blowers and compressors. Principle of ejectors. Mixing & agitation Applications, Dimensional analysis, Power requirement in agitation, Liquid agitation, Gas-liquid & solid-liquid systems-agitation scale up.

UNIT III CONDUCTION HEAT TRANSFER 12

Heat transfer phenomena - Heat conduction – Fourier's equation –steady state conduction in radial systems – Resistance concept – series and resistance in conduction – parallel resistance in conduction – unsteady state conduction – extended surfaces (Fins) –combined conduction & convection – 2 dimensional conduction.

UNIT IV CONVECTION HEAT TRANSFER 14

Forced and natural convection – Dimensional analysis, Dimensionless numbers, Convection heat transfer coefficient, Correlations for flow over plate, through tubes, over spheres and cylinders, Agitated systems, Packed columns, condensation phenomena, Film and drop wise condensation over tubes. Boiling of solutions – individual, overall heat transfer coefficients and solving related problems.

UNIT V RADIATION HEAT TRANSFER AND HEAT TRANSFER EQUIPMENTS 11

Electromagnetic waves, energy of radiation, Planck's equation-Blackbody Radiation. Kirchhoff's law, Stefan Boltzmann equation of radiant energy – Wien's law, Radiation exchange between surfaces – black and gray bodies - view factors - sample problems. Heat exchangers - types, boilers, Kettles. Heat exchanger Design concept. Correction Factor Charts and Plate Heat Exchangers. NTU concept- Industrial evaporators, Evaporator components. Elevation in boiling point - Duhring's rule -Factors affecting performance of evaporators, Material and energy balance in single effect evaporator – multiple effect evaporators, types of operation, simple application problems.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 understand the rheological behavior of fluids and its applications

CO2 understand mass balance in fluid flow operations and also calculation of drag coefficient for fluid flow past solid objects

CO3 understand the basic concepts on conduction, convection and radiation involved in heat exchanger equipment and furnace wall

TEXT BOOKS:

1. Mc Cabe, W.L., Smith, J.C. and Harriot, P., "Unit Operations in Chemical Engineering", 7th edition., McGraw-Hill, 2017.
2. Kern, D.Q., 'Process Heat Transfer', McGraw-Hill, 1999.
3. Geankoplis. C.J "Transport Process & separation Process Principles" IV edition, Prentice Hall of India, 2015.
4. P. K. Nag "Heat & Mass Transfer", Tata McGraw Hill, III edition, 2011.

REFERENCES:

1. Frank Kreith, Raj M. Manglik, and Mark S. Bohn "Principles of Heat Transfer" VII edition, Cengage Learning Inc., 2018.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	understand the rheological behavior of fluids and its applications	2	2	1	2	-	2	1	2	2	-	3	2	1	1	3	2
CO 2	Understandf mass balance in fluid flow operations and also calculation of drag coefficient for fluid flow past solid objects	1	2	2	3	-	-	1	2	-	-	3	1	1	1	3	2
CO 3	Understand the basic concepts on conduction convection and radiation involved in heat exchanger equipment and furnace wall	2	1	-	1	-	-	-	2	-	1	3	-	1	1	3	2
Overall CO		2	2	1	2	-	-	1	2	-	-	3	1	1	1	3	2

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

PM5401 CELL AND MOLECULAR BIOLOGY L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- enable students understand the structure and function of the eukaryotic cell and its organelles.
- present the concepts on the genetic information flow in the eukaryotic cell and account for how genes are regulated.
- expose students to the application of recombinant DNA technology in biotechnological research.
- train students in strategizing research methodologies employing cloning, construction of DNA libraries
- illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.

UNIT I CELLULAR BIOLOGY 9

The structure and ultrastructure of the cell. Organelles and membrane systems; their structure and function. Cell division: mitosis. Intracellular protein sorting and secretion as well as endocytosis. Cytoskeleton and cell motility.Extra- and intracellular signal transduction.Differences and similarities between prokaryotic and eukaryotic cells.Microscopy methods for structural analysis of the eukaryotic cell.Overview of differences in prokaryotic and eukaryotic DNA.

UNIT II MOLECULAR GENETICS 10

Bacterial conjugation, transduction and transformation, Introduction to nucleic acids, Structure and function of DNA, replication, Telomere replication in eukaryotes.Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.Structure and function of mRNA, rRNA and tRNA. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Translation: Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis.Post-translational modifications and its importance.Organization of genes in prokaryotic and eukaryotic chromosomes.

UNIT III RECOMBINANT DNA TECHNOLOGY 10

Manipulation of DNA – Restriction and Modification enzymes. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Prokaryotic and eukaryotic expression host systems, Introduction of recombinant DNA into host: Insulin, Interferons, Erythropoietin, DNA libraries: Construction of genomic and cDNA libraries.

UNIT IV SEQUENCING AND AMPLIFICATION OF DNA 8

Amplification of DNA; Types of PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Site directed mutagenesis. Organization and structure of genomes, Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, Next generation sequencing technologies, Genetic maps and Physical maps.

UNIT V GENOME ANALYSIS AND GENOMICS 8

Gene therapy and Transgenic technology, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Web resources for Genomics, Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi).

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 have an overview about the structure and functions of prokaryotic and eukaryotic cells

CO2 have an overview of nucleic acids and the central dogma of life and its significance

CO3 understand the basic tools and techniques involved in recombinant DNA technology

TEXT BOOKS:

1. David Friedfeld, "Molecular Biology." Narosa Publications, 1999.
2. Primrose S B and R. Twyman "Principles of Gene Manipulation & Genomic Blackwell Science Publications, 2006.
3. Principles of Genome Analysis and Genomics by S.B. Primrose and R.M. Twyman, Third Edition (Blackwell Publishing), 2003.

REFERENCES:

1. Tropp, Burton. "Molecular Biology: Genes to Proteins", 3rd Edition. Jones andBartlett, 2008.
2. Ausubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology", Greene Publishing Associates, NY, 1998
3. Genomes 3 by T.A.Brown, Third Edition (Garland Science Publishing), 2007.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	have an overview about the structure and functio of prokaryotic and eukaryotic cells	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3
CO 2	have an overview of nucleic acids and the central dogma of life and its significance	2	3	2	3	2	-	-	-	-	-	-	3	2	2	2	3
CO 3	understand the basic tools and techniques involved in recombinant DNA technology	2	2	3	3	3	3	-	-	-	-	-	2	3	3	-	3
Overall CO		2	3	2	3	2	1	-	-	-	-	-	3	2	2	1	3

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

PM5402 **PHARMACEUTICAL ANALYSIS** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to,

- provide the student with a basic understanding of the format of the pharmacopoeial monograph and instrumentation of various equipments.
- enable students to understand the principles of spectrophotometry and chromatography

UNIT I INTRODUCTION **5**

Pharmacopoeia, monograph, precision, accuracy, Titrations- non aqueous, redox and complexometric titrations. Thermal methods analysis- Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC)

UNIT II ULTRAVIOLET SPECTROSCOPY AND FLUORIMETRY **10**

Introduction to spectroscopy, colorimeter, **Ultraviolet Spectroscopy-** theory of atomic and molecular spectra, Electronic transitions, Beer and Lambert's law - derivation and deviations, Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption spectra. Instrumentation and applications.**Fluorimetry –** theory, types of fluorescence, factors affecting fluorescence, quenching of fluorescence, instrumentation and applications.

UNIT III IR AND NMR SPECTROSCOPY **10**

Infrared spectroscopy – principle, types of vibrations, instrumentation, applications.

NMR spectroscopy- principle, instrumentation, shielding and deshielding, chemical shift and applications, Principles of H-NMR and C-NMR.

UNIT IV ATOMIC ABSORPTION AND MASS SPECTROSCOPY **12**

Atomic absorption spectroscopy- Principle, instrumentationand applications. Advantages and limitations of Atomic absorption spectroscopy.

Mass Spectroscopy - Principles, instrumentation, Ionization techniques - chemical ionization (CI), electron impact ionization (EI), fast atom bombardment (FAB), matrix assisted laser desorption ionization (MALDI), Types of peaks, Applications, LC-MS/MS, GC-MS/MS

UNIT V CHROMATOGRAPHIC TECHNIQUES **8**

Introduction to chromatography. Principles, classification, Paper chromatography and TLC. High Performance Liquid Chromatography **(HPLC**)- theory, Columns, Packing materials, Detectors, Normal and reversed phase, Solvents, HPLC terms, retention factor, symmetry factor, resolution, HETP. **Column and gas** chromatography – principle, technique and applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 acquire knowledge related to assay standardization of different drugs
CO2 characterize and analyze different sources of analytes
CO3 quantify and study different drug moieties using advanced methods

TEXT BOOKS:

1. A. H. Beckett & J. B. Stenlake, "Practical Pharmaceutical Chemistry", Part II, 4th Edition,Bloomsbury Academic, 2001.
2. Gurdeep R. Chatwal, Instrumental methods of chemical analysis" Himalaya publishing house, 5th edition, 2018.

3. Siddiqui, Anees A. “Pharmaceutical Analysis”. 3rd edition, Vol.I&II, CBS, 2014.
4. Parimoo, P. “Pharmaceutical Analysis”. CBS, 2018.
5. Hobert H. Willard, “Instrumental Methods of Analysis”, 7th Edition,CBS Publishers & Distributors, 2004.
6. B.K. Sharma, “Instrumental Method of Chemical Analysis”, Krishna’s Education Publishers, 2014.
7. Dr. S. Ravi Sankar “Text of pharmaceutical analysis” 4th edition, Rx Publications.2010

REFERENCES:

1. Gennaro, Alfonso R. “Remington : The Science and Practice of Pharmacy” Vol. I & II, XXth Edition, Lippincott Williams & Wilkins / B.I. Publication, 2000.
2. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, “Principles of Instrumental Analysis”, 7th Edition, Brooks Cole, 2017.
3. Connors, Kenneth A. “A Textbook of Pharmaceutical Analysis”. IIIrd Edition,John-Wiley & Sons, 1982.
4. A.I. Vogel, Text Book of Quantitative Inorganic analysis, 3rd edition 1996.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	acquire knowledge related to assay standardization of different drugs	3	2	1	1	2	1	1	1	-	1	-	3	3	3	2	3
CO 2	characterize and analyze different sources of analytes	2	2	1	1	2	1	1	1	-	1	-	3	3	3	2	3
CO 3	quantify and study different drug moieties using advanced methods	3	3	2	2	2	1	1	-	-	-	-	3	2	2	2	2
Overall CO		3	2	1	1	2	1	1	1	-	1	-	3	3	3	2	3

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

PM5411 PHARMACEUTICAL ANALYSIS LAB

L T P C

0 0 4 2

OBJECTIVES

The course aims to,

- carry out analytical experiments related to spectroscopic and chromatographic techniques.
- enable students to learn the principles of analysis for pharmaceutical applications

LIST OF EXPERIMENTS

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Experiments involving titrimetric methods (permanganometry, iodometry, iodimetry, complexometry, non aqueous).
3. Experiments involving gravimetric analysis.
4. Determination of impurities by limit test: chloride, sulphate, iron, arsenic.
5. Determination of λ_{max}.
6. Validation of beer Lambert's law.
7. Quantitative and qualitative analysis of drug molecule using standard comparison method by UV/Vis spectroscopy.
8. Quantitative analysis by fluorimetry.
9. Analysis of drug molecule using standard comparison method by HPLC.
10. Interpretation of IR, NMR spectra.
11. Separation of components using paper, TLC and column chromatography.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Hot air oven
2. pH meter
3. UV-Visible spectrophotometer
4. HPLC
5. Fluorimetry
6. Arsenic limit test apparatus
7. Water bath
8. Weighing balance

OUTCOMES:

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

CO1 study and analyse the monograph of different drugs.

CO2 characterize and analyze different sources of impurities.

CO3 quantify and interpret drug moieties using advanced methods.

REFERENCES:

1. Atherden L.M, “Bentley and Driver’s Textbook of Pharmaceutical Chemistry”, 8th Edition, Oxford University Press, 2004.
2. Siddiqui, Anees A, “Pharmaceutical Analysis”. Vol.I& II, 3rd edition, CBS Publishers, 2014.
3. Takeru Higuchi, Einar Brochmann, Hanffen Hanssen, Hamffen Hanssen, “Pharmaceutical Analysis” 1st Edition, CBS Publishers, 2005.
4. Loyd V. Allen Jr, “Remington: The Science and Practice of Pharmacy”. Vol. I & II, 22nd Edition, Pharmaceutical Press;, 2012.
5. Kenneth A. Connors, “Textbook of Pharmaceutical Analysis”, 3rd Edition, John wiley and sons, New York, 2007.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	study and analyse the monograph of different drugs	2	1	1	1	-	-	-	-	-	-	-	2	2	2	1	3
CO 2	characterize and analyze different sources of impurities	2	1	1	1	-	-	-	-	-	-	-	2	2	2	1	3
CO 3	quantify and interpret drug moieties using advanced methods	2	1	1	1	-	-	-	-	--	-	-	2	2	2	1	3
Overall CO		2	1	1	1	-	-	-	-	-	-	-	2	2	2	1	3

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

PM5412 CELL AND MOLECULAR BIOLOGY LABORATORY L T P C

0 0 4 2

OBJECTIVES

The course aims to,

- understand the principle of nucleic acid isolation.
- understd the principles of PCR and their uses in genetic engineering.
- gain a thorough knowledge about nucleic acid hybridization.
- learn the history of DNA sequencing and current methods and gene synthesis

LIST OF EXPERIMENTS

1. Preparation of Genomic DNA
2. PCR amplification of gene from the genomic DNA
3. Preparation of plasmid DNA
4. Detection of Plasmid DNA by Agarose gel electrophoresis
5. Restriction Digestion of the vector and Insert
6. Ligation and Transformation of*E.coli*
7. Lysate PCR confirmation.
8. Restriction & gel elution of DNA fragments
9. Electroporation of Yeast
10. SDS-PAGE analysis of purified protein
11. Western blot confirmation of expressed protein (anti his)
12. Quantification of proteins.
13. RNA Isolation
14. cDNA preparation from RNA
15. Site directed mutagenesis
16. Southern hybridization experiment

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED FOR 30 STUDENTS

- PCR machine
- Electrophoretic assemblies for DNA and protein separations
- ELISA reader
- Ultracentrifuge
- Laminar air flow cabinets
- Cooling centrifuge

OUTCOMES:

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

CO1 experience basic techniques of DNA isolation and manipulation

CO2 experience in selecting genetically transformed organisms for downstream analysis

CO3 experience basic techniques involved in analysis of gene expression at nucleic acids and proteins level

REFERENCES:

1. Old RW, Primrose SB, "Principles of Gene Manipulation, "An Introduction to Genetic Engineering", Blackwell Science Publications, 1993.
2. Ausubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology, "Greene Publishing Associates, NY, 2003.
3. S. John Venison, "Laboratory manual for Genetic Engineering", Eastern economy edition, 2009.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	experience basic techniques of DNA isolation and manipulation	3	3	2	3	3	2	2	-	-	-	-	-	1	-	1	3
CO 2	experience in selecting genetically transformed organisms for downstream analysis	3	3	2	3	3	2	2	-	-	-	-	-	1	-	1	3
CO 3	experience basic techniques involved in analysis of gene expression at nucleic acids and proteins level	2	3	3	2	2	3	3	3	1	-	-	2	2	3	3	3
Overall CO		3	3	2	3	3	2	2	1	-	-	-	-	1	1	1	3

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

SEMESTER V

GE5451	TOTAL QUALITY MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES

The course aims to,

- 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- Benchmarking - Reasons to benchmark, Benchmarking process, What to BenchMark, 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:

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

CO1 apply TQM principles in a selected enterprise.

CO2 understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO3 understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO4 apply QMS and EMS in any organization.

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,Mary B.Sacre,Hemant Urdhware she 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

PM5501 MEDICINAL CHEMISTRY LT PC

3 0 0 3

OBJECTIVES

The course aims to,

- impart comprehensive understanding of the chemical basis of drug action including physicochemical and steric properties of drug.
- study the classification, chemical nomenclature, generic names and synthesis of various medicinal agents.
- understand the structure activity relationship, biochemical/molecular basis of the mechanism of action and uses of drugs.

UNIT I PRINCIPLES OF MEDICINAL CHEMISTRY 6

History/development of medicinal chemistry, Physicochemical properties in relation to biological action – Ionization, Drug distribution and pKa values, hydrogen bonding, protein binding, chelation, optical and geometrical isomerism, steric effect, redox potential and surface activity. Prodrugs – concepts/application of prodrug design. Introduction to QSAR.

UNIT II MEDICINAL CHEMISTRY OF DRUGS ACTING ON CNS AND ANS 9

Classification, biochemical/molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties and synthesis of selected drugs belonging to the class of General anaesthetics, local anaesthetics Anxiolytics, Sedatives and Hypnotics, Antipsychotics, Anticonvulsants/antiepileptics, CNS stimulants and Psychedelics, Analgesics, Morphine and related drugs., adrenergic neurotransmitters,

sympathomimetic agents. adrenergic antagonists, cholinergic receptors drugs and related agents, cholinergic blocking agents, ganglionic blocking agents and neuromuscular blockers.

UNIT III MEDICINAL CHEMISTRY OF ANTI-INFECTIVE AGENTS 12

Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties, design and synthesis of selected drugs belonging to the class of sulphonamides and sulphones, antibiotics like penicillins and cephalosporins, aminoglycosides, tetra cyclines., unclassified antibiotics – chloramphenicol and its prodrugs, peptide antibiotics, novobiocin and mupirocin, antiviral agents, anti-HIV agents, local anti-infective agents, anti-fungal agents, anti-tubercular agents, anti-protozoal agents, anthelmintics, anti-scabious and anti pedicular agents, antimalarials

UNIT IV MEDICINAL CHEMISTRY OF DRUGS ACTING ON CVS AND RENAL SYSTEMS 9

Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties, design and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers, cardiac glycosides, antiarrhythmic drugs, anti-hypertensive agents, anti-hyperlipidemic agents, anti platelet inhibitors, anti-coagulants and anti-thrombolytics. Diuretics and Anti-diuretics.

UNIT V MEDICINAL CHEMISTRY OF ANTICANCER DRUGS 9

chemistry and nomenclature, structure basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties, design and synthesis of selected drugs belonging to the class of antimetabolites, DNA alkylating agents, antibiotic anticancer agents, hormonal anticancer agents, anti-tubulin inhibitors.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 gain an appreciation of the importance of the physical properties of drugs with respect to the ionization, solubility and efficacy of drugs, understand how changes in the chemical structure of drugs affect efficacy.

CO2 obtain a working knowledge of chemical structures and nomenclature, to develop the ability to suggest suitable techniques to synthesize different drug molecules.

CO3 understand how current drugs were developed and demonstrate the importance of chemistry in the development and application of therapeutic drugs.

TEXT BOOKS:

1. Ashutosh Kar, Medicinal Chemistry, 6th Edition, New Age International (P) Ltd. Publishers, New Delhi 2015.
2. Graham L. Patrick, An introduction to Medicinal Chemistry ,6th Edition, Oxford University Press, 2017.
3. Ilango, K. and Valentina, P., “Text book of Medicinal Chemistry”, Vol.1, 1st edition, Keerthi Publishers,2007.

REFERENCES:

1. Donald J. Abraham, Burger’s Medicinal Chemistry and Drug Discovery, Vol V, 6thEdition, John Wiley and Sons, Inc., 2003.
2. William O Foye, Thomas L Lemke, David A Williams Foye’s Principles of Medicinal Chemistry, 7th Edition, Wolters Kluwer Health Adis (ESP) Publisher, 2012.
3. Indian Pharmacopoeia, Vol-I,7th Edition, Published by Indian Pharmacopoeia Commission India, 2014.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Gain an appreciation of the importance of the physical properties of drugs with respect to the ionization, solubility and efficacy of drugs, understand how changes in the chemical structure of drugs affect efficacy.	3	2	2	2	2	2	-	-	-	-	-	2	2	-	3	3
CO 2	Obtain a working knowledge of chemical structures and nomenclature, to develop the ability to suggest suitable techniques to synthesize different drug molecules.	3	2	2	2	2	2	-	-	-	-	-	2	2	-	3	3
CO 3	Understand how current drugs were developed and demonstrate the importance of chemistry in the development and application of therapeutic drugs.	3	2	2	2	2	2	-	-	-	-	-	2	2	-	3	3
Overall CO		3	2	2	2	2	2	-	-	-	-	-	2	2	-	3	3

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

PM5502 UNIT OPERATIONS IN PHARMACEUTICAL INDUSTRY LT PC

2 1 0 3

OBJECTIVES

The course aims to,

- provide the basic fundamentals and various unit operations such as size reduction, separation, filtration, centrifugation, crystallization and evaporation.
- understand the design concepts and equipment selection for various unit operations.

UNIT I MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION 9

Overview of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel and glass- Industrial Hazards and Safety Precautions – Mechanical, Chemical, Electrical, Fire and Dust hazards, etc., thecases of above operations prevalent in pharmaceutical bulk and formulation industries.

UNIT II SIZE REDUCTION & SEPARATION 9

Properties and characterization of particulate solids — Introduction to storage and conveying of solids - Analysis and technical methods for size determination of powders - Size reduction equipment – Screening equipment; thecases of above operations prevalent in pharmaceutical bulk and formulation industries.

UNIT III CRYSTALLIZATION 9

Characters of crystals like purity, size, shape, geometry, habit, forms, size and its factors- Solubility curves- Supersaturation theory and its limitations- nucleation mechanism and crystal growth- crystallisers- Swenson Walker crystalliser - Caking of crystals and its prevention and numerical problems on yields; thecases of above operations prevalent in pharmaceutical bulk and formulation industries.

UNIT IV FILTRATION AND CENTRIFUGATION 9

Theory of filtration, filter aids, filter media- Factors affecting filtration- industrial filters including filter press, rotary filter, edge filter, etc., - mathematical problems on filtration. Principles of centrifugation- industrial centrifugal filters - sedimentation centrifuges.

UNIT V MIXING 9

Mixing of powdered materials – Mechanism of random mixing and interactive mixing.Sampling techniques, size and mixing indices.Factors affecting the mixing process.Types, characteristics and operation of mixers.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 have a comprehensive understanding of the principles and equipment for filtration and centrifugation and membrane processes

CO2 understand the principles of equipment selection and design of size reduction and size enlargement processes

CO3 have a thorough understanding of theory and equipment selection for mixing, crystallization, drying and evaporation in pharmaceutical industry

TEXT BOOKS:

1. Roop K Khar, SP Vyas, Farhan J Ahmad, Gaurav K Jain “Lachman/Lieberman’s The theory and Practise of Industrial Pharmacy”, 4th Edition, CBS publishers & distributors, 2014.
2. Mc Cabe, W.L., Smith, J.C. and Harriot, P., “Unit Operations in Chemical Engineering”, 7th edition., McGraw-Hill, 2017.
3. Girish K.Jani, “Pharmaceutical Engineering I, Unit Operation I” B.S.Shah Prakashan, India, 2006.
4. Cooper and Gunn's Tutorial Pharmacy, Edited by S J Carter, CBS Publishers, New Delhi, 2005.

REFERENCES:

1. Badger, W.L and Banchero, J.T “Introduction to Chemical Engineering” Tata McGrawHill, 2002.
2. J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker “Coulson and Richardson’s Chemical Engineering. Vol I”, VI edition Butterworth-Heinemann, 1999.
3. J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker “Coulson and Richardson’s Chemical Engineering. Vol II”, V edition Butterworth-Heinemann, 2013.
4. K. Sambamurthy, “Pharmaceutical Engineering”, New Age International Publishers, New Delhi, 1998.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Have a comprehensive understanding of the principles and equipment for filtration and centrifugation and membrane processes	3	3	3	3	3	3	3	1	3	1	2	3	1	1	3	3
CO 2	understand the principles of equipment selection and design of size reduction and size enlargement processes	3	3	3	3	3	3	3	1	3	1	2	3	1	1	3	3
CO 3	Have a thorough understanding of theory and equipment selection for mixing, crystallization, drying and evaporation in pharmaceutical industry	3	3	3	3	3	3	3	1	3	1	2	3	1	1	3	3
Overall CO		3	3	3	3	3	3	3	1	3	1	2	3	1	1	3	3

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

PM5511 **MEDICINAL CHEMISTRY LABORATORY**

LT PC

0 0 4 2

OBJECTIVES

The course aims to,

- provide students with the practical laboratory skills of medicinal chemistry
- demonstrate the effect of the different synthetic methodology.
- clarify theoretical concepts of chemical synthesis of drug molecules.

LIST OF EXPERIMENTS:

1. Determination of melting point.
2. Determination of pKa.
3. Determination of partition coefficient of any medicinal compound by shake flask method.
4. Synthesis and characterization of the following drugs:
    a. Phenacetin, Antipyrine, Benzocaine
    b. Uramil, Tolbutamide
    c. Phenothiazine
    d. Isoniazid, Sulphasalazine
    e. Aspirin from salicylic acid
    f. Paracetamol from p-aminophenol
    g. Benzotriazole
    h. 2-Phenyl Indole
    i. 7-hydroxy-4 methyl coumarin
5. Any other relevant experiments based on theory.

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED FOR 30 STUDENTS

- Water bath
- Hot air oven
- Vacuum filtration unit
- Reflux condenser
- Distillation unit

OUTCOMES:

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

CO1 develop the ability to suggest suitable techniques to synthesize different drug molecules

CO2 learn a variety of synthetic techniques including purification methods and should gain the ability to design a synthetic scheme for a proposed drug molecule

CO3 demonstrate how to conduct chemical reactions within medicinal chemistry context and scientific report

REFERENCES:

1. K.Yogananda Reddy, Dr.K.N. Jayaveera & Dr.S.Subramanyam, Practical Medicinal Chemistry, S.Chand Publishing, 2013.
2. Vogel's Textbook of Practical Organic Chemistry, 5th edition, Pearson Publishers, 2003.
3. Mann & Saunders, Practical Organic Chemistry, 4th edition, Pearson Publishers, 2009.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	develop the ability to suggest suitable techniques to synthesize different drug molecules	2	1	1	2	1	3	1	2	1	2	1	-	3	3	3	1
CO 2	learn a variety of synthetic techniques including purification methods and should gain the ability to design a synthetic scheme for a proposed drug molecule	3	2	1	2	2	3	1	3	2	3	2	2	2	2	1	2
CO 3	Demonstrate how to conduct chemical reactions within medicinal chemistry context and scientific report	3	2	1	2	2	2	3	2	1	2	2	-	2	3	2	1
Overall CO		3	2	1	2	2	3	1	2	1	2	2	-	2	3	3	1

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

IB5451	CHEMICAL ENGINEERING LAB	LT PC 0 0 4 2

OBJECTIVES

The course aims to,

- enhance the understanding of measurement techniques of fluid flows.
- impart practical knowledge on various unit operations.

LIST OF EXPERIMENTS

1. Co-relate Reynolds Number and Friction factor.
2. Experiment on Orifice meter.
3. Experiment on Venturi meter.
4. To evaluate the performance of centrifugal pump.
5. To characterize the behavior of Fluidized bed.
6. Performance of packed bed (Gas- Liquid).
7. To determine the conduction parameters using composite wall.
8. To determine individual heat transfer film coefficient in forced convection.
9. To determine condensing heat transfer coefficient in vertical condenser.
10. To determine the overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
11. To determine the overall heat transfer coefficient of double pipe heat exchanger by counter flow.
12. To determine the overall heat transfer coefficient of shell and tube heat exchanger.
13. To determine the overall heat transfer coefficient of plate type heat exchanger by parallel flow.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Venturimeter
2. Orifice meter
3. Packed bed
4. Turbulent flow
5. Rectangular notch
6. Triangular notch
7. Drag on sphere
8. Centrifugal pump
9. Laminar flow

OUTCOMES:

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

CO1 select and operate the suitable instruments for the measurement of flow rate and rate of heat exchange

CO2 differentiate laminar and turbulent flows

CO3 calculate and analyse the performance of various pumps and heat exchangers

TEXT BOOKS:

1. Mc Cabe, W.L., Smith, J.C. and Harriot, P., “Unit Operations in Chemical Engineering”, 7th edition., McGraw-Hill, 2017.
2. J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker “Coulson and Richardson’s Chemical Engineering. Vol I”, VI edition Butterworth-Heinemann, 1999.
3. J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker “Coulson and Richardson’s Chemical Engineering. Vol II”, V edition Butterworth-Heinemann, 2013.
4. McCabe, W.L., Smith, J.C. and Harriot. P., “Unit Operations of Chemical Engineering”, VI edition, McGraw-Hill Book Co., 2001.

REFERENCES:

1. Bansal, R.K., “A text book of fluid mechanics and hydraulic machinery”, 10th edition, Laxmi publications, New Delhi, 2018.
2. Nevers, N.D., "Fluid Mechanics for Chemical Engineers", 3rd edition, McGraw-Hill, 2017.
3. De Nevers, L., “Fluid Mechanics for Chemical Engineers”, McGraw-Hill, 1994.
4. Coulson, J.M. and Richardson, J.F., “Chemical Engineering”, Vol. I, II and III, Pergamon Press, 1977.
5. Bennett, C.O. and Myers, J.E., “Momentum Heat and Mass Transfer”, 3rd Edition, McGraw Hill Book Company, 2015.
6. Geankoplis. C.J ”Transport Process & separation Process Principles” IV edition, Prentice Hall of India, 2015.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Select and operate the suitable instruments for the measurement of flow rate and rate of heat exchange	3	3	2	2	1	3	2	1	2	3	3	3	1	1	3	3
CO 2	Differentiate laminar and turbulent flows	3	3	2	2	1	3	2	1	2	3	3	3	1	1	3	3
CO 3	Calculate and analyse the performance of various pumps and heat exchangers	3	3	2	2	1	3	2	1	2	3	3	3	1	1	3	3
Overall CO		3	3	2	2	1	3	2	1	2	3	3	3	1	1	3	3

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

SEMESTER VI

PM5601 TECHNOLOGY OF SOLID AND SEMI SOLID DOSAGE FORMS

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- provide the knowledge on the principles of solid dosage forms formulation and development
- inculcate the concepts involved in troubleshooting and improvement of solid dosage forms

UNIT I PREFORMULATION CRITERIA **9**

Study of physical/physicochemical properties of drugs like physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution, organoleptic properties and their effect on formulation, stability and bioavailability.Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemisation, polymerization etc., and their influence on formulation. Stability Studies: Basic concepts, design and objectives of short term and long term stability studies.

UNIT II TABLETFORMULATION AND MACHINERY **9**

Classification of different types of tablets, tablets equipments, granulation technology on large scale by various techniques.Tablets tooling, different types of tablets compression machinery, processing problem of tablets and evaluation of tablets. Coating of tablets: Types of coating, Sugar coating, film forming materials, formulation of coating solution, equipments for coating, film defects and evaluation of coated tablets.

UNIT III CAPSULES **9**

Advantages & disadvantages of capsule dosage form, extraction of gelatin, production of hard gelatin capsules, size of capsules and method of capsule filling.Soft gelatin capsule, Nature of capsule shell & capsule content, importance of base adsorption, minimum gm factors in soft capsules, production, quality control, stability testing and storage of capsule dosage forms.

UNIT IV INTRODUCTION TO SEMISOLID DOSAGE FORMS **9**

Ideal properties of semisolid dosage forms - various types - advantages and disadvantages. Semi solid bases and their selection – preservatives - drug penetration through skin – mechanism - penetration enhancer. Preparation - various classes of materials for preparation - manufacturing method. Compendial Requirements for ointments - characterization, applications

UNIT V PASTES , GELS SUPPOSITORIES **9**

Introduction to Pastes – additives – manufacturing methods - containers and closures - characterisation. Gels – materials - manufacturing – characterisation - applications. Ideal requirements - bases used - manufacturing procedure - displacement value - packaging and evaluation – storage – packaging - stability studies

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand various preformulation characteristics of solid/ semi-solid dosage forms

CO2 understand formulation and evaluation techniques of tablets and capsules

CO3 have knowledge on basic requirements to formulate and evaluate semi-solid dosage forms

TEXT BOOKS:

1. Pharmaceutical dosage forms: tablets, vol 3, rational design and formulation, larry l. augsburger, stephen w. hoag, by informa healthcare USA, inc, III[rd] edition, 2008.
2. Lachman, Leon et al. "The Theory and Practice of Industrial Pharmacy" III[rd] Ed., Varghese Publishing House, 1987.
3. Aulton, Michael E. "Pharmaceutics: The Science of Dosage Form Design" II[nd] Ed., Churchill Livingstone, 2002.
4. Allen, Loyd V.. "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems" IX[th] Ed., Wolters Kluwer/LippinCott Williams & Wilkins, 2011.
5. H. A. Liberman,, L. Lachman, and J. B. Schwartz: Pharmaceutical dosage forms: Tablets, Vol. 1,2 and 3, II[nd] Edition Marcel Dekker, 1989.

REFERENCES:

1. Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania 1990
2. Coated Pharmaceutical Dosage Forms, K. H. Bauer, CRC Press, Boca Raton. Med Pharm.1998
3. Pharmaceutical Coating Technology, G. C. Cole, New York,1990

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Understand various preformulation characteristics of solid/ semi-solid dosage forms	2	3	1	2	3	-	1	1	2	1	2	-	3	2	3	1
CO 2	Understand formulation and evaluation techniques of tablets and capsules	3	3	1	2	3	2	1	2	1	2	1	-	3	2	1	2
CO 3	Have Knowledge on basic requirements to formulate and evaluate semi-solid dosage forms	3	2	1	2	3	3	3	1	-	1	2	1	3	3	1	1
Overall CO		3	3	1	2	3	2	1	1	1	1	2	1	3	2	1	1

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

PM5602 MASS TRANSFER OPERATIONS IN PHARMACEUTICAL TECHNOLOGY

L T PC

2 1 0 3

OBJECTIVES

The course aims to,

- introduce the principles of Mass Transfer Operations
- impart knowledge about various mass transfer operations equipments and its design concepts

UNIT I DIFFUSION AND MASS TRANSFER 9

Eddy Diffusion - Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Mass Transfer Theories & Analogies. Co current and counter current operations; Also **c**ases and processes relevant in pharmaceutical bulk and formulation industries

UNIT II GASLIQUID OPERATIONS 9

Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Industrial absorbers; Design principles of absorbers - HTU, NTU concepts; Solving design problems**;** Thecases of above processes prevalent in pharmaceutical bulk and formulation industries

UNIT III VAPOUR LIQUID OPERATIONS 9

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCabe-Thiele & Ponchon-Savarit Principles – design of distillation columns – solving design problems ; Industrial distillation equipments, HETP, HTU and NTU concepts. The cases of above processes prevalent in pharmaceutical bulk and formulation industries

UNIT IV EXTRACTION OPERATIONS 9

L-L equilibria, Solvent characteristics –Staged and continuous extraction – Spray, packed and mechanically agitated contactors- Pulsed and centrifugal extractors – supercritical extraction – solving problems - Solid-liquid equilibria, Leaching Principles – leaching equipments. Thecases of above processes prevalent in pharmaceutical bulk and formulation industries

UNIT V SOLID FLUID OPERATIONS 9

Adsorption equilibria – Nature of adsorbents; Batch and fixed bed adsorption – Adsorbers – steady state moving bed adsorber and unsteady state moving adsorbers – break through curves. Drying-Mechanism-Drying curves- Time of Drying; Batch and continuous dryers. Thecases of above processes prevalent in pharmaceutical bulk and formulation industries

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 demonstrate and classify the use of accurate engineering correlations of diffusion and mass transfer coefficient to model a separation process

CO2 get a basic knowledge to design and develop different equipments.

CO3 perceive knowledge about gas absorption, humidification, crystallization, adsorption and drying

TEXT BOOKS:

1. Treybal R.E. “Mass Transfer Operations” III edition. Mcgraw Hill, 2017.
2. Geankoplis. C.J ”Transport Process & separation Process Principles” IV edition, Prentice Hall of India, 2015.
3. Roop K Khar, SP Vyas, Farhan J Ahmad, Gaurav K Jain “Lachman/Lieberman’s The theory and Practise of Industrial Pharmacy”, 4th Edition, CBS publishers & distributors, 2014.

REFERENCES:

1. J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker “Coulson and Richardson’s Chemical Engineering. Vol I”, VI edition Butterworth-Heinemann, 1999.
2. J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker “Coulson and Richardson’s Chemical Engineering. Vol II”, V edition Butterworth-Heinemann, 2013.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	demonstrate and classify the use of accurate engineering correlations of diffusion and mass transfer coefficient to model a separation process	3	3	3	3	1	-	-	-	1	-	3	3	1	1	3	3
CO 2	get a basic knowledge to design and develop different equipments.	2	3	3	3	1	-	1	-	1	-	2	3	1	1	3	3
CO 3	perceive knowledge about gas absorption, humidification, crystallization, adsorption and drying	3	3	3	2	1	-	1	-	1	-	2	3	1	1	3	3
Overall CO		3	3	3	3	1	1	1	-	-	-	2	3	1	1	3	3

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

PM5603 PHARMACOLOGY AND CHEMOTHERAPY LT PC
3 0 0 3

OBJECTIVES

The course aims to,

- provide the general pharmacological principles.
- make understand the pharmacology of different types of drugs acting on various physiological systems.

UNIT I GENERAL PHARMACOLOGY 9

Routes of administration, Pharmacokinetics, Pharmacodynamics, Factors modifying drug action, adverse drug reactions, drug interactions, Bioassay of drugs, drug discovery and development.

UNIT II PERIPHERAL AND CENTRAL NERVOUS SYSTEM 9

Mechanism of action, Pharmacology of parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, neuromuscular blocking agents, general anaesthetics, antipsychotics, antidepressants, antiepileptic, analgesics, antipyretic, anti-inflammatory (NSAIDS) and CNS stimulants.

UNIT III CARDIOVASCULAR PHARMACOLOGY 9

Classification, Mechanism of action, Pharmacology of cardiac glycosides, antianginal, antihypertensive agents, vasodilators including calcium channel blockers, antiarrhythmic and anti- hyperlipidemic agents.

UNIT IV GASTROINTESTINAL PHARMACOLOGY 9

Classification, Mechanism of action, Antacids, antiulcer drugs, laxatives, antidiarrhoeal, emetics, antiemetics, appetite stimulants and suppressants.

UNIT V CHEMOTHERAPY AND ANTIMICROBIAL AGENTS 9

General principles of chemotherapy, sulphonamides, antibiotics – penicillins, cephalosporins, chloramphenicol, macrolides, fluoroquinolones. Chemotherapy of tuberculosis, leprosy, fungal, viral diseases, malignancy and immunosuppressive agents.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the various principles of general pharmacology
CO2 understand the pharmacology of various categories of drugs acting on nervous, cardiovascular and gastrointestinal systems
CO3 understand the principles of chemotherapy and pharmacology of antimicrobial agents

TEXT BOOKS:

1. Tripathi, K.D., “Essentials of Medical Pharmacology”, 7th Edition, Jaypee Brothers Medical Publishers (P) Ltd, 2015.
2. Satoskar, R.S., Bhandarkar, S.D. and Rege, N.,“Pharmacology and Pharmacotherapeutics”, 24th edition, Popular Prakashan (P) Ltd., 2015.
3. H. L. Sharma, K. K. Sharma, Principles of Pharmacology, Paras Medical Publishers, 3rd Edition, 2017.

REFERENCES:

1. Laurence L. Brunton, Bjorn C. Knollmann, Randa Hilal-Dandan, " Goodman and Gilman’s: The Pharmacological Basis of Therapeutics", 13thedition, McGraw-Hill Education / Medical, 2017.
2. Humphrey P. Rang,Maureen M .Dale ,James M .Ritter ,Rod J. Flower, Graeme Henderson, "Rang & Dale's Pharmacology", 8th edition, Churchill Livingstone, 2015.
3. Katzung, B.G., Trevor AJ. Basic and Clinical Pharmacology, McGraw-Hill Education, 13th Edition, 2015.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Understand the various principles of general pharmacology	2	2	2	1	1	2	2	1	3	2	1	-	1	1	2	1
CO 2	Understand the pharmacology of various categories of drugs acting on nervous, cardiovascular and gastrointestinal systems	3	1	2	1	2	2	1	2	3	2	3	2	3	2	3	2
CO 3	Understand the principles of chemotherapy and pharmacology of antimicrobial agents	3	2	3	1	3	2	3	3	2	3	2	3	2	1	2	1
Overall CO		3	2	2	1	2	2	2	2	3	2	2	2	2	1	2	1

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

PM5611 **PHARMACOLOGY LABORATORY** **LT PC**

0 0 4 2

OBJECTIVES

The course aims to,

- learn and understand the pharmacological aspects of drugs action
- correlate and apply the knowledge for drug development and evaluation.

LIST OF EXPERIMENTS

1. Experiments on humane handling of animals for research (Eg. Mice, Rats, Jirds/Gerbils, rabbits, chickens)
2. Preparation and study of physiological salt solutions and laboratory appliances used in experimental pharmacology.
3. Bioassay experiments - study of the effects of various drugs on isolated tissues (heart, muscle etc., from abattoir specimens or nematodes) e.g Ach, adrenaline, effect of adrenergic and cholinergic blockers, effect of ions (through direct/audiovisual demonstration)
4. Experiments of drug evaluation using zebrafish model (Eg. Teratogenic effects, etc.,)
5. Experiments of drug evaluation using *C.elegans* model
6. Evaluation of pyrogens by *in vitro* LAL test (Limulus Amebocyte Lysate) test (or Limulus clotting factor C)
7. Routes of drug administration in animal models (through direct/audiovisual demonstration)
8. Experiments to study general anaesthetic effects of drugs
9. Experiments to study analgesic effects of drugs
10. Experiments to study local anaesthetic effects of drugs
11. Experiments to study anti-inflammatory effects of drugs
12. Experiments to study antiparasitic drugs (*in-vitro* /*in-vivo* methods using nematodes)
13. Experiments to study anticancer drugs by cytotoxic assay (MTT assay)

TOTAL: 60 PERIODS

Equipments Required :

1. Animal House facility
2. UV-Visible spectrophotometer
3. Simulation softwares
4. Fish tanks, *E.coli* cultures *C.elegans*
5. Relevant consumables and drugs

OUTCOMES:

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

CO1 be familiar with various animal handling techniques

CO2 study the pharmacological effects in different *in-vitro, in-situ, in-vivo, in-silico* organ systems

CO3 learn evaluation of drug effects through physiological models

TEXT BOOKS:

1. Handbook of experimental pharmacology by S.K.Kulkarni, Vallabh Prakashan, 2014.
2. Pharmacological experiments on intact preparations by Churchill Livingstone.1970

REFERENCES:

1. The Pharmacological basis of therapeutics – Goodman and Gilman's, McGraw-Hill Education / Medical; 13 edition, 2017.
2. Fundamentals of experimental pharmacology by M.N.Ghosh, Hiltol & company, 6th edition, 2008.
3. https://zfin.org/ (The Zebrafish Information Network)
4. https://www.wormbase.org (Explore Worm Biology facilitating insights into nematode biology for research)

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	be familiar with various animal handling techniques	2	2	1	2	1	2	2	2	3	2	3	-	2	1	2	1
CO 2	study the pharmacological effects in different *in*-vitro, in-situ, in-vivo, in-silico organ systems	2	1	3	1	2	2	3	2	3	2	3	2	3	2	3	1
CO 3	learn evaluation of drug effects through physiological models	2	2	2	1	3	2	2	3	2	2	2	1	2	1	2	1
Overall CO		2	2	2	1	2	2	2	2	3	2	3	1	2	1	2	1

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

PM5612 **DOSAGE FORMS LABORATORY**

LT PC

0 0 4 2

OBJECTIVES

The course aims to,

- study the basic principles of formulating prototype dosage forms such as liquid, semisolid, solid and parenteral dosage forms
- learn various methods of characterizing and evaluating the dosage forms

LIST OF EXPERIMENTS

1. Preparation of solutions
2. Preparation of creams
3. Evaluation of creams
4. Preparation of ointments
5. Evaluation of ointments
6. Preformulation studies on prepared granules
7. Manufacture and evaluation of granules - wet granulation, dry granulation methods
8. Preparation of tablets
    a. Tablets prepared from wet and dry granules
    b. Tablets prepared by direct compression
9. Formulation and filling of hard gelatin capsules
10. Preparation and evaluation of parenterals
    a. Ascorbic acid injection
    b. Calcium gluconate injection
    c. Sodium chloride injection

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Tablet punching machine – Mini press
2. Automatic capsule filling machine
3. pH meter
4. Dissolution apparatus
5. Liquid filling Machine
6. Mortar/pestle

OUTCOMES:

After the completion of the course the students will be able to,

CO1 acquire knowledge to prepare and evaluate various liquid, semi solid dosage forms

CO2 acquire knowledge to prepare and evaluate solid dosage forms and parenteral dosage forms

CO3 apply the knowledge to formulate new dosage forms

TEXT BOOKS:

1. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, Jaypee medical publishers,Ninth edition, 2010.
2. Indian Pharmacopoeia, Indian Pharmacopoeia commission, Ghaziabad, 2016.
3. Cooper and Gunn's Dispensing for Pharmaceutical Students, Edited by S J Carter,CBS Publishers, New Delhi, 2008.

REFERENCES:

1. Handbook of Pharmaceutical Manufacturing Formulations, Second Edition,Sarfaraz K. NiaziMack Pub. Co., CRC Press, 2009.
2. Hard capsules, development and technology. Edited by K. Ridgway. The Pharmaceutical Press: London, UK. 1987. 320.
3. Pharmaceutical Dosage Forms: Parenteral Medications, Volume I, Kenneth E.Avis, Herbert A. Lieberman (Editor), Leon Lachman (Editor) Informa Healthcare, 1993.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Acquire knowledge to prepare and evaluate various liquid, semi solid dosage forms	2	2	2	3	1	3	3	2	1	2	1	1	1	2	2	2
CO 2	Acquire knowledge to prepare and evaluate solid dosage forms and parenteral dosage forms	2	2	3	2	3	3	2	2	1	2	1	1	2	2	3	1
CO 3	Apply the knowledge to formulate new dosage forms	1	2	2	3	3	1	2	3	3	3	3	2	2	3	2	3
Overall CO		2	2	2	3	3	3	2	2	1	2	1	1	2	2	2	2

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

SEMESTER VII

PM5701 BIOPHARMACEUTICS AND PHARMACOKINETICS

LT PC

3 0 0 3

OBJECTIVES

The course aims to,

- learn important parameters involved in drug disposition and its principles in living systems.
- make the students to understand how the drug disposition takes place in the *in vitro* and in vivo conditions.
- understand the concepts of bioavailability and bioequivalence of drug products and their significance

UNIT I DRUG ABSORPTION AND DISTRIBUTION 9

Mechanisms of drug absorption through GIT, factors influencing drug absorption through GIT, absorption of drug from Non-per oral extravascular routes, Distribution of drugs, Tissue permeability of drugs, binding of drugs, apparent volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs.

UNIT II ELIMINATION 9

Drug metabolism, metabolic pathways, factors affecting metabolism, renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non- renal routes of drug excretion of drugs

UNIT III BIOAVAILABILITY AND BIOEQUIVALENCE 9

Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UINT IV PHARMACOKINETICS 9

Introduction to Pharmacokinetics, Pharmacokinetic models, One compartment open model-Intravenous Bolus Injection – Intravenous infusion - Extra vascular administrations. Determination of pharmacokinetics parameters and their significance - Absorption Rate Constant (ka), Elimination Rate Constant (K) & Elimination Half- life ($t_{½}$), AUC, $C_{max,}$ and t_{max}. Apparent Volume of Distribution (V_d) & Renal Clearance (Q).

UNIT V MULTIPLE DOSAGE REGIMENS AND NONLINEAR PHARMACOKINETICS 9

Concept, Accumulation, Persistent and elimination factors. Calculation of dosage regimen following repetitive IV and oral administration.Nonlinear Pharmacokinetics **-** Introduction, factors causing Non-linearity, Michaelis-menton method of estimating pharmacokinetic parameters.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 study the various factors influencing the drug disposition, various pharmacokinetic parameters.

CO2 design and interpret the bioavailability and bioequivalence of dosage forms.

CO3 identify the factors affecting the rate of drug absorption.

TEXT BOOKS:

1. Rosenbaum, S. E. "Basic Pharmacokinetics and Pharmacodynamics: An Integrated Textbook and Computer Simulations", 2nd Edition, John Wiley & Sons, 2016.
2. Brahmankar, D.M. and Jaiswal, S.B. "Biopharmaceutics and Pharmacokinetics: a Treatise", 3rd Edition, Vallabh Prakashan, 2015.
3. Chatwal, G.R. "Biopharmaceutics and Pharmacokinetics", 2nd Edition, Himalaya Publishing House, 2014.

REFERENCES:

1. Shargel,L and Andrew, B.C. Yu. "Applied Biopharmaceutics & Pharmacokinetics",7th Edition, The McGraw-Hill Companies, Inc, 2016.
2. Gibaldi, M. "Biopharmaceutics & Clinical Pharmacokinetics", 4th Edition, Pharma Book Syndicate, 2016.
3. Jambhekar, S.S. and Philip, J. B. "Basic Pharmacokinetics" 2nd Edition, Pharmaceutical Press,2012.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Study the various factors influencing the drug disposition, various pharmacokinetic parameters.	2	2	2	2	2	-	1	-	-	-	-	2	1	1	3	3
CO 2	Design and interpret the bioavailability and bioequivalence of dosage forms.	2	2	1	2	2	-	1	-	-	-	-	2	1	1	3	3
CO 3	Identify the factors affecting the rate of drug absorption.	2	2	-	-	-	-	-	-	-	-	-	2	1	-	3	3
Overall CO		2	2	1	2	2	-	1	-	-	-	-	2	1	1	3	3

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

PM5702 **DRUG DELIVERY SYSTEMS**

LT PC

3 0 0 3

OBJECTIVES

The course aims to,

- understand the properties of polymer and its significance in drug delivery systems.
- interpret physicochemical properties of the drug with the drug delivery system modules.

UNIT I SUSTAINED RELEASE FORMULATIONS 10

Introduction, concept advantages and disadvantages. Physicochemical and biological properties of drugs relevant to sustained release formulations.

UNIT II TRANSDERMAL DRUG DELIVERY SYSTEMS 8

Permeation through skin, factors affecting permeation, basic components of TDDS, formulation approaches used in development of TDDS and their evaluation, permeation enhancers.

UNIT III PARENTERAL CONTROLLED RELEASE DRUG DELIVERY SYSTEMS 7

Approaches for injectable controlled release formulations and development of Implantable drug delivery systems.

UNIT IV TARGETED DRUG DELIVERY SYSTEMS 12

Concept. Advantages and disadvantages, biological processes and events involved in drug targeting, nanoparticles, liposomes, resealed erythrocytes, microspheres, and monoclonal antibodies.

UNIT V FUTURE DIRECTIONS OF DRUG DELIVERY AND TARGETING 8

Plasmid based Gene therapy, Protein delivery system, Nucleic acids delivery, Integrating Drug Discovery and delivery and New Generation Technology.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the properties and importance of polymer in novel drug delivery systems

CO2 apply the concepts of newer method of drug delivery systems involved in the pharmaceutical sciences and relevance of their drug delivery strategies

CO3 understand the application of polymer in sustained release, topical and targeted drug delivery systems.

TEXT BOOKS:

1. Binghe wang, Teruna Siahaan and Richard A Soltero “Drug delivery principles and applications” John wiley and Sons Inc, 2005.
2. Junginger H.E, “ Drug Targeting and Delivery- concepts in dosage form design”, Ellis Harwood series in Pharmaceutical Technology.1992
3. Vasant Ranade, mannfred A Hollinger “Drug delivery systems” II ed , CRC Press.2003
4. Grietje Molema and Dirk K F Meijer “Drug Targeting organ - specific strategies” WILEY-VCH , 2001.
5. Anya M Hillery et al “ Drug Delivery and Targeting”, CRC Press, 2010.

REFERENCES:

1. S.P.Vyas and R.K.Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi,First edition 2002.Remington: The science and practice of pharmacy, 20th edition Pharmaceutical Science (RPS)
2. Theory And Practice Of Industrial Pharmacy by Liberman & Lachman,2014
3. Pharmaceutics-the science of dosage form design by M.E.Aulton, Churchill livingstone, 2001
4. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea & febiger, Philadelphia, 5th edition, 2005
5. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, NewDelhi, First edition 1997 (reprint in 2001).

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Understand the properties and importance of polymer in novel drug delivery systems	1	1	2	2	2	-	1	-	-	-	-	2	1	1	3	3
CO 2	Apply the concepts of newer method of drug delivery systems involved in the pharmaceutical sciences and relevance of their drug delivery strategies	3	1	2	2	3	-	1	-	-	-	-	2	1	1	3	3
CO 3	Understand the application of polymer in sustained release, topical and targeted drug delivery systems.	2	1	1	-	3	-	1	-	-	-	-	2	1	-	3	3
Overall CO		2	1	1	2	2	-	1	-	-	-	-	2	1	1	3	3

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

PM5711 NOVEL DRUG DELIVERY SYSTEMS LABORATORY LT PC

0 0 4 2

OBJECTIVES

The course aims to,

- understand and analyse the factors influencing the formulation of novel drug delivery Systems,
- choose the right choice of excipients for the right delivery systems, characterize and interpret the results of marketed products**.**

LIST OF EXPERIMENTS

1. Preparation of transdermal films
2. Preparation of microspheres
3. Preparation and evaluation of matrix tablets using various polymers
4. Study on diffusion of drugs through various polymeric membranes
5. Preparation of solid dispersions
6. Study of in vitro dissolution of various sustained release formulations of marketed products
7. Preparation of Liposomes.
8. Preparation of polysaccharide particle based drug delivery
9. Preparation of DNA liposome complex.

TOTAL: 60 PERIODS

EQUIPMENTS REQUIRED

1. Weighing balance
2. pH meter
3. Rotary evaporator
4. Hot plate
5. Phase contrast microscope

OUTCOMES:

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

CO1 comprehend various classes of excipients involved in formulation of novel drug delivery systems.

CO2 formulate and evaluate appropriate novel drug delivery formulations in a practical setting in response to defined criteria.

CO3 perform various quality control tests for the marketed products.

TEXT BOOKS:

1. Binghe wang, Teruna Siahaan and Richard A Soltero “Drug delivery principles and applications” John wiley and Sons Inc, 2005.
2. Junginger H.E, “ Drug Targeting and Delivery- concepts in dosage form design”, Ellis Harwood series in Pharmaceutical Technology.1992
3. Vasant Ranade, mannfred A Hollinger “Drug delivery systems” II ed , CRC Press.2003
4. Grietje Molema and Dirk K F Meijer “Drug Targeting organ - specific strategies” WILEY-VCH , 2001.
5. Anya M Hillery et al “Drug Delivery and Targeting”, CRC Press, 2010.

REFERENCES:

1. S.P.Vyas and R.K.Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi,First edition 2002.
2. Theory And Practice Of Industrial Pharmacy by Liberman & Lachman,2014
3. Pharmaceutics-the science of dosage form design by M.E.Aulton, Churchill livingstone, 2001
4. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea & febiger, Philadelphia, 5th edition, 2005
5. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, NewDelhi, First edition 1997 (reprint in 2001).

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Comprehend various classes of excipients involved in formulation of novel drug delivery systems.	2	2	2	2	-	-	-	-	-	-	2	2	2	2	3	1
CO 2	Formulate and evaluate appropriate novel drug delivery formulations in a practical setting in response to defined criteria.	3	2	3	2	-	1	-	-	-	-	2	3	2	2	3	3
CO 3	Perform various quality control tests for the marketed products organ	2	1	1	-	-	-	-	-	-	-	2	2	2	2	2	3
Overall CO		2	2	2	2	-	1	-	-	-	-	2	2	2	2	3	3

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

PM5712 BIOPHARMACEUTICS AND PHARMACOKINETICS LABORATORY

L T P C

0 0 4 2

OBJECTIVES

The course aims to,

- understand the principles of pharmaceutical dosage form kinetics
- Impart the knowledge of the rate and extent of drug absorption and distribution.

LIST OF EXPERIMENTS

1. In-vitro dissolution study of the given sustained release dosage form using various dissolution media.
2. Study the effect of formulation on drug release (Tablet, Solution, suspension etc.).
3. Determination of effect of pH on the partition coefficient of drug(s)
4. Determination of protein binding of the given drug(s) and the effect of protein binding on drug bioavailability.
5. In-vitro drug absorption study using everted small intestine sac technique.
6. To calculate the various Pharmacokinetic parameters from the given blood data of I.V bolus injection (one compartment model).
7. To calculate various Pharmacokinetic parameters from the given urinary excretion data of I.V bolus injection using both methods (Rate of elimination & sigma minus method one compartment model).
8. To determine the various Pharmacokinetic parameters from the given blood data of oral dosage form.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- pH Meter
- Dissolution test apparatus
- Cooling Centrifuge
- Ultra Violet Spectrophotometer
- HPLC

OUTCOMES:

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

CO1 perform dissolution studies for the modified dosage forms

CO2 estimate various pharmacokinetic parameters using plasma and urine drug level data

CO3 predict the effects of dosage form design and routes of drug administration on drug levels in body

REFERENCES:

1. Vijaya Raghavan, C and Judith Justin, “Experimental Biopharmaceutics and Pharmacokinetics”, New century book house (P) Ltd., 2006.
2. Burton, M.E. “Applied Pharmacokinetics & Pharmacodynamics: Principles of Therapeutics”, 4th Edition, Lippincott Williams Wilkins, 2006.
3. Brahmankar, D.M. and Jaiswal, S.B. “Biopharmaceutics and Pharmacokinetics: a Treatise”, 3rd Edition, Vallabh Prakashan, 2015.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Perform dissolution studies for the modified dosage forms	2	2	1	1	2	1	1	-	-	1	1	2	1	2	2	2
CO 2	Estimate various pharmacokinetic parameters using plasma and urine drug level data	2	1	1	2	2	2	3	2	3	3	3	3	3	3	3	1
CO 3	Predict the effects of dosage form design and routes of drug administration on drug levels in body	1	2	2	1	2	1	3	-	-	2	3	2	-	3	2	1
Overall CO		2	2	1	1	2	1	3	-	-	2	3	2	2	3	2	1

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

PM5713 INTERNSHIP / TRAINING (MINIMUM 4 WEEKS)

L T P C

0 0 0 2

OBJECTIVES

The course aims to,

- encourage the students to get connected with any industry/ laboratory/research institute.
- acquire knowledge on solving practical problems, gaining work experience and skills.
- learn to work in an academic/ industrial/research environment.

The students individually undergo training in reputed companies/research institutes/ organizations for the specified duration.

OUTCOMES:

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

CO1 learn to work in an industry/academia/research institute

CO2 gain experience to work as an individual as well as a team member.

CO3 acquire practical knowledge and enhance their technical skills

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	learn to work in an industrial/academic/research institute	1	1	2	-	1	-	-	1	1	1	-	-	-	1	1	1
CO 2	gain experience to work as an individual as well as a member of a team	1	1	2	1	1	-	-	2	2	1	1	2	-	1	-	1
CO 3	Acquire practical knowledge and enhance skills	1	1	2	1	1	-	-	2	2	1	1	2	2	2	2	3
Overall CO		1	1	2	1	1	-	-	2	2	1	1	2	2	2	2	3

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

PM5714 **PROJECT I**

L T P C

0 0 6 3

OBJECTIVES

The course aims to,

- make the students identify project/problems relevant to their field of interest that can be carried out.
- make them equipped to search databases and journals to collect relevant data and learn methods to develop understanding and formulate solutions.
- plan, learn and perform experiments to verify the solutions.

OUTCOMES:

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

CO1 gain knowledge in the identification of field of interest.

CO2 equip the students to search and think about logical solutions.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	gain knowledge in the Identification of field of interest	2	2	2	1	1	2	-	2	1	2	-	2	1	2	1	2
CO 2	Equip the students to search and think about logical solutions	2	2	1	1	1	2	-	2	2	2	-	2	1	1	2	3
Overall CO		2	2	1	1	1	2	-	2	2	2	-	2	1	1	2	3

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

SEMESTER VIII

PM5811 **PROJECT II** **L T P C**

0 0 16 8

OBJECTIVES

The course aims to,

- train students to analyze a problem
- make them understand how to find solutions innovatively
- enable them to acquire technical and experimental skills to validate the solution, analyze the results and communicate.

COURSE OUTCOMES:

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

CO1 formulate and analyze a problem

CO2 plan experiments to find solutions in a logical manner

CO3 analyze the results, interpret and communicate.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Formulate and analyze a problem	2	2	1	1	1	1	1	2	2	2	1	2	1	-	-	1
CO 2	Plan experiments to find solutions in a logical manner	2	1	2	2	2	1	2	3	3	2	2	3	2	2	2	3
CO 3	Analyze the results, interpret and communicate	3	2	3	3	2	2	2	3	3	3	2	3	2	3	1	3
Overall CO		2	2	3	3	2	1	2	3	3	2	2	3	2	2	2	3

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

PM5001 **PHARMACOGNOSY** **LT PC**

2 0 2 3

OBJECTIVES

The course aims to,

- study about the general pharmacognosy and drug containing various active substances,
- classify, identify and understand the medicinal compounds derived from plant sources and relate to therapeutic applications

UNIT I GLYCOSIDES **12**

Introduction to primary and secondary metabolites.Study of the biological sources, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing glycosides. Anthraquinone glycosides: Aloe, Senna, rhubarb and cascara. Cardiac glycosides: digitalis, squill, strophanthus and thevetia. Saponins: glycyrrhiza, ginseng, dioscorea.

UNIT II ALKALOIDS **12**

Study of the biological sources, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing Alkaloids **:**vinca, atropa belladonna ephedra, ergot, cinchona, ipecac, rauwolfia, opium.

UNIT IIIOTHER SECONDARY METABOLITES **12**

Study of the biological sources, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing **Flavonoids:** Lignans, Tea, Ruta. **Volatile oils**: Mentha, Clove, Cinnamon, Fennel, Coriander, isolation techniques involved.

UNIT IV QUALITY CONTROL OF CRUDE DRUGS **12**

Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.WHO guidelines for quality control of herbal drugs.

UNIT VBASICS OF PHYTOCHEMISTRY **12**

Modern methods of extraction, application of latest techniques like Spectroscopy and chromatography in the isolation, purification and identification of crude drugs

LIST OF EXPERIMENTS

1. Organoleptic characters of clove, fennel, ginger, cinnamon, nux vomica, ipecac etc
2. Histology of clove, fennel, ginger, cinnamon, nux vomica, ipecac etc
3. Experiments to perform the ash value, extractive value, refractive index swelling index etc
4. Extraction of active components using soxhlet apparatus
5. Isolation of volatile oil
6. Phytochemical analysis of crude drugs

TOTAL: 60 PERIODS

EQUIPMENTS REQUIRED

- Microscope, polarimeter, soxhlet apparatus, water bath, hot air oven, rotary vacuum evaporator, camera lucida, phytochemical reagents, Chromatographic plates, UV spectrophotometer, HPLC, HPTLC.

OUTCOMES:

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

CO1 study the physiological characteristics of medicinal plants

CO2 separate and characterize the phytoconstituents

CO3 learn about the evaluation and isolation of various crude drugs

TEXT BOOKS:

1. Evans, W.C. “Trease and Evans Pharmacognosy”, 16th Edition, Saunders / Elsevier, 2009.
2. Kokate, C.K.., “Pharmacognosy”, 53rd Edition, Nirali Prakashan, 2008.
3. Wallis, T.E. “Textbook of Pharmacognosy”, 5th Edition, CBS Publishers, 2005.

REFERENCES:

1. Gennaro, A.R. “Remington : The Science and Practice of Pharmacy”, Vol. I & II. 21th Edition, B.I. Publications Pvt. Ltd. / Lippincott Williams & Wilkins, 2009.
2. Mohammed Ali, “Textbook of Pharmacognosy”, 2nd Edition, CBS Publishers, 2007.
3. Kalia, A.N. “Textbook of Industrial Pharmacognosy”, CBS Publishers, 2007
4. Qadry J.S, “ A Textbook of Pharmacognosy Theory and practicals, 17nd Edition, CBS Publishers, 2005
5. Ayurvedic pharmacopoeia. Volume I & II, First edition, Department of AYUSH, New Delhi, 2008.
6. Pulok K. Mukherjee, Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals, Business Horizons Ltd., New Delhi, 2002.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	study the physiological characteristics of medicinal plants	2	1	1	-	-	-	1	-	-	-	-	2	1	1	-	2
CO 2	separate and characterize the phytoconstituents	2	1	1	-	-	-	1	-	-	-	-	2	1	1	-	2
CO 3	learn about the evaluation and isolation of various crude drug	1	-	-	-	-	-	1	-	-	-	-	2	1	1	-	1
Overall CO		2	1	1	-	-	-	1	-	-	-	-	2	1	1	-	2

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

PM5002 CLINICAL RESEARCH AND PHARMACOVIGILANCE

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- give an opportunity to learn the different types and designs of clinical trials, requirements for conducting clinical trials, an opportunity to conceptualize, conduct, manage and report clinical trials
- teach the students on conceptualizing, designing, conducting, managing, and reporting of clinical trials.
- focus on global scenario of pharmacovigilance in different methods that can be used to generate safety data.
- teach the students in developing drug safety data in pre-clinical, clinical phases of drug development and post market surveillance

UNIT I REGULATORY PERSPECTIVES OF CLINICAL TRIALS 9

Origin and Principles of International Conference on Harmonization – Good Clinical Practice (ICH-GCP) guidelines Ethical Committee: Institutional Review Board, Ethical Guidelines for Biomedical Research and Human Participant-Schedule Y, ICMR, the Informed Consent Process: Structure and content of an Informed Consent Process Ethical principles governing informed consent process

UNIT II CLINICAL TRIALS- TYPES AND DESIGN 9

Experimental Study- RCT and Non RCT, Observation Study: Cohort, Case Control, Cross sectional Clinical Trial Study Team Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management.

UNIT III CLINICAL TRIAL DOCUMENTATION 9

Guidelines to the preparation of documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study Report Clinical Trial Monitoring-Safety Monitoring in CT Adverse Drug Reactions: Definition and types. Detection and reporting methods.Severity and seriousness assessment.predictability and preventability assessment. Management of adverse drug reactions; Terminologies of ADR.

UNIT IV BASIC ASPECTS/TERMINOLOGIES OF PHARMACOVIGILANCE 9

History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of ADR, evaluation of medication safety, Establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance.

UNIT V METHODS, ADR REPORTING, TOOLS FOR PHARMACOVIGILANCE 9

International classification of diseases, International Nonproprietary names for drugs, Passive and Active surveillance, Comparative observational studies, targeted clinical investigations and Vaccine safety surveillance. Spontaneous reporting system and Reporting to regulatory authorities, Guidelines for ADRs reporting. Argus, Aris G Pharmacovigilance, VigiFlow, Statistical methods for evaluating medication safety Data.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 explain the regulatory requirements for conducting clinical trials and demonstrate the types of clinical trial designs

CO2 explain the responsibilities of key players involved in clinical trials and execute safety monitoring, reporting, close-out activities etc.

CO3 explain the principles of pharmacovigilance and detect new adverse drug reactions and their assessment

TEXT BOOKS:

1. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons.
2. A textbook of Clinical Pharmacy Practice: Essential Concepts and Skills. Second Edition, 2012, University Press
3. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.
4. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice. E6; May 1996.230
5. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.
6. Textbook of Pharmacovigilance: Concept and Practice. G. P. Mohanta and P. K. Manna. 2016, Pharma Med Press.

REFERENCES:

1. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications.
2. Handbook of clinical Research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone.
3. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.
4. Blaisdell, Peter, “Twenty – First Century Pharmaceutical Development”, Interpharm Press, 2001.
5. Gad, Shayne C. “Drug Safety Evaluation”, John – Wiley & Sons, 2002.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Explain the regulatory requirements for conducting clinical trials and Demonstrate the types of clinical trial designs	-	1	2	2	3	1	1	3	2	1	-	2	-	1	2	3
CO 2	Explain the responsibilities of key players involved in clinical trials and Execute safety monitoring, reporting,close-out activities etc.	-	1	2	2	3	1	1	2	3	2	2	2	-	2	2	3
CO 3	Explain the principles of Pharmacovigilance and Detect new adverse drug reactions and their assessment	-	-	2	2	3	1	-	2	2	1	-	2	-	2	2	3
Overall CO		-	1	2	2	3	1	1	2	2	1	-	2	-	2	2	3

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

PM5003 CHEMISTRY OF NATURAL PRODUCTS

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- learn, classify and understand the chemistry and structural aspects of medicinal compounds from various natural sources
- understand the structural elucidation principles of compounds from natural sources and relate their therapeutic applications

UNIT I STRUCTURAL BASIS OF NATURAL PRODUCTS 9

Chemical and spectral approaches to simple molecules of natural origin.identification of natural products by chromatographic and spectroscopic methods and application of I.R., N.M.R. and Mass spectroscopy in the structural elucidation of organic compounds. Concept of stereoisomerism taking examples of natural products Eg.citral, menthol, camphor, ephedrine, atropine etc.; standardization of traditional drug formulations, chromatographic study of some herbal constituents

UNIT II GLYCOSIDES 9

Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, isolation, medicinal properties and structural elucidation of sennosides, cardenolides and bufadienolides, digoxin and digitoxin, introduction to scillaren A and ouabain.

UNIT III ALKALOIDS 9

Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, isolation and structural elucidation of Pyridine alkaloids, Tropane alkaloids, Quinoline and Isoquinoline alkaloids, Phenanthrene alkaloids, Indole alkaloids, Imidazole alkaloids, Alkaloid amines, Glycoalkaloid, Xanthine alkaloid

UNIT IV TERPENES AND FLAVONOIDS 9

Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, isolation, medicinal properties and structural elucidation, flavonoids, quercetin; Terpenes– special isoprene rule, mono, diterpenes, triterpenoids and sesquiterpenes, and structural elucidation of citral, carvone, menthol and camphor; Steroids – cholesterol, colour reactions, reactions of steroids, stigmasterol, β-Sitosterol, bile acids, ergosterol, diosgenin, solasodine, hecogenin

UNIT V STUDY OF TRADITIONAL DRUGS 9

Classification of indigenous drugs traditional drugs, common vernacular names, botanical source, chemical constituents, uses and marketed formulations with ingredients like – Amla, Shatavari, Bhilwua, bael, bach, rasna, punarnava, gokhru, shankhapushpi, brahmi adusa, arjuna, lahsun, guggul, gymnema, neem ,tulsi, Shilajit and Spirulina

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 classify extract, isolate and characterize the natural products by chemical tests

CO2 understand the classification, metabolic pathways, metabolites and their structural elucidation

CO3 explore the therapeutic applications of various molecules from natural sources

TEXT BOOKS:

1. O.P. Agarwal, “Chemistry of Organic Natural Products: Volume I & II”, Goel Publishing House, 1980.
2. Gurdeep R. Chatwal, “Organic Chemistry of Natural Products: volume I & II”, edited by Arora M, Himalaya publishing house, 2014.
3. I.L. Finar, “Organic Chemistry: Stereochemistry and the Chemistry Natural Products”, Volume II, V edition, 2002.

REFERENCES:

1. James E Robbers, Varro E Tyler and Lynn R Brady, “Pharmacognosy”, Wolters Kluwer India Pvt. Ltd., Ninth edition, 2011.
2. William C. Evans “Trease and Evans Pharmacognosy”, Elsevier Health, UK, 16th edition, 2009.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	classify extract, isolate and characterize the natural products by chemical tests	1	2	1	2	-	2	1	1	2	1	2	1	-	1	2	1
CO 2	understand the classification, metabolic pathways, metabolites and their structural elucidation	1	2	1	2	2	-	1	2	1	-	1	-	1	1	2	1
CO 3	explore the therapeutic applications of various natural sources	2	1	-	1	1	2	1	1	2	1	-	1	-	1	2	1
Overall CO		1	2	1	2	1	2	1	-	1	1	1	1	-	1	2	1

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

PM5004 MEDICINAL CHEMISTRY OF THERAPEUTIC AGENTS

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- know the basics of medicinal chemistry, principles of drug design, biochemical and molecular basis of the mechanism of action
- understand the structure-activity-relationship including stereo chemical aspects, physicochemical properties and synthesis of medicinal agents

UNIT I PRODRUGS AND METABOLIC CHANGES OF DRUGS 9

History and basic concept of prodrugs.Prodrugs of functional groups.Bioprecursor prodrugs.Chemical delivery system.General pathways of drug metabolism.Role of cytochrome P450 monooxygenase in Biotransformation, Oxidative, Reductive and Hydrolytic reaction.Conjugation reaction.Factors Affecting Drug Metabolism.

UNIT II MEDICINAL CHEMISTRY OF HORMONES, STEROIDS AND RELATED DRUGS 9

Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physicochemical properties, design and synthesis of selected drugs belonging to the class of hypoglycemic agents, synthetic hypoglycemic agents, glucocorticoids, mineralocorticoids, oestrogens, progestogens, Androgens, chemistry of natural hormones and synthetic derivatives including contraceptives, insulin and its preparation, oxytocin and vasopressin, thyroid and antithyroid drugs, medicinal chemistry of Diagnostic drugs and reagents:

UNIT III MEDICINAL CHEMISTRY OF ANTIHISTAMINIC AGENTS, ANTIULCER AGENTS, ASTHMA AND EICOSANOIDS 9

Classification, structure basis of mechanism of action, structure activity relationship including drugs acting on Histamine receptors, Antiulcer Agents.Eicosanoids biosynthesis, drug action mediated by eicosanoids, design of eicosanoid drugs.Antipyretics, anti-rheumatoid drugs and non-steroidal anti-inflammatory drugs.Asthma and Chronic Obstructive Pulmonary Disease.

UNIT IV MEDICINAL CHEMISTRY OF RADIOPAQUES, AND OVER THE COUNTER DRUGS 9

Classification, structure basis of mechanism of action, structure activity relationship including drugs used for Diagnostic Imaging. Heavy Metals, and its salt. Technetium, Fluorine, Gallium, Iodine, Indium, Thallium, Xenon Radiochemistry, Radiological Contrast Agents, Paramagnetic Compounds, Ultrasound Contrast Agents. Medicinal Chemistry of drug for Hair growth disorders, sunscreens, smoking cessation agents, sexual disorders.

UNIT V MEDICINAL CHEMISTRY OF VITAMINS, PROTEINS, ENZYMES 9

Lipid-Soluble Vitamins, Water-Soluble Vitamins, Miscellaneous Considerations. Protein hydrolysate. Amino Acid Solutions, Proteins and Protein-Like Compounds, Enzymes, Blood Proteins, Impact of Biotechnology on the Development and Commercial Production of Proteins and Peptides as Pharmaceutical Products. Biotechnology-Derived Pharmaceutical Products

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the molecular basis, biochemical, physicochemical properties and synthesis of medicinal agents

CO2 understand the mechanism of action and structure activity relationship

CO3 understand the stereochemical aspects of the medicinal agents acting on various physiological systems

TEXT BOOKS:

1. Ashutosh Kar "Medicinal Chemistry", New Age International Publishers, 7th edition, 2018.
2. Graham L. Patrick, "An Introduction to Medicinal Chemistry", 5th edition, Oxford University Press, 2013.

REFERENCES:

1. Burger's medicinal chemistry Vol I to IV. Wiley-Blackwell; 7th edition, 2010.
2. Foye's Principles of Medicinal Chemistry, Lippincott Williams and Wilkins; 7th Edition, 2012.
4. Wilson and Giswold, "Textbook of Organic Medicinal and Pharmaceutical Chemistry", Lippincott Williams and Wilkins; 11th edition, 2004.
4. Indian/British Pharmacopoeia 2018

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Understand the molecular basis, biochemical, physicochemical properties and synthesis of medicinal agents	2	1	1	1	-	1	1	-	-	2	2	-	1	1	2	1
CO 2	Understand the mechanism of action and structure activity relationship	1	2	-	2	1	1	2	1	1	-	1	-	1	2	2	1
CO 3	Understand the stereochemical aspects of the medicinal agents acting on various physiological systems	1	1	2	1	1	2	1	-	-	1	1	1	-	1	2	1
Overall CO		1	2	1	1	1	1	1	-	-	1	1	-	1	1	2	1

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

PM5005 PHARMACOLOGY OF THERAPEUTIC AGENTS

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- know in detail the classification, therapeutic use, mechanism of action, metabolism, adverse effects of drugs pertaining to GIT, endocrine system, haemopoietic system.
- know and learn the principles of chemotherapy and toxicology.

UNIT I PHARMACOLOGY OF GASTROINTESTINAL TRACT AND ENDOCRINE SYSTEM 12

Antacids, antisecretory and antiulcer drugs, Laxatives and Antidiarrheal drugs, Appetite stimulants and suppressants, Emetics and antiemetics. Hypothalamic and pituitary hormones, Thyroid hormones and antithyroid drugs, Parathormone, Calcitonin and Vitamin D, Insulin, Oral hypoglycemic agents and glucagon. ACTH and corticosteroids, Androgens and anabolic steroids, Estrogens, progesterone and oral contraceptives, Drugs acting on the uterus. Chronopharmacology – Definition of rhythms and cycles. Biological clock and their significance leading to chronotherapy.

UNIT II CHEMOTHERAPY 12

General principles of chemotherapy, Sulfonamides, Antibiotics – Penicillins, Cephalosporins, Chloramphenicol, macrolides, Quinolones, fluoroquinolones and other antibiotics.Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases.Chemotherapy of malignancy and immunosuppressive agents.

UNIT III DRUGS ACTING ON THE HAEMOPOIETIC SYSTEM 7

Haematinics, Anticoagulants, vitamin K and haemostatic agents, Fibrinolytic and antiplatelet drugs, Blood plasma volume expanders. Autacoids – Histamine, 5-HT and their antagonists, Prostaglandins, Thromboxanes and Leukotrienes, Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin

UNIT IV PRINCIPLES OF TOXICOLOGY 7

Definition of poison, general principles of treatment of poisoning, Heavy metals and heavy metal antagonists, Definition for acute, sub acute and chronic toxicity, genotoxicity, carcinogenicity, teratogenicity and mutagenicity studies.

UNIT V IMMUNOPHARMACOLOGY 7

Cell and biochemical mediators involved in allergy, immunomodulation and inflammation, Classification of hypersensitivity reactions and diseases involved Therapeutic agents for allergy, asthma, COPD and other immunological diseases with emphasis on immunomodulators

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 learn the mechanism of drug action and its relevance in the treatment of different diseases.

CO2 comprehend the principles of toxicology and treatment of various poisonings, locate and isolate different organs/tissues from the laboratory animals

CO3 demonstrate the various receptor actions using isolated tissue preparation

TEXT BOOKS:

1. Tripathi, K.D., "Essentials of Medical Pharmacology", 7th Edition, Jaypee Brothers Medical Publishers (P) Ltd, 2015.
2. Satoskar, R.S., Bhandarkar, S.D. and Rege, N.,"Pharmacology and Pharmacotherapeutics", 24th edition, Popular Prakashan (P) Ltd., 2017.
3. Mycek M.J., Gerlnet S.B and Perper M.M. Pharmacology, Lippincott's Illustrated Reviews, Lippincott Company, Philadelphia,2005

REFERENCES:

1. Rang, M.P, Dale M.M, Reter J.M-Pharmacology, Churchill Livingstone; 8th Revised edition edition, 2015.
2. Goodman and Gilman's, The Pharmacological basis of therapeutics, McGraw-Hill Education / Medical; 13th edition, 2017.
3. Ghosh M.N, Fundamentals of Experimental Pharmacology, Hilton and company, 6th Edition, 2008.
4. Katzung, B.G., Basic and Clinical Pharmacology, McGraw Hill, 13th Edition, 2015.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	learn the mechanism of drug action and its relevance in the treatment of different diseases.	2	-	1	1	2	1	1	2	-	1	1	-	-	1	3	2
CO 2	comprehend the principles of toxicology and treatment of various poisonings, locate and isolate different organs/tissues from the laboratory animals	2	1	-	1	2	2	2	1	2	-	2	1	1	2	2	1
CO 3	demonstrate the various receptor actions using isolated tissue preparation	1	2	2	2	1	2	1	-	-	1	1	2	-	1	2	1
Overall CO		2	1	1	1	2	2	1	1	-	1	1	1	-	1	2	1

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

CH5751 TRANSPORT PHENOMENA

L T P C

2 1 0 3

OBJECTIVES

The course aims to,

- introduce the concept of simultaneous mass, momentum and energy transport
- develop velocity, temperature and concentration profiles for various systems involving turbulent flow

UNIT I MOMENTUM TRANSPORT 7

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

UNIT II EQUATIONS OF CHANGE AND TURBULENT FLOW 8

Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems, dimensional analysis of equations of change, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions.

UNIT III ENERGY TRANSPORT 10

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

UNIT IV EQUATIONS OF CHANGE FOR NON ISOTHERMAL SYSTEM AND TEMPERATURE DISTRIBUTION IN TURBULENT FLOWS 10

Energy equations, special forms, use of equations of change, dimensional analysis of equations of change, time-smoothed equations of change, empirical expressions, temperature distribution for turbulent flow in tubes, jets.

UNIT V MASS TRANSPORT, EQUATIONS OF CHANGE FOR MULTICOMPONENT SYSTEMS AND CONCENTRATION DISTRIBUTION IN TURBULENT FLOWS 10

Diffusivity, temperature and pressure effects, Fick's law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow : stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst.The equation of continuity, summary of equations of change and fluxes, use of equations of change, dimensional analysis, time smoothed equations of change, empirical expressions for turbulent mass flux.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 learn the fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes

CO2 understand the mechanism of fluids in motion under different conditions

CO3 learn non isothermal system and temperature distribution in turbulent flows

TEXT BOOKS:

1. Bird, R. B., Stewart, W. E. and Lighfoot, E. N., “Transport Phenomena”, II edition, John Wiley, 2006
2. Brodkey, R. S., and Hershey, H. C., “Transport Phenomena”, McGraw-Hill, 1987.
3. Brodkey, R. S., and Hershey, H. C., “Transport Phenomena: A unified approach”, Volume I & II Brodkey publishing, 2003.

REFERENCES:

1. Welty, J. R., Wilson, R. E., Wicks, C. E., and Rorer,G. L., “Fundamentals of Momentum, Heat and Mass Transfer ”, V edition, John Wiley & sons Inc., 2010.
2. Slattery , J. S., “Advanced Transport Phenomena”, Cambridge University Press, London, 1999.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	learn the fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes	3	2	3	2	-	1	-	-	-	-	1	-	1	1	3	3
CO 2	understand the mechanism of fluids in motion under different conditions	2	3	2	1	-	2	-	-	-	-	2	-	1	1	3	3
CO 3	learn non isothermal system and temperature distribution in turbulent flows	3	2	1	2	-	1	-	-	-	-	1	-	2	1	3	3
Overall CO		3	2	2	2	-	2	-	-	-	-	1	-	1	1	3	3

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

PM5006 COLLOIDS AND INTERFACIAL PHENOMENA **L T P C**

3 0 0 3

OBJECTIVES

The course aims to,

- focus on surface and colloidal phenomena in industry
- understand the basics of surfactant structures, Capillarity systems like wetting agents, emulsifiers and stabilisers.

UNIT I INTRODUCTION TO INTERFACE AND COLLOIDAL SCIENCE 9

Examples of surface and colloidal phenomena in industry and nature, Historical perspective. Areas where future research is needed, nature of interfaces, Surface free energy, Work of cohesion and adhesion, Surface activity and surfactant structures, Physical and chemical interactions between atoms and molecules interactions between surfaces and particles, Surface tension.

UNIT II ADSORPTION 9

Gibbs Surface Excess, Gibbs Adsorption Isotherm, Adsorption at solid-vapour interface, Energetic considerations, Physical adsorption versus chemisorption, Chemisorption and catalysis, Solid-Vapour adsorption isotherms: Langmuir, Freundlich, BET, Adsorption at solid-liquid interfaces. Adsorption at liquid-liquid interfaces, Gibbs monolayers.

UNIT III CAPILLARITY 9

Capillary flow, Driving forces, Interfacial tension, Contact angle, Laplace expression for pressure difference across a curved interface, Capillary flow and spreading processes, Contact angle effects, Some practical capillary systems such as wetting in woven fibers and papers, repellency control, detergency, enhanced oil recovery

UNIT IV ELECTROSTATIC FORCES AND ELECTRICAL DOUBLE LAYER 9

Sources of interfacial charge, Electrostatic theory, Coulomb's law, Boltzmann's distribution and the Electrical double layer, Double layer thickness, Specific ion adsorption and the stern layer, Overview of electrokinetic phenomena (Electro-osmosis and Electrophoresis).

UNIT V COLLOIDS AND COLLOIDAL STABILITY 9

Working definition of colloids, Practical applications of colloids and colloids phenomena, mechanisms of colloid formation, Sources of colloidal stability, Steric or entropic stabilization, Coagulation kinetics, DLVO theory and its applications. Emulsion formation, Classification of emulsifiers and stabilizers, Flocculation and coalescence. Adsorption at liquid-liquid interfaces, general considerations of emulsion formation and stability. Mechanistic details of stabilization, Solubility parameters, Hydrophilic-Lipophilic balance. Phase inversion temperature, Association colloids such as micelles, Ionic and nonionic surfactants. Kraft temperature, Critical micelle concentration, Microemulsions

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 learn the fundamentals of colloidal classification and interface adsorption

CO2 understand the concept behind the interfacial charge and the physics involved in interfacial adsorption

CO3 understand the basics of electrokinetic phenomena and various colloid parameters

TEXT BOOKS:

1. Drew Myers, “Surfaces, Interfaces and Colloids: Principles and Applications”, Second Edition, Wiley-VCH, 1999.
2. Adamson Arthur M.and Gast A.P., “Physical Chemistry of Surfaces”, Sixth Ed, John Wiley & Sons, 1997

REFERENCES:

1. Hiemenz P. C., Rajagopalan R., “Principles of Colloid and Surface Science”, Third Edition, Marcel Dekker, 1997

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	learn the fundamentals of colloidal classification and interface adsorption	1	2	2	3	2	1	1	1	-	-	-	1	2	3	1	2
CO 2	understand the concept behind the interfacial charge and the physics involved in interfacial adsorption	1	2	2	2	1	1	2	1	3	-	1	-	2	1	1	2
CO 3	understand the basics of electrokinetic phenomena and various colloid parameters	1	2	3	2	1	1	-	-	-	1	2	-	2	1	2	2
Overall CO		1	2	2	2	1	1	1	1	1	-	1	-	2	2	1	2

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

PM5007 **COMPUTER AIDED DRUG DESIGN**

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- learn about modern techniques of drug design, which include quantitative structure activity relationship (QSAR)
- learn about prodrug concept, combinatorial chemistry and Computer aided drug design (CADD)
- learn about planning and selection of *In-silco* approaches and tools

UNIT I STEREOCHEMISTRY AND DRUG DESIGN **9**

Structurally Rigid Groups – Conformation – Configuration, Introduction to Drug Discovery and Development: Stages of drug discovery and development, Drug properties and Databases, Introduction to Virtual Screening

UNIT II STRUCTURE ACTIVITY RELATIONSHIP **9**

Changing size and shape – degree of unsaturation, Addition and removal of ring system – New substitutions – methyl – halogen. Basic groups – changing existing substituents for a lead compound, Structure and property - Drug likeness, ADME

UNIT III QUANTITATIVE STRUCTURE – ACTIVITY RELATIONSHIP **9**

QSAR- Pharmacophore based approach, Scaffold hopping ,Target based design, Partitional parameters – partition coefficients – hepo substituent constants – electronic parameters – Hammet constant steric parameters – Hansch analysis

UNIT IV DOCKING **9**

Docking ligands to macromolecules – Structure based and ligand based approaches, Scoring functions, Docking algorithms – Introduction to AUTODOCK

UNIT V MOLECULAR SIMULATIONS **9**

Introduction to Molecular Dynamic Simulations – Force Field, Energy Minimisation, Introduction to GROMACS – Setup, run MD Simulation of a Protein and Analyse the results

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand various stereo chemical aspects of drug binding

CO2 understand Quantitative Structure Activity Relationship

CO3 perform and analyse various *in-silico* docking and MD Simulations experiments in drug research

TEXT BOOKS

1. Patrick Bultinck , Hans De Winter , Wilfried Langenaeker, Jan P. Tollenare, Computational Medicinal Chemistry for Drug Discovery 1st Edition Marcel Dekker Inc. , 2004

2. Andrew R. Leach Molecular Modeling Principles and Applications (2nd Ed.). Prentice Hall ,2009
3. Cohen, N.C. “Guide Book on Molecular Modeling in Drug Design”, Academic Press / Elsevier, 2006
4. Eliel, E.L. “StereoChemistry of Organic Compounds”, John Wiley, 1994.

REFERENCES:

1. Frenkel, Dean and Berend Smith “Understanding Molecular Simulation: From Algorithms to Applications”, 2nd Edition Academic Press, 2002.
2. Lee, Mike S. “Integrated Strategies for Drug Discovery using Mass Spectrometry” John Wiley – Interscience, 2005.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Understand various stereo chemical aspects of drug binding	2	3	2	3	3	-	-	-	-	-	-	-	2	2	1	3
CO 2	Understand Quantitative Structure Activity Relationship	2	3	2	3	3	-	-	-	-	-	-	-	2	2	1	3
CO 3	perform and analyse various in-silico docking and MD Simulations experiments in drug research	2	2	3	3	3	-	-	-	-	-	-	-	2	3	1	3
Overall CO		2	3	2	3	3	-	-	-	-	-	-	-	2	2	1	3

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

PM5008 EXPERIMENTAL DESIGN AND BIOSTATISTICS

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- Define, learn, and understand the principles of experimental design
- Plan and select statistical tools; To execute effectively and analyze results of experimental data

UNIT I FUNDAMENTALS OF STATISTICS 9

Define Statistics, intuitive biostatistics, relevance to research, preparation of data, analysis of data, frequency tables, graphical techniques, measuring variability, identify measure central tendency and variability, probability, tools in statistics, selection of various statistics tools

UNIT II PRINCIPLES OF EXPERIMENTAL DESIGN 9

Designing an experiment, controlled experiments, natural and quasi-experiments, population definitions, sampling unit, types of variables, treatment structure, design structure, collecting and analyzing data, types of effects, randomization, replication, blocking, orthogonality, factorial design, completely randomized design, randomized complete block design,

UNIT III CORRELATION AND REGRESSION 9

Correlation and regression: Graphical presentation of two continuous variables; Pearson's product moment correlation coefficient; its statistical significance; Multiple and partial correlations; Linear regression; Regression line; Coefficient of determination; Interval estimation and hypothesis testing for population slope; Introduction to multiple linear regression models; Probit and logit transformations.

UNIT IV PARAMETRIC TESTS 9

Estimation and Hypothesis testing: Point and interval estimation including fiducial limits; Concepts of hypothesis testing and types of errors; Student-t and Chi square tests; Sample size and power; Experimental design and analysis of variance: Completely randomized, randomized blocks; Latin square and factorial designs; Post- hoc procedures

UNIT V NON-PARAMETRIC TESTS 9

Non-parametric tests: Sign; Mann-Whitney U; Wilcoxon matched pair; Kruskal wallis and Friedman two way anova tests. Spearman rank correlation; Statistical techniques in pharmaceutics: Experimental design in clinical trials; Parallel and crossover designs; Statistical test for bioequivalence; Dose response studies; Statistical quality control.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the fundamentals of statistical data analysis

CO2 understand various tools for statistical analysis

CO3 learn the principles of systematic approaches to experimental design and statistical validation of results

TEXT BOOKS:

1. Gupta S.P, Statistical Methods, Sultan Chand & Sons, New Delhi, 2005.
2. P.S.S. Sundar Rao, P.H.Richard, J.Richard, An introduction to Biostatistics, Prentice Hall of India(P) Ltd., New Delhi, 2003.

REFERENCES:

1. Jerrold H. Zar, Bio Statistical Analysis, Tan Prints(I) Pvt. Ltd., New Delhi, 2003.
2. Goulden, Methods of Statistical Analysis, Asia Publishing Co., New Delhi, 1962.
3. Intuitive Biostatistics by Harvey Motulsky. Copyright,1995 Oxford University Press Inc.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	understand the fundamentals of statistical data analysis	1	1	2	1	2	1	2	-	-	-	-	1	-	2	1	1
CO 2	Understand various tools for statistical analysis	1	2	1	1	1	2	1	-	-	-	1	1	1	2	1	2
CO 3	Learn the principles of systematic approaches to experimental design and statistical validation of results	1	-	2	1	2	1	2	1	-	2	-	2	1	2	1	2
Overall CO		1	1	2	1	2	1	2	-	-	-	-	1	1	2	1	2

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

PM5009 FUNDAMENTALS OF MATERIAL SCIENCE AND ENGINEERING

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- impart basic knowledge about crystal structures
- learn the basics of phase diagrams and properties of materials.

UNIT ICRYSTAL STRUCTURE 9

Introduction – material classification of materials – structure- property relationship - atomic Structure - space lattice and crystal structure- Miller indices, crystal planes – symmetry – crystal imperfections – point, line, surface, volume – solid solutions - ceramic crystal structures. Diffusion: Fick's laws of diffusion – mechanism and applications.

UNIT II PHASE DIAGRAMS 9

Gibb's Phase rule – thermodynamic criteria for phase stability – phase diagrams - single, binary and ternary phase diagrams – lever rule – applications of phase diagrams

UNIT III MECHANICAL PROPERTIES 9

Elastic behavior – plastic deformation by slip – dislocation movement – effect of stress and temperature – work hardening – creep – fracture, modes of fracture - fracture toughness – hardness – wear - corrosion.

UNIT IV ELECTRICAL AND ELECTRONIC PROPERTIES 9

Classification of materials using free electron theory and band theory -conductivity of metals – Matheisen's Rule – concentration and mobility of charge carriers and their variation with temperature .– energy gap in solids – dielectric materials - types of polarizations – polarization calculations – polymer dielectrics – Fast ionic conductors – ionic conduction in zirconia and other systems - dipole moment – static permittivity – dielectric constant – dielectric loss – dielectric breakdown – superconductivity – semiconducting materials

UNIT V MAGNETIC ,THERMAL AND OPTICAL PROPERTIES 9

Introduction – types of magnetic materials - Classification of dia- para -ferro- antiferro and ferri magnetic materials – magnetic semiconductors – specific heat capacity – thermal conductivity – measurement by Laser Flash and other methods - thermal expansion – Light Interaction with solids – optical properties of metals & non metals – refraction, reflection, absorption, transmission , color, opacity, translucency - applications.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 have a basic understanding about crystal structures and various laws related to structures

CO2 have learnt about various properties

CO3 have basic knowledge about phase diagrams

TEXT BOOKS:

1. Saxena, B.S., R.C. Gupta and P.N. Saxena, Fundamentals of Solid State Physics, 1988, Pragathi Pragasan, Meerut.
2. Raghavan,V., Materials Science and Engineering, 1982, Prentice Hall India, NewDelhi.
3. Shewmon, P.G. Diffusion of Solids, 1963, McGraw- Hill Book Company, New York.
4. Bergeron, C.G., and S.H.Risbud, Introduction to Phase Equilibria in Ceramics, 1984, Am.Ceram.Soc, Inc., Westerville Ohio, USA.

REFERENCES:

1. Arzamasov, B., Materials Science, 1989, Mir Publishers, Moscow.
2. Weidmann, G., P.Lewis and N.Reid, Structural Materials, 1990, Butterworths, London.
3. William D Callister.Jr, Materials Science & Engineering, 2000, John Wiley & Sons

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Have a basic understanding about crystal structures and various laws related to structures	2	1	1	1	-	1	1	-	-	1	-	1	1	1	3	2
CO 2	Have learnt about various properties	2	1	2	1	1	1	2	-	2	-	1	2	1	2	1	1
CO 3	Have basic knowledge about phase diagrams	1	2	2	1	1	1	1	-	-	1	1	2	-	1	2	1
Overall CO		2	1	2	1	1	1	1	-	-	1	1	2	1	1	2	1

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

IB5017 FUNDAMENTALS OF MOLECULAR PATHOLOGY

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- make the students learn about host defense against pathogens and virulence factors.
- study about the virulence factors and life cycle in different pathogens.
- provide basic information on molecular pathogenesis of infectious diseases

UNIT I INTRODUCTION 7

Molecular Koch's postulates, Concepts of disease, Virulence, Optimal virulence**,** Horizontal and vertical transfer of virulent gene, Virulent factors, Evolution of bacterial pathogens, Biofilms, Quorum sensing molecules, Multidrug resistance mechanisms, Plasmid-mediated resistance.

UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES 8

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) 15

Virulence, virulence factors, virulence- associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, **Vibrio Cholerae**: Cholera toxin, co-regulated pili, filamentous phage, survival **E.coli pathogens**: EnterotoxigenicE.coli (ETEC), labile & stable toxins, Entero- pathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohemorrhagic E.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteroaggregative E.coli (EAEC). **Shigella**: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage **Plasmodium**:Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitic parous vacuoles, and knob protein transport, Antimalarials based on transport processes. **Influenza virus**: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantadine.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS 7

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses

UNIT V MODERN APPROACHES TO CONTROL PATHOGENS 8

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 obtain the knowledge on the interaction of host and the pathogens.

CO2 help the students to know evasion strategies of pathogen against host defence

CO3 help the students to understand how to develop preventive measures and develop the probable treatment strategies for infectious diseases.

TEXTBOOKS:

1. Iglewski B.H and Clark V.L " Molecular basis of Bacterial Pathogenesis ", Academic Press, 1990.
2. Peter Williams, Julian Ketley& George Salmond, "Methods in Microbiology : Bacterial Pathogenesis, Vol. 27", Academic Press, 1998.
3. Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", McGraw Hill, 3rd Edition, 2001.
4. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	obtain the knowledge on the interaction of host and the pathogens.	-	3	2	2	2	1	1	-	2	1	-	2	2	3	2	3
CO 2	help the students to know evasion strategies of pathogen against host defence	1	3	2	3	3	1	1	-	2	-	2	1	3	1	2	3
CO 3	help the students to understand how to develop preventive measures and develop the probable treatment strategies for infectious diseases.	1	3	2	2	2	-	1	-	2	1	1	2	2	2	2	2
Overall CO		1	3	2	2	2	1	1	-	2	1	1	2	2	2	2	3

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

PM5011 FUNDAMENTALS OF POLYMER SCIENCE AND ENGINEERING

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- familiarize the fundamentals of polymers and its properties.
- impart knowledge in chain polymerization, Step growth polymerizations and copolymerization and techniques of polymerization in an industrial aspect.

UNIT I BASIC CONCEPTS OF POLYMERS 9

Basic concepts of polymers – classification of polymers – organic and inorganic polymers.- classification based on occurrence, end use, thermal properties and structure.Tacticity and its determination using ^{1}H NMR.Crystalline and amorphous polymers – Factors affecting crystallinity and crystallisability. Effect of crystallinity on properties- Glass transition temperature and its determination.- thermal transitions- dilatometer-variation of specific volume of polymers with temperature- Factors affecting glass transition temperature.

UNIT II CHAIN POLYMERISATION 9

Kinetics and mechanism of free radical, cationic and anionic polymerization Trommsdorff's effect – chain transfer reactions and constants – living polymers – alfin catalysts — coordination polymerisation -Ziegler-Natta catalysts-iniferters -Atom transfer radical polymerization.

UNIT III STEP GROWTH POLYMERIZATION 9

Kinetics of polycondensation reactions – copolymerization – co-polymer equation – copolymer compositions from ^{1}H-NMR, FT-IR, UV spectra and chemical methods –Monomer reactivity ratios- Mayo-Lewis and Fineman-Ross methods- significance of reactivity ratios- Sequence length–Metathetical, Group transfer, Electrochemical and Ring-opening polymerization

UNIT IV POLYMERIZATION TECHNIQUES 6

Polymerisation techniques– homogeneous and heterogeneous polymerisation – bulk (liquid, gas and solid monomers), solution, suspension and emulsion polymerisation –merits and demerits –interfacial, and melt polycondensation.

UNIT V MOLECULAR WEIGHT AND ITS DISTRIBUTION AND POLYMER PROPERTIES 12

Number, weight and viscosity average molecular weights of polymers – determination of constants in Mark Houwink's equation. Polydispersity index and molecular weight distribution – Molecular weight determination by GPC and viscometry; Polymer dissolution, thermodynamics of polymer dissolution –solubility parameter – Fractionation of polymers- fractional precipitation and fractional dissolution methods.Effect of structure on mechanical, chemical, thermal, electrical and optical properties.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the classification and will have knowledge in factors affecting polymerization, reactions of polymerization.

CO2 learn synthesis and characterization techniques of polymers.

CO3 Have knowledge in the kinetics of polymerization using various catalysts.

TEXT BOOKS:

1. M.S.Bhatnagar, " A Text Book of Polymers (chemistry and Technology of polymers), Vol I, II & III, 1st Edn., S.Chand and Company, New Delhi (2007).
2. V.R.Gowarikar, N.V.Viswanathan and Jayadev Sreedhar, Polymer Science,Wiley Eastern Limited, Madras (2006).

REFERENCES:

1. F.N. Billmayer, "Textbook of polymer Science", 3rdEdn., John Wiley & Sons, New York, 2002.
2. George Odian, "Principles of Polymerisation", 3rdEdn., McGraw Hill Book Company, New York, 2003.
3. R.S. Young, "Introduction to Polymers", Chapman and Hall Ltd., London, 1999.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Understand the classification and will have knowledge in factors affecting polymerization , reactions of polymerization	1	2	2	2	2	1	2	-	-	1	1	-	2	1	2	2
CO 2	Learn synthesis and characterization techniques of polymers	2	1	2	2	1	2	2	2	-	2	-	-	2	1	3	2
CO 3	Have Knowledge in the kinetics of polymerization using various catalysts	2	2	1	3	3	1	2	1	1	1	-	1	2	2	1	1
Overall CO		2	2	2	2	2	1	2	1	-	1	-	-	2	1	2	2

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

PM5012 BIOMATERIALS AND TISSUE ENGINEERING

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- enable the students to learn the fundamentals of tissue engineering and tissue repair
- acquire knowledge on biomaterials and its applications

UNIT I INTRODUCTION 10

Introduction to tissue engineering: Basic definition-current scope - cell numbers and growth rates- measurement of cell characteristics –morphology- number viability- motility and functions. Measurement of tissue characteristics - appearance- cellular component-ECM component- physical properties.

UNIT II TISSUE ARCHITECTURE 8

Tissue types and Tissue components, Tissue repair and Engineering -wound healing and sequence of events - Cell-Matrix- Cell-Cell Interactions - telomeres and Self renewal- Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS 9

Biomaterials: Properties of biomaterials-Surface, bulk, mechanical and biological- Scaffolds & tissue engineering - Types of biomaterials-biological and synthetic materials- Biopolymers-Applications – Modifications - Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS 9

Stem Cells: Introduction- hematopoietic differentiation pathway -Potency and plasticity of stem cells- Stem Cell markers- Types and sources of stem cell with characteristics: embryonic- adult- haematopoietic- fetal- cord blood-placenta- bone marrow-primordial germ cells- cancer stem cells- induced pluripotent stem cells.

UNIT V CLINICAL APPLICATIONS 9

Stem cell therapy-Molecular therapy - In vitro Organogenesis-Neuro degenerative diseases-spinal cord injury- heart disease- diabetes- burns and skin ulcers- muscular dystrophy-orthopedic applications - Patent protection and regulation of tissue engineered products-ethical issues.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the components of the tissue architecture

CO2 get familiarized with the stem cell characteristics and their relevance in medicine

CO3 gain awareness about the properties and broad applications of biomaterials

CO4 know the role of tissue engineering and stem cell therapy in organogenesis

TEXT BOOKS:

1. Bernhard O.Palsson, Sangeeta N.Bhatia, ”Tissue Engineering” Pearson Publishers 2009.
2. Meyer, U. Meyer, Th. Handschel, J. Wiesmann, H.P. “Fundamentals of Tissue Engineering and Regenerative Medicine”, 2009.
3. R. Lanza, J. Gearhart et al (Eds), “Essential of Stem Cell Biology”, Elsevier Academic Press, 2006.

REFERENCES:

1. J. J. Mao, G. Vunjak - Novakovic et al (Eds), “Translational Approaches in Tissue Engineering & Regenerative Medicine”, Artech House, INC Publications, 2008.
2. Bernard N. Kennedy (editor), “Stem cell transplantation, tissue engineering, and cancer applications”, New York: Nova Science Publishers, 2008.
3. Raphael Gorodetsky, Richard Schäfer Stem cell- based tissue repair, Cambridge: RSC publishing, 2011.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	understand the components of the tissue architecture	2	1	1	1	1	2	2	-	-	2	2	1	1	2	1	2
CO 2	get familiarized with the stem cell characteristics and their relevance in medicine	2	2	2	2	2	1	3	1	-	-	3	1	3	3	2	1
CO 3	Gain awareness about the properties and broad applications of biomaterials	1	2	2	2	2	2	2	2	1	-	3	-	1	3	2	1
CO4	Know the role of tissue engineering and stem cell therapy in organogenesis	1	1	2	2	1	2	1	3	1	2	1	-	2	1	2	1
Overall CO		2	2	2	2	2	2	2	2	-	1	3	-	2	2	2	1

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

PM5013 MOLECULAR MODELING AND DRUG DESIGN

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- learn the principles of computer aided bio-molecular docking and simulation.
- plan and select *in-silico* approaches and tools.
- execute and analyse the results of *in-silico* molecular dynamics simulation and docking experiments for research in drug development.

UNIT I INTRODUCTION TO THE DRUG DISCOVERY/DEVELOPMENT 9

Definition and introduction to Drug Discovery, Stages of Drug Discovery, Strategic Issues in drug discovery and Development, Ligand sources – Natural, synthetic and semi – synthetics, Protein Structure Basics, Protein Databases, Structure file formats, Cheminformatics databases, Graphical and structure viewers.

UNIT II CRYSTALLOGRAPHY METHODS OF MODEL DEVELOPMENT 9

Introduction to Crystallography, Protein crystals, Collecting X-ray Data, Diffraction, Coordinate systems in crystallography, Electron Density maps, Obtaining a model, Judging the molecular models, Other diffraction methods for model building, Tools for studying macromolecules.

UNIT III MOLECULAR MODELING AND MOLECULAR MECHANICS 9

Introduction to Molecular Modelling, Protein Secondary and Tertiary structure elements, Homology Modelling - steps to get a model, Refinement of the model, Empirical Force Fields for Molecular Mechanics: bond stretching, angle bending, torsion, improper torsion, Lennard-Jones potential and van der waals interactions.

UNIT IV COMPUTER SIMULATION METHODS 12

Introduction to Molecular Dynamics Simulation and Monte Carlo Simulation Methods, History of Molecular Dynamics, Calculation of thermodynamic properties, System Preparation, Energy Minimisation, Periodic Boundary conditions, Hydrogen Bonding, Running Molecular Dynamics Simulation of a Protein, Analysis of Molecular Dynamics Simulation.

UNIT V MOLECULAR DOCKING METHODS 6

Introduction to Molecular docking, Structure Based methods to identify lead components, Denovo ligand design, Simulation and docking case studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the basic concepts of Molecular Modeling and MD Simulation

CO2 choose appropriate tools and methods for Molecular Modeling and Drug design

CO3 apply MD Simulation and Molecular docking methods for Biological problems

TEXT BOOKS:

1. Andrew R. Leach “Molecular Modeling Principles and Applications”, 2nd Ed., Prentice Hall ,2009.
2. J.M. Haile, “ Molecular Dynamics Simulation Elementary Methods “, John Wiley and Sons, 1997.
3. Gale Rhodes , “Crystallography made crystal clear”, Academic Press Inc. 2012.

REFERENCES:

1. Jan H Jensen, “Molecular Modeling Basics”, CRC Press, 2010.
2. Visualisation Tools : PyMol or VMD Manual, https://pymol.org
3. GROMACS Manual, https://manual.gromacs.org
4. AUTODOCK Manual, autodock.scripps.edu

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Understand the basic concepts of Molecular Modeling and MD Simulation	2	3	2	3	3	-	-	-	-	-	-	-	2	2	1	3
CO 2	Choose appropriate tools and methods for Molecular Modeling and Drug design	2	3	2	3	3	-	-	-	-	-	-	-	2	2	1	3
CO 3	Apply MD Simulation and Molecular docking methods for Biological problems	2	2	3	3	3	-	-	-	-	-	-	-	2	3	1	3
Overall CO		2	3	2	3	3	-	-	-	-	-	-	-	2	2	1	3

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

PM5014 **NUTRACEUTICALS**

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- understand the role of Nutraceuticals and functional food in health and disease and their regulations.

UNIT I INTRODUCTION AND SIGNIFICANCE **5**

Introduction to Nutraceuticals and its role in health benefits Dietary supplements, importance, definition, classification, list and specifications of dietary supplements in Indian pharmacopoeia (IP) and USP. Current status and challenges in the optimization of herbal drugs as nutraceuticals in India.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS **12**

Phytochemicals as nutraceuticals: Classification, occurrence and characteristic features (chemical nature medicinal benefits) of following a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, lutein b) Sulfides: Diallyl sulfides, Allyl trisulfide. c) Polyphenolics: Resveratrol d) Flavonoids- Rutin , Naringin, Quercetin, Anthocyanidins, catechins, Flavones e) Prebiotics / Probiotics,Fructo oligosaccharides, Lactobacillus f) Phyto estrogens : Isoflavones, daidzein, Geebustin, lignans g) Tocopherols.

UNIT III FREE RADICALS IN HEALTH AND DISEASE **9**

Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids - Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders.

UNIT IV MECHANISM OF ANTIOXIDANT DEFENSE **9**

Free radicals and oxidative stress - Antioxidant mechanisms.The biochemical basis for nutraceuticals for the chemoprevention of disease.Application of herbs to functional foods. Free radical theory of ageing. Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole

UNIT V REGULATIONS IN NUTRACEUTICALS **8**

Nutraceuticals and functional food regulations in India.FSSAI regulations in the production of nutraceuticals. FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety.Adulteration of foods. AYUSH – Regulation of claims pertaining nutraceuticals - Overview of regulations in other Asian countries - China, Japan and Europe. Nutraceuticals in Herbal pharmacopoeia.USDA and FDA regulations in USA.European food regulations (EFSA).

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 learn the effect of nutraceuticals in health and disease.

CO2 learn the underlying mechanism of lifestyle diseases.

CO3 learn the nutritional supplements in health and disease.

TEXT BOOKS:

1. Bisset, Normal Grainger and Max WichH “Herbal Drugs and Phytopharmaceuticals”, 2nd Edition, CRC, 2001.
2. Handbook of Nutraceuticals and Functional Foods: Robert Wildman, CRC, Publications. 2006.
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006.
4. Ikan, Raphael “Natural Products : A Laboratory Guide”, 2nd Edition, Academic Press / Elsevier, 2005.
5. Tipnis, H.P. “Bioavailability and Bioequivalence : An Update” New Age International.,1999.
6. Debasis Bagchi,, “Nutraceutical and Functional Food Regulations in the United States and Around the World”, 2nd Edition, Elsevier Inc., 2014.

REFERENCES:

1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007
2. Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson (Author), Blackwell Publishing, 2007
3. Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink (Author),2007
4. Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Woodhead Publ., 2000
5. Hanson, James R. “Natural Products : The Secondary Metabolites”, Royal Society of Chemistry, 2003.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Study the role of nutraceuticals in health and disease	2	-	1	-	-	-	1	-	-	-	-	2		1	1	1
CO 2	Study the underlying mechanism of lifestyle diseases	2	-	1	-	-	-	1	-	-	-	-	2		1	1	1
CO 3	Learn Nutritional supplements and its health benefits	2	-	1	-	-	-	1	-	-	-	-	2		1	1	1
Overall CO		2	-	1	-	-	-	1	-	-	-	-	2		1	1	1

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

PM5015 PRINCIPLES OF BIOENGINEERING

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- enable students to understand the basic concepts in scaling in biology, Microfabrication techniques.
- equip students with the understanding of chemical grafting of biomolecules, Miroelectromechanical sensing of cells, biomimetic nanodevices, tissue microengineering and its industrial application.

UNIT I INTRODUCTORY CONCEPTS 9

Scaling in biology: basic review of the various sizes, time, and energy scales found in biological systems from organisms to atoms **Microfabrication techniques:** extensive review of the fundamentals of microfabrication technology: photolithography, electron beam lithography, micromachining, micromolding, and soft lithography

UNIT II MICROPATTERNING NON-CONVENTIONAL MATERIALS 9

Review of self-assembled monolayers, chemical grafting of biomolecules and thin polymeric layers; approaches to patterning those materials as well as cells.

UNIT III MEMS APPLICATIONS 9

Microelectromechanical Sensing of cellbehavior: Introduction to bioelectricity, interaction of cells with electric fields, microphysiometer**. Microengineered biosensors:** Introduction to massively parallel measurements, implantable electrodes, micro tweezers, immunosensors. The frontiers of BioMEMS: Nanolithography, biomimetic nanodevices. Laboratory exercises will reinforce critical concepts provided in lectures.

UNIT IV MICROFLUIDICS AND NANOFLUIDICS 9

Microengineering fluid flows: Introduction to microfluidics and Nanofluidics, properties ofbiological fluids in microchannels, mathematical modeling of fluid flow, Applications in Drug delivery system design

UNIT V TISSUE MICROENGINEERING AND APPLICATIONS 9

Introduction to biomimetic substrates, microscaffolds, cellular co-cultures Microfabrication techniques that enable the control of cell-substrate, cell-cell, and cell-medium interactions, Introduction to enzymatic assays, DNA microarrays, optical detection methods amenable to miniaturization. Applications in controlled and targeted drug delivery

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 be aware of scaling up concepts for Industrial Applications.

CO2 have knowledge in microfabrication technology.

CO3 learn the principles of designing microengineered biosensors, fluidics and their application in drug delivery systems and biomimetic substrate.

TEXT BOOKS:

1. Robert Lanza, Robert Langer and Joseph, Vacanti, “Principles of Tissue Engineering”, Third Edition,Academic Press, 2007.
2. Mauro Ferrari, Abraham Lee and James Lee, (Eds.) “Bio MEMS and Biomedical Nanotechnology”, Volume I, 2006.

REFERENCES:

1. Steven S. Saliterman, “Fundamentals of BioMEMS and Medical Microdevices”, Wiley-Blackwell, 2006.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	be aware of scaling up concepts for Industrial Applications	1	2	1	1	1	-	1	2	2	2	1	2	1	2	2	1
CO 2	have knowledge in microfabrication technology	1	2	1	2	2	1	2	-	-	-	1	-	1	2	1	2
CO 3	learn the principles of designing microengineered biosensors, fluidics and their application in drug delivery systems and biomimetic substrate	1	-	1	2	3	1	2	1	-	1	-	1	2	2	1	1
Overall CO		1	2	1	2	2	1	2	1	1	1	1	1	1	2	1	1

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

PM5016 **VACCINE TECHNOLOGY**

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- develop understanding and provide scientific basics of the life processes at the molecular level
- understand the structure-function and inter-relationships of biomolecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

UNIT I IMMUNOLOGICAL CONCEPTS IN VACCINOLOGY 9

Short history of vaccination, requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterisation and location of APC, MHC and immunogenicity, Rational vaccine design based on clinical requirements: Hypersensitivity, Immunity to Infection, Autoimmunity, Transplantation, Tumor immunology, immunodeficiency, mechanism of adjuvant action, Scope of future vaccine strategies

UNIT II CLASSIFICATION OF VACCINES AND ITS PREPARATIONS 10

Active and passive immunization; Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, subunit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, edible vaccines, reverse vaccinology, combination vaccines, therapeutic vaccines; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries, Transfusion of immuno-competent cells; Cell based vaccines

UNIT III VACCINE RESEARCH AND DESIGN 9

Fundamental research to rational vaccine design , Antigen identification and delivery , T-Cell expression cloning for identification of vaccine targets for intracellular pathogens , Fundamentals of Immune recognition , implications for manipulating the T-Cell repertoire , Targeting Dendritic cells ; a rational approach for Vaccine development , Cellular basis of T-Cell memory , Rational design of new vectors , CpG adjuvant activity , Transcutaneous immunisation , Vaccination studies and recent advances in Malaria, Tuberculosis , HIV

UNIT IV COMPUTATIONAL TOOLS FOR VACCINE DESIGN 8

Antigen Sequence analysis, Epitope Mapping, Predictions of Immunogenic peptides of T-Cell and B-Cells. Prediction of HLA binding peptides, Comparative Genomics as a tool for vaccine design, introduction to online epitope databases

UNIT V ANIMAL TESTING, COMMERCIALISATION, QUALITY CONTROL 9

Quality control and regulations in vaccine research, In-vitro experimental validations for predictions of vaccines by software , Animal testing , Rational design to clinical trials ,Large scale production , Commercialisation , ethics.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 gets a basic idea of types and preparation of vaccine

CO2 design recombinant vaccines and novel methods of reverse vaccinology

CO3 gain knowledge about validation, testing and quality control of vaccines

TEXTBOOKS:

1. Male, David et al., “Immunology”, 7th Edition, Mosby Publication, 2007.
2. Kindt, T.J. etal., “Immunology”, 6th Edition, W.H. Freeman, 2007.
3. Janeway, C.A. etal., “Immunology: The Immune Systems in Health and Diseases”, 6th Edition, Garland Science, 2005.
4. Lydyard, P.M. “Instant Notes in Immunology”, Viva Books Pvt. Ltd., 2000.

REFERENCES

1. S. Hockfield, S. Carlson, C. Evans, P. Levitt, J. Pintar, L. Silberstein, Selected Methodsfor Antibody and Nucleic Acid probes, Volume1, Cold Spring Harbor Ed Harlow, David Lane, Antibodies Laboratory Manual, Cold Spring Harbor Laboratory Press, 1988 Laboratory Press,1993.
2. Coico, R, “Immunology: A Short Course”, 5th Edition, Wiley – Liss, 2003.
3. Parham, Peter “The Immune System”, 2nd Edition, Garland Science, 2005.
4. Abbas, A.K., “The Cellular and Molecular Immunology”, 6th Edition, Sanders / Elsevier,2007.
5. Weir, D.M. and Stewart, John “Immunology”, 8th Edition, Churchill Pvt. Ltd., 2000.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	gets a basic idea of types and preparation of vaccine	1	2	1	2	1	-	1	1	2	1	1	-	1	2	2	1
CO 2	Design recombinant vaccines and novel methods of reverse vaccinology	2	1	1	1	1	2	1	2	1	2	1	-	1	2	1	2
CO 3	Gain knowledge about validation, testing and quality control of vaccines	1	2	1	2	3	1	3	1	-	1	2	1	3	2	1	1
Overall CO		1	2	1	2	1	1	2	1	1	1	1	-	2	2	1	1

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

GE5074 **FUNDAMENTALS OF NANOSCIENCE**

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- learn about basis of nanomaterial and its preparation
- learn about characterization and applications in other fields

UNIT I INTRODUCTION **8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nanoparticles- quantum dots, nanowires-ultra- thin films - multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION **9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS **12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nano alumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots preparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES **9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS **7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 gain knowledge gain in nanoparticle preparation methods.

CO2 test and characterize methodologies of nanoparticles.

CO3 use the fundamentals in various applications of nanoscience in Pharmaceutical Technology.

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia,) 2nd Edition, 1998.
2. N John Dinardo, Nanoscale characterization of surfaces & Interfaces, Second Edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor) The Hand Book of Nano Technology, "Nanometer Structure", Theory, Modeling and Simulations. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Gain knowledge gain in nanoparticle preparation methods	3	2	2	2	3	2	2	1	2	1	2	2	3	2	2	2
CO 2	Test and characterization methodologies of nanoparticles	2	2	2	2	3	2	2	1	2	1	2	2	2	3	2	3
CO 3	use the fundamentals in various applications of nanoscience in Pharmaceutical Technology	2	2	2	2	3	2	2	1	2	1	2	2	3	2	3	2
Overall CO		2	2	2	2	3	2	2	1	2	1	2	2	2	2	2	2

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

CH5702 INSTRUMENTATION AND PROCESS CONTROL

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- familiarize the students about concepts of process dynamics and control leading to control system design.
- introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION 6

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, Volumetric Flow Rate and mass flow rate (for liquids and solids), viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS 11

Laplace transformation, application to solve ODEs. 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.

UNIT III CLOSED LOOP SYSTEMS 10

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, transient response of closed-loop control systems and their stability

UNIT IV FREQUENCY RESPONSE 9

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

UNIT V ADVANCED CONTROL SYSTEMS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 draw block diagrams for a process and devise simple but effective plant wide control strategies using appropriate techniques

CO2 design and tune process controllers and specify the required final elements to ensure that well-tuned control is achieved

CO3 analyse the performance of control loop systems

CO4 understand the principle behind cascade, feed-forward and Smith predictor controllers

TEXT BOOKS:

1. Stephanopoulos, G., “Chemical Process Control“, Pearson Education India, 2015.
2. Coughanowr, D., LeBlanc, S., “ Process Systems Analysis and Control “, 3rd edition., McGraw Hill, New Delhi, 2017.
3. Coughanowr, D., “ Process Systems Analysis and Control “, 2nd edition., McGraw Hill, New York, 1991.

REFERENCES:

1. Marlin, T. E., " Process Control ", 2nd edition, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 3rdedition., John Wiley, New York, 2015.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Draw block diagrams for a process and devise simple but effective plant wide control strategies using appropriate techniques	3	3	3	1	1	-	-	-	2	1	1	3	1	1	3	1
CO 2	Design and tune process controllers and specify the required final elements to ensure that well-tuned control is achieved	3	3	3	1	1	-	1	-	2	1	3	3	1	1	3	1
CO 3	Analyse the performance of control loop systems	3	3	3	1	1	-	1	-	2	1	2	3	1	1	3	1
CO 4	Understand the principle behind cascade, feed-forward and Smith predictor controllers	3	3	3	1	1	-	-	-	2	-	1	3	1	1	3	1
Overall CO		3	3	3	1	1	-	1	-	2	1	2	3	1	1	3	1

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

IB5071 BIOCONJUGATE TECHNOLOGY AND APPLICATIONS

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- explain about the principles involved in the different functional targets and its modification
- study about the applications of conjugate technology in Immunology and enzyme technology

UNIT I FUNCTIONAL TARGETS 9

Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II CHEMISTRY OF ACTIVE GROUPS 9

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III BIOCONJUGATE REAGENTS 9

Zero length cross linkers – Homobifunctional cross linkers – Heterobifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION 9

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V BIOCONJUGATE APPLICATIONS 9

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal – gold-labeled proteins – modification with synthetic polymers.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 familiarise with the various conjugates available in the pharmaceutical and biotechnological industry

CO2 design and develop efficient conjugates

CO3 apply the knowledge gained about bioconjugates in various fields

TEXT BOOKS:

1. Bioconjugate Techniques , G.T. Hermanson, Academic Press, 3rdEdition, 2013.
2. Bioconjugation Protocols: Strategies and Methods (methods In Molecular Biology) illustrated edition, 2004.

REFERENCES:

1. Principles of Biochemistry, Lehninger, 7th edition,Elsevier, 2017.
2. Chemistry of Bioconjugates : synthesis, characterization and biomedical applications, 1st edition Ravin Narain, 2013.
3. Antibody drug conjugates : fundamentals of drug development and clinical outcomes to target cancer, 1st edition, 2016.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	familiarize with the various conjugates available in the pharmaceutical and biotechnological industry	2	3	2	2	2	1	2	1	2	2	-	1	1	2	3	1
CO 2	design and develop efficient conjugates	2	3	1	2	3	2	2	1	1	1	1	2	1	2	3	2
CO 3	apply the knowledge gained about bioconjugates in various fields	2	1	2	2	1	3	1	2	1	3	1	2	1	3	2	-
Overall CO		2	3	2	2	2	2	2	1	1	2	1	2	1	2	3	1

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

IB5072 **BIOLOGICAL SPECTROSCOPY**

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- instruct the students on various spectroscopic and microscopic techniques that are used in research and practice in biotechnology.
- understand the concepts of spectroscopy in biological systems

UNIT I CIRCULAR DICHROISM (CD) AND OPTICAL ROTATORY DISPERSION (ORD)4

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins .

UNIT II FLUORESCENCE AND RAMAN SPECTROSCOPY 11

Molecular energy level diagrams – principles of fluorescence and Raman – parameters for measurement – excited state processes - fluorescence polarization – Forster Resonance Energy Transfer – fluorescence quenching – single molecule spectroscopy - application to proteins and nucleic acids.

UNIT III NUCLEAR MAGNETIC RESONANCE 6

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – multidimensional NMR spectroscopy – determination of macromolecular structure by NMR – magnetic resonance imaging.

UNIT IV MASS SPECTROMETRY 5

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

UNIT V X-RAY DIFFRACTION 7

Scattering by X- rays – diffraction by a crystal – measuring diffraction pattern – Bragg reflection – unit cell – phase problem – anomalous diffraction – determination of crystal structure – electron and neutron diffraction.

UNIT VI SPECIAL TOPICS 12

Electron microscopy – transmission and scanning electron microscopy; CryoElectron Microscopy – scanning tunneling and atomic force microscopy (AFM); Fluorescence Correlation Spectroscopy (FCS); FRAP; Two-photon Microscopy; STED and STORM microscopies.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the principle of spectroscopic techniques widely used in many quantitative experiments

CO2 understand the central techniques associated with the elucidation of structure and composition molecules in natural and life sciences

CO3 comprehend the high-resolution imaging techniques to assess surface and intracellular complexity.

TEXTBOOKS:

1. Banwell, Colin N. and E.M. McCash. “Fundamentals of Molecular Spectroscopy” IVthEdition, Tata McGraw-Hill, 2017.
2. Aruldas, G. “Molecular Structure and Spectroscopy”. IIndEdition, Prentice Hall of India, 2007.
3. Pavia, D.L., G.M. Lampman and G.S. Kriz. “ Introduction to Spectroscopy:” Cengage Learning India Private Limited; 5th edition, 2015.
4. Williams, Dudley H. and Ian Fleming. ”Spectroscopic Methods in Organic Chemistry”. McGraw Hill Education; 6th edition, 2011.

REFERENCES:

1. Siuzdak, Gary. “Mass Spectrometry for Biotechnology”. Academic Press / Elsevier,1996.
2. Hammes, Gordon G. “Spectroscopy for the Biological Sciences”. John Wiley, 2005.
3. Campbell I.D and Dwek R.A., “Biological Spectroscopy “, Benjamin Cummins and Company, 1986.
4. Atkins P.W., “Physical Chemistry “, Oxford IV Edition, 1990.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	understand the principle of spectroscopic techniques widely used in many quantitative experiments	2	2	1	2	1	-	-	-	-	-	-	2	1	2	2	3
CO 2	Tnderstand the central techniques associated with the elucidation of structure and composition molecules in natural and life sciences	1	2	1	3	2	1	-	-	-	-	1	1	2	2	1	3
CO 3	comprehend the high-resolution imaging techniques to assess surface and intracellular complexity.	1	2	2	1	2	2	-	-	-	-	2	2	1	2	1	3
Overall CO		1	2	1	2	2	1	-	-	-	-	1	2	1	2	2	3

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

IB5025	PROTEIN STRUCTURE AND FUNCTION	L T P C
		3 0 0 3

OBJECTIVES

The course aims to,

- provide fundamental knowledge on the existence of various structures of proteins and how these structures relate to their functions.
- understand the building blocks and other factors contributing to the structures.
- learn about the methods for characterization of proteins

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 10

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander waals interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II PROTEIN ARCHITECTURE 10

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass- spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn- beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites.

UNIT III TERTIARY STRUCTURE 5

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP 10

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications.

UNIT V PROTEOMICS 0

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.

Computer exercise on the above aspects **TOTAL : 45 PERIODS**

OUTCOMES:

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

CO1 learn the existence of various levels of protein structure

CO2 learn the building blocks of proteins and other factors contributing to protein structures

CO3 learn how these protein structures relate to protein functions

TEXT BOOKS:

1. Branden C. and Tooze J., "Introduction to Protein Structured" 2nd Edition, Garland Publishing, 1999.
2. Creighton T.E. "Proteins" 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, "Proteomics: Protein Sequence to Function". Viva Books, 2002
4. Liebler, "Introduction to Proteomics" Humana Press, 2002.

REFERENCES:

1. Voet D. and Voet G., "Biochemistry". 3rd Edition. John Wiley and Sons, 2008.
2. Haggerty, Lauren M."Protein Structure : Protein Science and Engineering".Nova Science Publications, 2011.
3. Williamson, Mike "How Proteins Work". Garland Science, 2012.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Learn the existence of various levels of protein structures	-	-	-	-	-	-	1	-	-	1	-	3	1	-	-	-
CO 2	Learn the building blocks of proteins and other factors contributing to protein structures	-	1	-	1	1	-	1	-	-	1	-	3	1	-	2	-
CO 3	Learn how these protein structures relate to protein functions	2	-	2	3	2	2	2	1	2	1	2	2	3	2	-	3
Overall CO		2	-	-	3	3	3	2	2	2	1	2	2	2	3	-	3

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

IB5752 **BIOINFORMATICS**

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- introduce the student to biological data resources, algorithms and alignment tools
- understand about machine learning techniques and neural networks in the analysis of biological data

UNIT I BIOLOGICAL DATABASES AND SEQUENCE ANALYSIS 9

Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Sequence Analysis, Pairwise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment.

UNIT II ALGORITHMS FOR SEQUENCE ALIGNMENT 9

Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSI BLAST and PHI BLAST algorithms, Functional annotation.

UNIT III NEXT GENERATION SEQUENCING, DATA ANALYSIS AND APPLICATIONS 9

Genome sequencing, Assembling the genome, Next Generation Sequencing, Data formats, Exome sequencing, RNA-seq and its applications.

UNIT IV PHYLOGENETICS, MOLECULAR MODELLING AND DOCKING 9

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, ab initio approaches, Threading, Critical Assessment of Structure Prediction, Molecular docking principles and applications.

UNIT V MACHINE LEARNING,OTHER BIOINFORMATICS APPLICATIONS 9

Machine learning techniques: Artificial Neural Networks for protein secondary structure prediction, Hidden Markov Models for gene finding, Support Vector Machines. Introduction to Systems Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 get acquainted with various bioinformatics algorithms and tools.

CO2 acquire skills to perform phylogenetic studies, molecular docking, analyze next generation sequencing data and interpret results.

CO3 acquainted with machine learning techniques.

TEXT BOOKS:

1. Arthur K. Lesk, “Introduction to Bioinformatics”, Oxford University Press, 4th edition, 2014

2. Dan Gusfield, Algorithms on Strings, Trees and Sequences", Cambridge University Press, 1999.
3. R.Durbin, S.Eddy, A.Krogh and G.Mitchison, "Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids", Cambridge University Press, 2013.
4. David W. Mount, "Bioinformatics Sequence and Genome Analysis",Cold Spring Harbor Laboratory Press, 2nd Edition, 2004.

REFERENCES:

1. Pierre Baldi and Soren Brunak, "Bioinformatics The Machine Learning Approach", Cambridge University Press, 2001.
2. Eija Korpelainen, Jarno Tuimala, Panu Somervuo, Mikael Huss and Garry Wong, "RNA-seq Data Analysis: A Practical Approach", CRC Press, 2014.
3. Xinkun Wang "Next Generation Sequencing Data Analysis", CRC Press, 2016.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Get acquainted with various bioinformatics algorithms and tools	2	3	1	2	3	-	-	-	-	-	-	-	3	2	-	-
CO 2	Acquire skills to perform phylogenetic studies, molecular docking, analyze next generation sequencing data and interpret results	3	3	1	3	3	-	-	-	-	-	-	-	3	3	-	-
CO 3	Acquainted with machine learning techniques	3	3	1	3	3	-	-	-	-	-	-	-	3	3	-	-
Overall CO		3	3	1	3	3	-	-	-	-	-	-	-	3	3	-	-

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

IB5751 DOWNSTREAM PROCESSING

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- understand the fundamentals of biological product recovery , isolation separation purification and formulation
- acquire in depth knowledge and hands on training on design and optimization of Downstream process operations and equipment

UNIT I DOWNSTREAM PROCESSING 10

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre treatment and stabilisation of bio-products.

UNIT II PHYSICAL METHODS OF SEPARATION 6

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS 12

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION 12

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS 5

Crystallization, drying and lyophilization in final product formulation.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 have a comprehensive understanding of the physicochemical properties of biotechnological products and economics of downstream processing

CO2 acquire knowledge about equipment selection and design of mechanical separation process for recovery of biotechnological products

CO3 identify and optimize the suitable bioproduct isolation process at laboratory and pilot scale

CO4 have a thorough understanding of chromatographic separation processes and equipment selection

CO5 have complete knowledge of stability of biotechnology products and should be capable of formulation and stabilization for enhanced shelf-life

TEXT BOOKS:

1. Belter, P.A., E.L. Cussler and Wei-Houhu “Bioseparations – Downstream Processing for Biotechnology”, John Wiley, 2011.
2. Asenjo, Juan A. “Separation Processes in Biotechnology”. Taylor & Francis / CRC, 1990.
3. Scopes, R.K. “Protein Purification: Principles and Practice”. Narosa Publication, 1994.
4. Scopes, R.K. “Protein Purification: Principles and Practice”. Springer Nature, 3rd edition, 2014.

REFERENCES:

1. Ghosh, Raja “Principles of Bioseparations Engineering”, World Scientific, 2006.
2. “Product Recovery in Bioprocess Technology”. (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Have a comprehensive understanding of the physicochemical properties of biotechnological products and economics of downstream processing	3	3	3	3	3	3	2	1	3	1	3	3	1	1	3	3
CO 2	Acquire knowledge about equipment selection and design of mechanical separation process for recovery of biotechnological products	3	3	3	3	3	3	3	1	3	1	3	3	1	1	3	3
CO 3	identify and optimize the suitable bioproduct isolation process at	3	3	3	3	3	3	2	1	2	1	3	3	1	1	3	3

	laboratory and pilot scale																
CO 4	Have a thorough understanding of chromatographic separation processes and equipment selection	3	3	3	3	3	3	3	1	3	1	3	3	1	1	3	3
CO 5	Have complete knowledge of stability of biotechnology products and should be capable of formulation and stabilization for enhanced shelf-life	2	2	2	2	2	2	3	1	3	1	3	3	1	1	3	3
Overall CO		3	3	3	3	3	3	3	1	3	1	3	3	1	1	3	3

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

IB5075 METABOLIC ENGINEERING L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- impart knowledge about basics of metabolic design and pathway analysis.
- understand about quantification of metabolism with focus of pathways leading to industrially relevant products.

UNIT I BASICS OF METABOLIC DESIGN AND PATHWAY ANALYSIS 9

Basic principles of metabolic design, thermodynamics of pathway, redox balancing, , transport of substrates, enzyme candidates, substrate and product transport and choice of appropriate genetic strategies.

UNIT II MATERIAL BALANCES AND DATA CONSISTENCY 9

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, lumping of reaction rates, analysis of overdetermined systems using black box model- identification of gross measurement errors. Introduction to MATLAB®

UNIT II METABOLIC FLUX ANALYSIS 9

Theory of determined ,overdetermined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling.

UNIT IV METABOLIC CONTROL ANALYSIS 9

Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Experimental determination of flux control coefficients and other coefficients. Theory of large deviations

UNIT-V ANALYSIS OF METABOLIC NETWORKS 9

Stoichiometric Network Analysis, Elementary mode analysis, extreme pathways. Control of flux distribution at a single branch point, grouping of reactions, optimization of flux amplifications, consistency tests and experimental validation.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 learn pathway analysis by understanding material balances and stoichiometry.

CO2 understand the basics of metabolic flux and control analysis.

CO3 perform theoretical analysis of metabolic networks and experimental validation.

TEXT BOOKS:

1. Gregory N. Stephanopoulos ,Aristos A. Aristidou, Jens Nielsen, Metabolic Engineering: Principles and Methodologies ,Academic Press, 1998.
2. Sang Yup Lee E. Terry Papoutsakis Marcel Dekker, Metabolic Engineering.inc 1998.
3. Nielsen J, Villadsen J. (1994) Bioreaction Engineering Principles. New york: Plenum Press.

REFERENCES:

1. Computational Analysis of Biochemical Systems: A Practical Guide for Biochemists and Molecular Biologists by Eberhard O. Voit, Cambridge University Press, 2000.
2. Applications of Plant Metabolic Engineering. R. Verpoorte, A. W. Alfermann and T. S. Johnson (eds). Springer, P.O. Box 17, 3300 AA Dordrecht, The Netherlands, 2007.
3. Systems Modeling in Cellular Biology: From Concepts to Nuts and Bolts Edited by Zoltan Szallasi, JorgStelling and Vipul Periwal, MIT Press, Cambridge, 2006.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	learn pathway analysis by understanding material balances and stoichiometry	2	2	1	2	3	3	1	2	1	1	-	3	1	2	1	1
CO 2	understand the basics of metabolic flux and control analysis	2	2	1	1	-	2	1	-	1	-	1	2	3	2	-	1
CO 3	perform Theoretical analysis of metabolic networks and experimental validation	1	2	3	2	1	-	1	-	1	-	-	1	2	2	1	3
Overall CO		2	2	1	2	2	2	1	-	1	-	-	2	2	2	1	2

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

PM5018 **BIOPROCESS EQUIPMENT DESIGN** **L T P C**

2 1 0 3

OBJECTIVES

The course aims to,

- learn to do in detail process and mechanical design
- learn engineering drawing of different chemical engineering equipment

UNIT I INTRODUCTION TO PLANT LAYOUTS **9**

Design of Plant Layout, Pipelines and Pipe Layouts, Schematics and Presentation Materials of Construction and Selection of process equipment

UNIT II FUNDAMENTALS OF DESIGN EQUATIONS AND DRAWING **9**

Fundamental principles, general design equations and drawing considerations of Heat Exchangers, Condensers, reboilers.

UNIT III DESIGN CONSIDERATIONS OF EQUIPMENTS **9**

General design and drawing considerations of Cooling Tower, cooling coil, evaporators, Dryers, economic evaluation.

UNIT IV PROCESS EQUIPMENT DESIGN **9**

Process equipment design of Absorption column, Distillation Column, bubble cap tray column, Extraction Column, Adsorption column.

UNIT V BIOREACTOR AND FERMENTOR DESIGN **9**

Packed Bed Reactors, Plug flow reactor, Continuous stirred tank reactor, Pressure Vessel, Storage Vessel and Fermenter.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 apply the skills in thermal design of heat transfer equipment like shell and tube, double pipe heat exchangers and evaporators, and assessing thermal efficiency of the above equipment in practice.

CO2 apply the concepts involved in phase separation and design of distillation, Extraction and absorption columns.

CO3 acquire knowledge for designing the process equipment generally used in the bioprocess industries.

CO4 examine and analyse a problem, and finding a design method and mechanical specifications to accomplish a particular process objective.

TEXT BOOKS:

1. Green D. W., “Perry’s Chemical Engineer’s Handbook”, 8th Edition McGraw Hill, 2007.

Note: Green D. W., “Perry’s Chemical Engineer’s Handbook”, 8th Edition McGraw Hill, 2007, should be permitted for the end semester examination.

REFERENCES:

1. Baranan, C.R., “Rules of Thumb for Chemical Engineers”, Gulf Publishing Co, Texas, 1996.

2. R. K. Sinnott, “Coulson & Richardson’s Chemical Engineering”, Vol. 6, Butterworth Heinemann, Oxford, 1996.

3. Dawande, S. D., “Process Design of Equipments”, 4th Edition, Central Techno Publications, Nagpur, 2005.

4. Coulson and Richardson’s., “Chemical Engineering Design - Volume 6”, Pergamon; 2nd edition,1991

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	Apply the skill in thermal design of heat transfer equipment like shell and tube, double pipe heat exchangers and evaporators , and assessing thermal efficiency of the above equipment in practice.	2	2	1	1	1	1	3	-	-	-	2	1	-	2	1	2
CO2	Apply the concepts involved in phase separation and design of distillation, Extraction and absorption columns	2	1	2	2	1	1	3	3	-	-	-	2	1	2	2	1

CO3	acquire knowledge for designing the process equipment generally used in the bioprocess industries	1	2	2	2	2	1	2	2	-	-	2	-	2	3	-	1
CO4	Examine and analyse a problem, and finding a design method and mechanical specifications to accomplish a particular process objective	1	2	1	1	-	-	1	3	1	2	2	-	2	1	2	1
Overall CO		2	2	2	2	1	1	2	3	-	-	2	1	2	2	2	1

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

IB5551 **IMMUNOLOGY** **LT P C**

3 0 0 3

OBJECTIVES

The course aims to,

- discuss the structure, functions and integration of the immune system.
- explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases.

UNIT I INTRODUCTION TO IMMUNE SYSTEM **12**

Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; Toll receptors and responses, classification of antigens – chemical and molecular nature; haptens, adjuvants; cytokines; complement pathway, antigen presenting cells; major histocompatibility complex.

UNIT II HUMORAL AND CELLULAR IMMUNITY **12**

Development, maturation, activation, regulation, differentiation and classification of T-cells andB-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies:structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions: precipitation, Agglutination, complement fixation, IFT, RIA, ELISA.

UNIT III IMMUNITY AGAINST PATHOGENS AND TUMORS **8**

Inflammation; protective immune responses to viruses, bacteria, fungi and parasites; tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy.

UNIT IV IMMUNE TOLERANCE AND HYPERSENSITIVITY **7**

Immune tolerance, Immunodeficiencies; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Autoimmune disorders and diagnosis.

UNIT V APPLIED IMMUNOLOGY **6**

Monoclonal antibodies, engineering of antibodies; Classification of Vaccines, methods of vaccine development, immunodiagnostic methods (Immunodiffusion ELISA, FACS), immunomodulatory drugs.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand about immune system structure and functions.

CO2 learn about immunity to various pathogens.

CO3 understand the principles behind the production of therapeutic /diagnostic molecules.

TEXT BOOKS:

1. Roitt I, Male, Brostoff. Immunology, Mosby Publications, XII edition, 2011.
2. Kuby J, Immunology, WH Freeman & Co., VII edition, 2012.
3. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006.

REFERENCES:

1. Coico, Richard, “Immunology: A Short Course”, VI Edition, John Wiley, 2008.
2. Khan, Fahim Halim, “Elements of Immunology”, Pearson Education, 2009.
3. Abbas, Lichtman and Shiv Pillai, “Cellular and Molecular Immunology”, VI edition, Elsevier, 2017.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Understand about immune system structure and functions	2	3	3	3	2	2	-	-	-	-	-	3	1	-	-	2
CO 2	Learn about immunity to various pathogens	1	3	1	2	1	-	-	-	-	-	-	3	1	-	-	1
CO 3	Understand the principles behind the production of therapeutic /diagnostic molecules	2	3	2	2	3	-	1	-	-	-		3	-	-	-	1
Overall CO		2	3	1	2	3	2	1	-	-	-	-	3	1	1	-	1

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

IB5010 DEVELOPMENTAL BIOLOGY

L T P C

3 0 0 3

OBJECTIVES

The course aims to,

- make the students understand the basics of development.
- makeout the differences in the developmental pathways of different organisms**.**
- make them aware how the basic developmental pathways are regulated by biotic and abiotic factors.

UNIT I HISTORY AND BASIC CONCEPTS OF DEVELOPMENT 9

Overview of how the modern era of developmental biology emerged through multidisciplinary approaches,stages of development- zygote, blastula, gastrula ,neurula. Cell fate & commitment –potency- concept of embryonic stem cells, differential gene expression, terminal differentiation,lineages of three germ layers, fate map. Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, mosaic and regulative development.Pattern formation-- axis specification, positional identification (regional specification).Morphogenetic movements Model organisms in Developmental biology.

UNIT II EARLY DEVELOPMENT IN INVERTEBRATE /VERTEBRATE MODELS 9

Drosophila, C.elegans, Xenopus,Mouse/ human. Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates.

UNIT III LATE DEVELOPMENT IN INVERTEBRATE /VERTEBRATES 9

Organogenesis- development of central nervous system in vertebrates, vulval formation in *C.elegans.*

UNIT IV GERM CELL SPECIFICATION & MIGRATION 9

Germplasm and determination of primordial germ cells, germ cell migration (drosophila, vertebrates), Gamete maturation (amphibians, mammal) Medical aspects in developmental biology (genetic errors in human development, teratogenesis) developmental therapies.

UNIT V APPLICATIONS 9

Overview of plant development, Medical implications of developmental biology - genetic errors/ teratogenesis/ stem cell therapy etc.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 learn the basics of developmental biology

CO2 learn the differences in the developmental pathways of different organisms**.**

CO3 learn the influence of biotic and abiotic factors on developmental pathways

TEXT BOOKS:

1. Developmental Biology, 11th edition by Scott F. Gilbert (Sinauer Associates, Inc.), 2016.
2. Essential Developmental Biology by Jonathan Slack, 3rd edition, Wiley Blackwell, 2012.
3. Developmental Biology, Werner A Muller ,Springer, 1991.
4. Principles of Development - Lewis Wolpert, 4th edition, Oxford University Press, 2010.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Learn the basics of developmental biology	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	1
CO 2	learn the differences in the developmental pathways of different organisms	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	1
CO 3	learn the influence of biotic and abiotic factors on developmental pathways	1	1	-	-	-	1	-	1	-	-	-	2	1	3	2	2
Overall CO		1	1	-	-	-	1	-	1	-	-	-	2	1	3	2	2

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

IB5076 **BIOSAFETY** **L T P C**

3 0 0 3

OBJECTIVES

The course aims to,

- create awareness about biosafety and containment guidelines
- assess the risk analysis and the stringency requirements

UNIT I NEED FOR BIOSAFETY **9**

Introduction; the history and incidence of laboratory-acquired infections (LAI) ,incidents of secondary transmission from the laboratory, Outline the types of laboratory accidents leading to LAIs, Explain the role of aerosols in LAIs, Illustrate the importance of biosafety and biocontainment in minimizing the risk of LAIs

UNIT II BIOLOGICAL SAFETY CABINETS **9**

Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; recommended Biosafety Levels for Infectious Agents and Infected Animals, The classes and types of biological safety cabinets (BSC), Understand the principles of HEPA filtration, Explain the practices for safely working in a BSC , Identify other laminar flow devices and their limitations for use with microorganisms . Outline the certification process for BSCs

UNIT III BIOSAFETY GUIDELINES **9**

Biosafety guidelines - Government of India; Definition of GMOs and LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMO

UNIT IV GENETICALLY MODIFIED ORGANISMS AND REGULATIONS **9**

Biosafety for human health and environment. - Global scenario of transgenic microorganisms and plants. Ecological risk of engineered microorganisms/plants and remedial measure .Components of a risk assessment for microorganisms Outline factors affecting risk assessment (agent, host, environment, behavioural) . Risk Assessment; Risk Analysis; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol

UNIT V BIOCONTAINMENT AND CERTIFICATION **9**

Describe the progression of building a new biocontainment laboratory from conceptualization through to certification. Outline the concepts to be addressed during the laboratory programming phase, architectural and engineering biocontainment features, key security features and control systems, commissioning and certification process and understand the difference between them.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 get familiarize with the concept of biosafety

CO2 work in a GLP accredited laboratory and their standards

CO3 familiarize themselves with the concept of GMO

TEXTBOOKS:

1. Biosafety in Microbiological and Biomedical Laboratories, 5th ed., 2009.
2. Diane O. Fleming & Debra A. Hunt, "Biological Safety, Principles and Practices", 4th ed., ASM Press, 2006.
3. Guide for the care and use of laboratory animals, 8th ed., (National Research Council), National Academies Press, 2011.
4. Control of communicable diseases manual, 20th ed. (Heymann), 2014.
5. NIH guidelines for research involving recombinant or synthetic nucleic acid molecules, 2013.

REFERENCES:

1. Collins, C.H., and Kennedy, D.A. Laboratory-acquired infections. In: Laboratory acquired infections: history, incidence, causes and preventions. Oxford, UK: Butterworth-Heinemann, 1999;
2. Harding, A.L., and Brandt Byers, K. Epidemiology of laboratory-associated infections. In: Fleming, D.O., and Hunt, D.L. Biological safety: principles and practices. Washington, DC: ASM Press, 2000.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	Get familiarized with the concept of biosafety	3	2	3	1	2	1	2	2	1	2	-	1	2	1	3	1
CO 2	work in a GLP accredited laboratory and their standards	2	2	2	1	2	1	1	1	2	1	-	2	1	2	3	1
CO 3	familiarize themselves with the concept of GMO	1	1	1	2	1	1	3	1	3	1	-	-	1	2	3	1
Overall CO		2	2	2	1	2	1	2	1	2	1	-	2	1	2	3	1

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

PM5019 **NUTRAGENETICS** **L T P C**

3 0 0 3

OBJECTIVES

The course aims to,

- understand the concept of nutrition, malnutrition and their effects during health and sickness.
- learn the scope of Nutrition in the light of genomic science and develop methods to enhance the outcome of therapy.

UNIT I CONCEPT OF NUTRIGENOMICS AND NUTRIGENETICS **9**

Introduction to Nutrition and its effect on genes, including biology and protein synthesis, up regulation of genes, down regulation of genes, heritability risk due to genetic factors, The Influence of Dietary Components on Gene Expression,The role of genes in the determination of nutritional requirements.

UNIT II NUTRITION AND DISEASE **9**

Genetic Susceptibility to Common Diseases and Diet Intakes Medical Genomics and Cancer, Effects of Genes and Nutrition on Inflammation and Reactive Oxygen Species, Epigenetics and how the Environment can Shape Energy Balance through Genes, Bioactive Compounds and Gene Transcription. Role of nutritional factors in pathogenesis of diseases : Modulating the risk of various diseases through nutrigenomics – CVS, Diabetes Mellitus, Inflammatory diseases, Obesity, Malnutrition. Recent trends in omics based methods and techniques for lung disease prevention, Novel nutrigenomics approaches in food functions.

UNIT III APPLICATION OF NUTRITIONAL METABOLOMICS FOR HEALTH **9**

Proteomics as a Comprehensive Molecular Means to Understand Dietary Health Effects.Role of Genetic variation and dietary response, Role of specific nutrients in controlling gene expression, Nutrigenomics aspects of Vitamins and Trace Elements.

UNIT IV TECHNOLOGIES IN NUTRIGENOMICS **9**

Genomics: Different sequencing approaches, Microarray, Massarray, SNP genotyping, PCR and RT-PCR techniques. Proteomics: 1-D, 2-D gel electrophoresis, DIGE, novel peptide identification, peptide sequencing methods. Metabolomics: Chromatography and mass spectrometry techniques, Discovery and validation of biomarkers for important diseases and disorders. Computational Approaches: Introduction to different types of public domain databases, data mining strategies, primer designing.

UNIT V NUTRIGENOMICS TO INDUSTRY AND PUBLIC **9**

Nutrigenomics to the food industry: Industry-Academia partnerships as an important challenge; Interaction with health professionals in bringing nutrigenomics to the public; Public health significance of nutrigenomics and nutrigenetics.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 understand the essential components of nutrition

CO2 get to know about the genetic components related with nutritional factors

CO3 learn the interplay and dynamics that nutrition and genetics in health and disease

TEXT BOOKS:

1. Handbook of nutraceuticals and functional foods /edited by Robert E.C. Wildman Wildman, Robert E. C., 2nd Edition, 2016.
2. Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutritionby Lynnette R. Ferguson, 1st Edition, 2016.
3. Handbook of Nutraceuticals Volume I: Ingredients, Formulations, and Applications 1st Edition by Yashwant Vishnupant Pathak, 2nd Edition, 2016.
4. Nutrigenomics and Nutraceuticals: Clinical Relevance and Disease Prevention by Yashwant Pathak, Ali M. Ardekani CRC Press, 2017.
5. Giuseppe Mazza; Functional Foods:Biochemical and Processing Aspects, Vol I, CRC Press. 1st Edition, 1988.
6. Robert E.C.Wildman, Handbook of Nutraceuticals & Functional Foods, 2ndEdition; CRC Press. 2001
7. Jones and Barlett; Benjamin Lewin, Gene IX, 9th Edition, Publishers, 2007.
8. P.S. Kalsi, Stereochemistry; New Age International, 2000.

REFERENCES:

1. Nutrition 25 (2009) 1085–1093; Proteomics at the center of nutrigenomics: Comprehensive molecular understanding of dietary health effects.
2. Davis, M.B., Austin, J. and Partridge, D.A. (1991).Vitamin C: Its Chemistry and Biochemistry. The Royal Society of Chemistry.
3. Metzler, D. E. (2003): Biochemistry: The Chemical reactions of living cell. Vol. 1 & 2. Academic Press.
4. Bowman JE, Murray RF. 1990. Genetic Variation and Disorders in Peoples of African Origin. Baltimore, MD: Johns Hopkins Univ. Press
5. www.icmr.nic.in.
6. www.whoindia.org.
7. www.fda.gov.
8. www.wto.org.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	understand the essential components of nutrition	2	1	1	2	1	1	1	2	-	2	-	-	1	-	3	2
CO 2	get to know about the genetic components related with nutritional factors	2	2	2	1	1	-	3	-	3	-	1	2	1	3	1	1
CO 3	learn the interplay and dynamics that nutrition and genetics in health and disease	1	2	2	2	1	1	2	-	-	1	2	2	-	1	2	1
Overall CO		2	2	2	2	1	1	2	-	-	1	1	2	1	2	2	1

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

IB5073 **CHEMICAL REACTION ENGINEERING**

LT PC

2 1 0 3

OBJECTIVES

The course aims to,

- provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

UNIT ISCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING 8

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions.Industrial scale reactors.

UNIT II IDEAL REACTORS 10

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT IIIIDEAL FLOW AND NON IDEAL FLOW 10

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IVGAS-SOLID, GAS-LIQUID REACTIONS 9

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT VFIXED BED AND FLUID BED REACTORS 8

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 write the rate equation for any type of reaction.

CO2 design reactors for homogeneous and heterogeneous reactions and optimize operating conditions.

CO3 relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.

TEXT BOOKS:

1. Levenspiel O. “Chemical Reaction Engineering”, III edition, John Wiley, 2012.
2. Fogler H.S. “Elements Of Chemical Reaction Engineering”,IV edition, Pearson Education India, 2015.

REFERENCES:

1. Missen R.W., Mims C.A., and Saville B.A. “Introduction to Chemical Reaction Engineering and Kinetics”, John Wiley & sons, 1999.
2. Dawande, S.D., “Principles of Reaction Engineering”, I edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., “Coulson & Richardson’s Chemical Engineering, Vol. III”, III edition, Butterworth- Heinemann- Elsevier, 2014.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	Write the rate equation for any type of reaction.	3	3	2	1	1	1	-	-	1	1	-	2	3	2	1	1
CO 2	Design reactors for homogeneous and heterogeneous reactions and optimize operating conditions.	3	3	2	1	1	1	-	-	1	1	-	2	2	2	1	1
CO 3	Relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.	3	3	2	1	1	1	-	-	1	1	-	2	2	2	1	1
Overall CO		3	3	2	1	1	1	-	-	1	1	-	2	2	2	1	1

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

PM5020 TECHNOLOGY OF STERILE DOSAGE FORMS AND DISPERSIONS

LT PC

3 0 0 3

OBJECTIVES

The course aims to,

- impart the knowledge of the various types and stages of process of sterile pharmaceutical products.
- understand the principles of formulating emulsion and suspension

UNIT I PARENTERALS **9**

Introduction, historical perspective - parenteral routes of administration - formulation additives. Small volume parenterals - large volume parenterals.

UNIT II STERILIZATION **9**

Sterilization methods – Steam - Dry heat – Filtration – Gas - Ionizing radiation with their advantages and disadvantages.Validation of sterility.Particulate contamination.

UNIT III INJECTIONS **9**

Types of injections - aqueous and non- aqueous vehicles used for injection – manufacturing – packaging - labeling - storage of injections.

UNIT IV PARENTERAL SUSPENSION AND EMULSION **9**

Introduction – need for parenteral suspension and emulsion - manufacturing additives – formulation of parenteral suspension and emulsion – characterization – applications.

UNIT V OPHTHALMIC PRODUCTS **9**

Absorption of drugs in the eye - raw materials - ocular penetration enhancers - general safety consideration. Formulation of various ophthalmic products with their characterization.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 understand the concepts of different types of sterile pharmaceutical formulations

CO2 understand the sterilisation process for the sterile products

CO3 understand the technology used for formulations of various sterile products

TEXT BOOKS:

1. Loyd V. Allen, Howard C. Ansel, Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th Edition, Wolters Kluwer Health 2013.
2. Roop K. Khar, SP. Vyas “Lachman/Liebermans: The Theory and Practice of Industrial Pharmacy”, 4th Edition, CBS Publishers and Distributors 2013.

REFERENCES:

1. James Swarbrick "Encyclopedia of Pharmaceutical Science and Technology",4th Edition, CRC Press, 2012.
2. Sandeep Nema, Nema Sandeep, John D "Pharmaceutical Dosage Forms: Parenteral Medications", 3rd Edition, Informa Healthcare 2010.

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	understand the concepts of different types of sterile pharmaceutical formulations	2	1	1	1	2	3	2	2	2	2	2	2	3	1	2	1
CO 2	understand the sterilisation process for the sterile products	3	2	2	2	1	1	2	3	2	3	3	2	2	2	2	2
CO 3	Understand the technology used for formulations of various sterile products	3	2	3	2	3	2	3	3	1	3	2	3	2	1	2	1
Overall CO		3	2	2	2	2	3	2	3	2	3	2	2	2	1	2	1

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

PM5021 REGULATORY ISSUES IN PHARMACEUTICAL INDUSTRY

LT PC

3 0 0 3

OBJECTIVES

The course aims to,

- enable students to acquire knowledge in drug regulatory affairs in India and at International level.
- understand the implications of regulatory issues concerning pharma industries

UNIT I INDIAN DRUG REGULATORY ASPECTS 9

Drug regulatory bodies in India,Drugs and Cosmetics Act 1940 and its rules 1945,Drug regulatory bodies in India –CDSCO, MHFW, IPC, ICMR, NPPA,TheThe Drugs (Prices Controls) Order, 1955. The Indian Patents and Designs, Act 1970, Magic Remedies and Objectionable advertisements Act,Prevention of Food Adulteration Act 1954],Intellectual property rights,Patent act- Patent, TradeMark Regn, TRIPS.

UNIT II PHARMACOPOEIA AND REGULATORY BODIES, PHARMACOPOEIA AND REGULATORY BODIES 8

Pharmacopoeias; Indian, British, U.S, European, Japanese Regulatory bodies & amp;requirements - Indian FDA, WHO GMP; U.S. FDA, U.K. MCA, Australian TGA, JapanesePMDA. Monographs; Standards, Specifications of different dosage forms

UNIT III cGMPS& DRUG DOSSIERS 9

Good manufacturing practices for active pharmaceutical ingredients (bulk drug substances), pharmaceutical excipients, pharmaceutical products, sterile pharmaceutical products, biological products, manufacture of herbal medicines and radiopharmaceutical products .documentation, good laboratory practices (GLPs), good clinical practices (GCPs) Drug dossier contents - CTD (CMC section) & data

UNIT IV PRECLINICAL/CLINICAL TRIALS AND VARIOUS PHASES 7

Schedule-Y, pre-clinical study requirements, clinical trial phases, types of trials, bioethics & stakeholders, Bioavailability & Bioequivalence studies,Drug development stages,FDA guidelines on IND, new drug approvals (NDA), ANDA approvals. European regulatory agency, types of filing process (Centralized, de-centralized, RMS countries),Regulation of preclinical studies, Design of clinical studiesCFR/ICH/EU GCP guidelines.

UNIT V REGULATORY AND ETHICAL ISSUES IN HEALTH AND DISEASE 12

Animal experimentation: concerns of welfare, Justification of use of animals in research; use of alternatives; Human experimentation-Nuremberg code and Helsinki declaration; Assisted Reproductive Technologies, Pre-implantation genetic diagnosis, Surrogacy, Use of Embryos; Therapeutic and Reproductive Cloning-Ethical, Legal and Social Issues; genetic testing and Genetic Screening, Types of Testing, Clinical Utility and Validity of Tests, Testing processes, Social stigma, discrimination, misuse of data; HGP & ELSI, case study; Somatic and Germline gene therapy; Organ transplantation and Xenotransplantation;Biosafety and biodiversity: Classification of microorganisms based on safety, Biosafety levels, Risk groups, Risk Assessment and Management, Spill Protocols, Biosafety Containment guidelines; Biodiversity – Need and Methods for Protection; Convention for preservation of biodiversity and farmer’s rights; patenting of biodiversity: ethical issues

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 acquire knowledge about the regulatory aspects of pharmaceutical industry practices.

CO2 know the process of patenting activities and IPR rights.

CO3 update the bioethical guidelines related to various health practices.

TEXT BOOKS:

1. C.V.Subbrahmanyam & J.Thimmasetty, "Pharmaceutical regulatory affairs", 1st Edn., vallabh Prakashan, New Delhi, 2012.
2. Willig, H., Tuckeman, M.M. and Hitchings, W.S., "Good Manufacturing Practices for Pharmaceuticals", 5th Edition, Marcel Dekker Drugs and the Pharmaceutical Sciences, by CRC Press, New York, 2000.
3. N Udupa, Krishnamurthy Bhat, "A Concise Textbook of Drug Regulatory Affairs", Manipal University Press (MUP); First Edition, 2015.
4. Malik, Vijay "Drugs and Cosmetics Act – 1940", 11th Edition, Eastern Book Co., 1998.
5. "Quality Assurance of Pharmaceuticals : A Compendium of Guidelines and Related Materials", Vol.I and Vol.II. Good Manufacturing Practices and Inspection", WHO / Pharma Book Syndicate, 2002.

REFERENCES:

1. Ira R. Berry, The Pharmaceutical Regulatory Process, marcel dekker Series: Drugs and the Pharmaceutical Sciences, by CRC Press, Newyork, 2004.
2. Mindy J. Allport-Settle, Current Good Manufacturing Practices: Pharmaceutical, Biologics, and Medical Device Regulations and Guidance Documents Concise Reference, Pharmalogika Inc., USA, 2009.
3. Sharma, P.P., "How to Practice GMPs", 3rd Edition, Vandana Publications, 2006.
4. Abraham, John and Smith, Helen Lawton, "Regulation of the Pharmaceutical Industry", Palgrave / Macmillan, 2003.
5. Weinberg, Sandy "Good Laboratory Practice Regulations", 3rd Rev. Edition, Marcel Dekker Inc., 2003.
6. Gad. Shayne C. "Drug Safety Evaluation", John Wiley Intersciences, 2002.
7. Thomas, J.A. and Fuchs, R.L. "Biotechnology and Safety Assessment", 3rd Edition, Academic Press, 2002

Course Articulation Matrix

Course Outcome Statements		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	acquire knowledge about the regulatory aspects of pharmaceutical industry practices .	3	1	1	1	-	-	1	2	-	-	-	2	-	-	-	2
CO 2	know the process of patenting activities and IPR rights	2	1	-	-	-	-	-	1	-	-	-	2	-	-	-	2
CO 3	update the bioethical guidelines related to various health practices	1	1	1	1	-	-	-	1	-	-	-	2	-	-	-	2
Overall CO		2	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)

AUDIT COURSES (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 onGood Administration,Rulerand Subjects–Emotion&itsEffectin 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 completionofthiscourse, the studentswillbeable to:

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate‘Agathinai’ and‘Purathinai’in their personal andsocietallife.

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: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

	P												PS		
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.