

**ANNA UNIVERSITY, CHENNAI**  
**UNIVERSITY DEPARTMENTS**  
**B. TECH. PHARMACEUTICAL TECHNOLOGY**  
**REGULATIONS – 2015**  
**CHOICE BASED CREDIT SYSTEM**

**Program Objectives**

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 with particular emphasis on the engineering aspects of drug manufacturing, pharmaceutical production, pharmaceutical development, and pharmaceutical operations. They are trained to

1. Achieve successful professional and technical career
2. Have strong foundation in basic sciences, mathematics and process engineering
3. Have knowledge on the theory and practices in the field of Pharmaceutical Engineering and allied areas
4. Engross in life-long learning to keep themselves abreast of new developments
5. Practice and inspire high ethical values and technical standards

**Program Outcome:**

- a) Ability to apply knowledge of Mathematics, Sciences and Engineering
- b) Ability to understand, analyze and apply basic theorems and postulates in the design, optimization and scale-up of Pharmaceutical production systems
- c) Ability to understand, analyze and apply physicochemical and engineering concepts in Dosage Form Design and Drug Delivery Systems.
- d) Ability to understand, analyze and apply the process engineering concepts in the manufacture of Active Pharmaceutical Ingredients and in the manufacture of biologicals
- e) Ability to understand and apply the scientific and engineering concepts for new drug discovery and development.
- f) Ability to understand ethical and professional responsibilities
- g) Ability to communicate effectively and work in interdisciplinary groups
- h) Ability to review, comprehend and report technological development

PROGRESS THROUGH KNOWLEDGE

Programme Educational Objectives	Programme Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
I						✓	✓	✓
II	✓		✓		✓			
III		✓	✓	✓				
IV						✓	✓	✓
V						✓	✓	

*Attested*

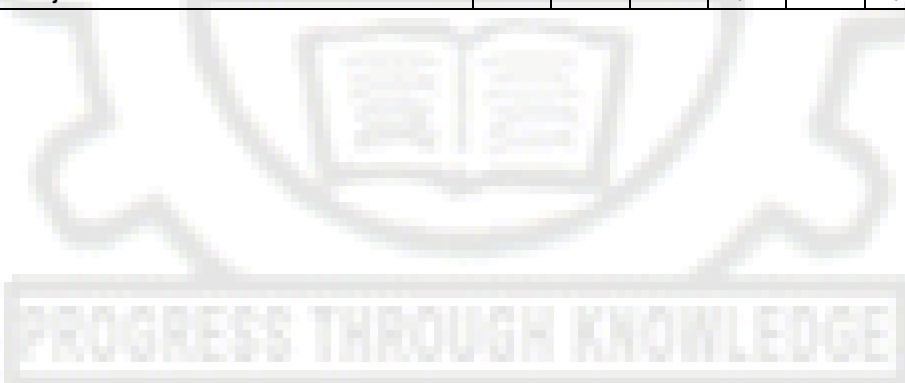
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			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	
Year 1	SEM 1	Foundation English								✓	
		Mathematics-1	✓								
		Engineering Physics	✓								
		Engineering Chemistry	✓								
		Computing Techniques	✓				✓				
		Engineering Graphics									
		Basic Sciences Laboratory	✓							✓	
	Engineering Practices Laboratory	✓							✓		
	SEM 2	Technical English								✓	✓
		Mathematics-2	✓								
		Physics of Materials	✓								
		Microbiology	✓					✓			
		Engineering Mechanics	✓								
		Biochemistry	✓					✓			
Microbiology Lab										✓	
Biochemistry Lab									✓		
Year 2	SEM 3	Transform Techniques and Partial Differential equations				✓					
		Human Physiology	✓				✓				
		Pharmaceutical Chemistry			✓	✓	✓				
		Stoichiometry and Chemical Process Calculations				✓					
		Chemical Engineering Thermodynamics	✓			✓					
		Physical Pharmaceutics				✓	✓				
		Physiology Lab				✓				✓	
		Physical Pharmaceutics Lab				✓				✓	
Year 2	SEM 4	Probability and statistics	✓								
		Pharmaceutical Analysis				✓	✓				
		Environmental science and Engineering		✓		✓	✓				
		Molecular biology and Genetic Engineering		✓			✓				
		Fluid Flow Operations				✓					
		Fundamentals of Heat and Mass Transfer in pharmaceutical Technology	✓			✓					
		Analytical methods and Instrumentation Lab								✓	
		Molecular biology and Genetic Engineering Lab								✓	
Year 3	SEM 5	Chemical Reaction Engineering	✓			✓					
		Medicinal Chemistry					✓				
		Unit Operations and Unit Processes		✓	✓	✓					
		Pharmacology and Chemotherapy	✓				✓				
		Professional Elective I									
		Professional Elective II									

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		Medicinal Chemistry and Pharmacology Lab								✓	
		Unit Operation Lab								✓	
	SEM 6		Total Quality Management		✓	✓	✓				
			Creativity, Innovation and New Product Development		✓	✓	✓	✓			
			Bioprocess Engineering	✓		✓					
			Technology of Solid Dosage Forms		✓	✓	✓				
			Employability Skills								
			Professional Elective III								
			Professional Elective IV						✓		
		Bioprocess Engineering Lab								✓	
		Technology of Dosage Forms Lab				✓				✓	
Year 4	SEM 7	Regulatory Issues in Pharmaceutical Industry and Drug Validation		✓	✓	✓	✓				
		Technology of Semisolid Dosage Forms and Dispersions		✓	✓	✓					
		Biopharmaceutics and Pharmacokinetics		✓		✓	✓				
		Technology of Sterile Products		✓							
		Professional Elective V									
		Professional Elective VI									
SE M 8		Drug Delivery Systems Lab			✓					✓	
		Medicinal Natural Products Lab								✓	
		Internship Program						✓		✓	
		Project Work				✓		✓	✓	✓	



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**CHOICE BASED CREDIT SYSTEM**  
**CURRICULA AND SYLLABI I – VIII SEMESTERS**

**SEMESTER I**

SI. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	MA7151	Mathematics – I	BS	4	4	0	0	4
3.	PH7151	Engineering Physics	BS	3	3	0	0	3
4.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE7151	Computing Techniques	ES	3	3	0	0	3
6.	GE7152	Engineering Graphics	ES	5	3	2	0	4
<b>PRACTICALS</b>								
7.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
8.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
<b>TOTAL</b>				<b>30</b>	<b>20</b>	<b>2</b>	<b>8</b>	<b>25</b>

**SEMESTER II**

SI. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	HS7251	Technical English	HS	4	4	0	0	4
2.	MA7251	Mathematics - II	BS	4	4	0	0	4
3.	PH7257	Physics of Materials	BS	3	3	0	0	3
4.	IB7252	Microbiology	PC	3	3	0	0	3
5.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
6.	IB7251	Biochemistry	PC	3	3	0	0	3
<b>PRACTICALS</b>								
7.	IB7262	Microbiology Lab	PC	4	0	0	4	2
8.	IB7261	Biochemistry Lab	PC	4	0	0	4	2
<b>TOTAL</b>				<b>29</b>	<b>21</b>	<b>0</b>	<b>8</b>	<b>25</b>

### SEMESTER III

SI. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MA7358	Transform Techniques and Partial Differential Equations	BS	4	4	0	0	4
2.	PM7301	Chemical Engineering Thermodynamics for Pharma Technologist	PC	3	3	0	0	3
3.	PM7302	Human Physiology	PC	3	3	0	0	3
4.	PM7303	Pharmaceutical Chemistry	PC	3	3	0	0	3
5.	PM7304	Physical Pharmaceutics	PC	3	3	0	0	3
6.	PM7305	Stoichiometry and Chemical Process Calculations	PC	3	3	0	0	3
<b>PRACTICALS</b>								
7.	PM7311	Physical Pharmaceutics Laboratory	ES	4	0	0	4	2
8.	PM7312	Physiology Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>27</b>	<b>19</b>	<b>0</b>	<b>8</b>	<b>23</b>

### SEMESTER IV

SI. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	MA7357	Probability and Statistics	BS	4	4	0	0	4
2.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
3.	PM7401	Fluid Flow Operations	PC	3	3	0	0	3
4.	PM7402	Fundamentals of Heat and Mass Transfer in Pharmaceutical Technology	PC	3	3	0	0	3
5.	PM7403	Molecular Biology and Genetic Engineering	PC	4	4	0	0	4
6.	PM7404	Pharmaceutical Analysis	PC	3	3	0	0	3
<b>PRACTICALS</b>								
7.	PM7411	Analytical methods and Instrumentation Laboratory	PC	4	0	0	4	2
8.	PM7412	Molecular Biology and Genetic Engineering Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>28</b>	<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>

### SEMESTER V

Sl. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	IB7552	Chemical Reaction Engineering	PC	3	3	0	0	3
2.	PM7501	Medicinal Chemistry	PC	4	4	0	0	4
3.	PM7502	Pharmacology and Chemotherapy	PC	4	4	0	0	4
4.	PM7503	Unit Operations in Pharma Industries	PC	4	4	0	0	4
5.		Professional Elective I	PE	3	3	0	0	3
6.		Open Elective I	OE	3	3	0	0	3
<b>PRACTICALS</b>								
7.	PM7511	Medicinal Chemistry and Pharmacology Laboratory	PC	4	0	0	4	2
8.	PM7512	Unit Operations in Pharma Industries Lab	PC	4	0	0	4	2
<b>TOTAL</b>				<b>29</b>	<b>21</b>	<b>0</b>	<b>8</b>	<b>25</b>

### SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	GE7652	Total Quality Management	HS	3	3	0	0	3
2.	FT7651	Creativity, Innovation, and New Food Product Development	PC	3	3	0	0	3
3.	IB7551	Bioprocess Engineering	PC	3	3	0	0	3
4.	PM7601	Technology of Solid Dosage Forms	PC	4	4	0	0	4
5.	HS7551	Employability Skills	HS	3	3	0	0	3
6.		Professional Elective II	PE	3	3	0	0	3
7.		Professional Elective III	PE	3	3	0	0	3
<b>PRACTICALS</b>								
8.	PM7611	Bioprocess Engineering Lab	PC	4	0	0	4	2
9.	PM7612	Technology of Dosage Forms Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>30</b>	<b>22</b>	<b>0</b>	<b>8</b>	<b>26</b>

### SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	PM7701	Biopharmaceutics and Pharmacokinetics	PC	3	3	0	0	3
2.	PM7702	Regulatory Issues in Pharmaceutical Industry and Drug Validation	PC	3	3	0	0	3
3.	PM7703	Technology of Semi Solid Dosage forms and Dispersions	PC	3	3	0	0	3
4.	PM7704	Technology of Sterile Products	PC	3	3	0	0	3
5.		Professional Elective IV	PE	3	3	0	0	3
6.		Open Elective II	OE	3	3	0	0	3
<b>PRACTICALS</b>								
7.	PM7711	Drug Delivery Systems Lab	PC	4	0	0	4	2
8.	PM7712	Internship Program	EEC	4	0	0	4	2
9.	PM7713	Medicinal Natural Products Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>30</b>	<b>18</b>	<b>0</b>	<b>12</b>	<b>24</b>

### SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
<b>PRACTICALS</b>								
1.	PM7811	Project Work	EEC	20	0	0	20	10
<b>TOTAL</b>				<b>20</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>

**TOTAL NO. OF CREDITS : 182**

### PROFESSIONAL ELECTIVES (PE)

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PM7012	Pharmacognosy	PE	3	3	0	0	3
2.	PM7002	Clinical Research and Regulations	PE	3	3	0	0	3
3.	PM7001	Chemistry of Natural Products	PE	3	3	0	0	3
4.	PM7015	Special Topics in Medicinal Chemistry	PE	3	3	0	0	3
5.	PM7016	Special Topics in Pharmacology	PE	3	3	0	0	3
6.	CH7751	Transport Phenomena	PE	3	3	0	0	3
7.	PM7003	Colloids and Interfacial Phenomena	PE	3	3	0	0	3
8.	PM7004	Computer Aided Drug Design	PE	3	3	0	0	3

9.	PM7005	Experimental Design and Biostatistics	PE	3	3	0	0	3
10.	PM7006	Fundamentals of Material Science and Engineering	PE	3	3	0	0	3
11.	PM7007	Fundamentals of Molecular Pathology	PE	3	3	0	0	3
12.	PM7008	Fundamentals of Polymer Science and Engineering	PE	3	3	0	0	3
13.	PM7009	Introduction to Biomaterials and Tissue Engineering	PE	3	3	0	0	3
14.	PM7010	Molecular Modeling and Drug Design	PE	3	3	0	0	3
15.	PM7011	Nutraceuticals	PE	3	3	0	0	3
16.	PM7013	Principles of Bioengineering	PE	3	3	0	0	3
17.	PM7017	Vaccine Technology	PE	3	3	0	0	3
18.	GE7073	Fundamentals of Nanoscience	PE	3	3	0	0	3
19.	CH7072	Instrumentation and Process Control	PE	3	3	0	0	3
20.	IB7071	Bioconjugate Technology and Applications	PE	3	3	0	0	3
21.	IB7072	Biological Spectroscopy	PE	3	3	0	0	3
22.	PM7014	Protein Structure, Function and Proteomics	PE	3	3	0	0	3
23.	IB7751	Bioinformatics	PE	5	3	2	0	4
24.	IB7752	Downstream Processing	PE	3	3	0	0	3
25.	IB7073	Metabolic Engineering	PE	3	3	0	0	3
26.	GE7071	Disaster Management	PE	3	3	0	0	3
27.	GE7074	Human Rights	PE	3	3	0	0	3
28.	IB7753	Immunology	PE	3	3	0	0	3
29.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

### HUMANITIES AND SOCIAL SCIENCES(HS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS 7151	Foundational English	HS	4	4	0	0	4
2.	HS 7251	Technical English	HS	4	4	0	0	4
3.	HS 7551	Employability Skills	HS	3	3	0	0	3
4.	GE 7251	Environmental Science and Engineering	HS	3	3	0	0	3
5.	GE7652	Total Quality Management	HS	3	3	0	0	3



### BASIC SCIENCES(BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS 7151	Mathematics – I	BS	4	4	0	0	4
2.	PH 7151	Engineering Physics	BS	3	3	0	0	3
3.	CY 7151	Engineering Chemistry	ES	3	3	0	0	3
4.	BS 7161	Basic Sciences Laboratory	BS	4	0	0	4	2
5.	MA 7251	Mathematics – II	BS	4	4	0	0	4
6.	PH 7257	Physics of Materials	BS	3	3	0	0	3
7.	MA 7358	Transform Techniques and Partial Differential Equation	BS	4	4	0	0	4
8.	MA 7357	Probability and Statistics	BS	4	4	0	0	4

### ENGINEERING SCIENCES(ES)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE 7152	Engineering Graphics	ES	5	3	2	0	4
2.	GE 7151	Computing Techniques	ES	3	3	0	0	3
3.	GE 7162	Engineering Practices Laboratory	ES	4	0	0	4	2
4.	GE 7153	Engineering Mechanics	ES	4	4	0	0	4
5.	PM 7311	Physical Pharmaceutics Laboratory	ES	4	0	0	4	2

### PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEG ORY	CONTACT PERIODS	L	T	P	C
1.	IB 7252	Microbiology	PC	3	3	0	0	3
2.	IB 7251	Biochemistry	PC	3	3	0	0	3
3.	IB 7262	Microbiology Lab	PC	4	0	0	4	2
4.	IB 7261	Biochemistry Lab	PC	4	0	0	4	2
5.	PM 7302	Human Physiology	PC	3	3	0	0	3
6.	PM 7303	Pharmaceutical Chemistry	PC	3	3	0	0	3
7.	PM 7305	Stoichiometry and Chemical Process	PC	3	3	0	0	3

		Calculations						
8.	PM 7301	Chemical and Engineering Thermodynamics	PC	3	3	0	0	3
9.	PM 7304	Physical Pharmaceutics	PC	3	3	0	0	3
10.	PM 7312	Physiology Laboratory	PC	4	0	0	4	2
11.	PM 7403	Molecular Biology and Genetic Engineering	PC	4	4	0	0	4
12.	PM 7401	Fluid Flow Operations	PC	3	3	0	0	3
13.	PM7402	Fundamentals of Heat and Mass Transfer in Pharmaceutical Technology	PC	3	3	0	0	3
14.	PM 7411	Analytical Methods and Instrumentation Lab	PC	4	0	0	4	2
15.	PM 7412	Molecular Biology and Genetic Engineering Lab	PC	4	0	0	4	2
16.	PM 7404	Pharmaceutical Analysis	PC	3	3	0	0	3
17.	IB 7552	Chemical reaction Engineering	PC	3	3	0	0	3
18.	PM 7501	Medicinal Chemistry	PC	4	0	0	0	3
19.	PM 7502	Pharmacology and Chemotherapy	PC	4	4	0	0	4
20.	PM 7503	Unit Operations in Pharma Industries	PC	4	4	0	0	3
21.	PM 7512	Unit Operations in Pharma Industries Lab	PC	4	0	0	4	2
22.	PM 7511	Medicinal Chemistry and Pharmacology Lab	PC	4	0	0	4	2
23.	FT 7651	Creativity, Innovation and New Food Product Development	PC	3	3	0	0	3
24.	IB 7551	Bioprocess Engineering	PC	3	3	0	0	3
25.	PM 7601	Technology of Solid Dosage Forms	PC	4	4	0	0	4
26.	PM 7611	Bioprocess Engineering Lab	PC	4	0	0	4	2
27.	PM 7612	Technology of Dosage Forms Laboratory	PC	4	0	0	4	2
28.	PM 7702	Regulatory Issues in Pharmaceutical Industry and Drug Validation	PC	3	3	0	0	3
29.	PM 7703	Technology of Semi Solid Dosage forms and Dispersions	PC	3	3	0	0	3
30.	PM 7704	Technology of Sterile Products	PC	3	3	0	0	3
31.	PM 7701	Biopharmaceutics and Pharmacokinetics	PC	3	3	0	0	3
32.	PM 7711	Drug Delivery Systems Lab	PC	4	0	0	4	2
33.	PM 7713	Medicinal Natural Products Laboratory	PC	4	0	0	4	2

**EMPLOYABILITY ENHANCEMENT COURSES(EEC)**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PM 7712	Internship Program	EEC	4	0	0	4	2
2.	PM 7811	Project Work	EEC	20	0	0	20	10

**SUMMARY**

S.No	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	HS	4	4	-	3	-	6	-	-	17
2	BS	12	7	4	4	-	-	-	-	27
3	ES	9	4	2	-	-	-	-	-	15
4	PC	-	10	17	17	19	14	16	-	90
5	PE	-	-	-	-	3	6	3	-	12
6	OE	--	-	-	-	3	-	3	-	6
7	EEC	-	-	-	-	-	-	2	10	15
	<b>Total</b>	<b>25</b>	<b>25</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>24</b>	<b>10</b>	<b>182</b>
8	Non-Credit/Mandatory									

PROGRESS THROUGH KNOWLEDGE

Attested

*Sobhan*  
DIRECTOR

**COURSE DESCRIPTION:**

This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

**OBJECTIVES:**

- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students' communicative competence in English.
- To teach students the various aspects of English language usage.

**CONTENTS****UNIT I GREETING AND INTRODUCING ONESELF 12**

**Listening**- Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend;**Reading** – Skimming a passage– Scanning for specific information;**Writing**- Guided writing - Free writing on any given topic ( My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

**UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12**

**Listening** – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing** –Process description( non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation – Word expansion ( root words).

**UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12**

**Listening**- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material;**Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

**UNIT IV CRITICAL READING AND WRITING 12**

**Listening**- Watching videos/ documentaries and responding to questions based on them; **Speaking**Informal and formal conversation;**Reading** –Critical reading (prediction & inference);**Writing**–Essay writing ( compare & contrast/ analytical) – Interpretation of visual materials;**Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

**UNIT V LETTER WRITING AND SENDING E-MAILS 12**

**Listening**- Listening to programmes/broadcast/ telecast/ podcast;**Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation;**Reading** –Extensive reading;**Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives;**Vocabulary** –Collocation;

**TEACHING METHODS:**

Interactive sessions for the speaking module.  
Use of audio – visual aids for the various listening activities.  
Contextual Grammar Teaching.

**EVALUATION PATTERN:**

Internals – 50%

**LEARNING OUTCOMES:**

- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

**TEXTBOOK:**

1. Richards, Jack.C with Jonathan Hull and Susan Proctor **New Interchange : English for International Communication. (level2, Student’s Book)** Cambridge University Press, New Delhi: 2010.

**REFERENCES:**

1. Bailey, Stephen. **Academic Writing: A practical guide for students.** New York: Rutledge, 2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering.** London: Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student’s Book & Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skills for Business English.** Cambridge University Press, Cambridge: Reprint 2011.

**MA7151**

**MATHEMATICS – I**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**(Common to all branches of B.E. /B.Tech. Programmes in I Semester)**

**COURSE OBJECTIVES**

- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

**UNIT I DIFFERENTIAL CALCULUS**

**12**

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

**UNIT II 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 III 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 IV MULTIPLE INTEGRALS**

**12**

*Attested*  
  
**DIRECTOR**  
 Centre For Academic Courses  
 Anna University, Chennai-600 025.

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.

## UNIT V DIFFERENTIAL EQUATIONS

12

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

**TOTAL : 60 PERIODS**

### COURSE OUTCOMES

- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

### TEXT BOOKS

1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9<sup>th</sup> Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.

### REFERENCE BOOKS

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11<sup>th</sup> Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3<sup>rd</sup> Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
4. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2<sup>nd</sup> Edition, 5<sup>th</sup> Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH7151

**ENGINEERING PHYSICS**

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

**L T P C**  
**3 0 0 3**

### OBJECTIVE:

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

## UNIT I PROPERTIES OF MATTER

Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending-

of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

## **UNIT II ACOUSTICS AND ULTRASONICS 9**

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - calculation of reverberation time for different types of buildings – sound absorbing materials - factors affecting acoustics of buildings : focussing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonic method: scan modes and practice.

## **UNIT III THERMAL AND MODERN PHYSICS 9**

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

## **UNIT IV APPLIED OPTICS 9**

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – CO<sub>2</sub> and Nd:YAG laser - semiconductor lasers: homo junction and hetro junction - construction and working – applications. Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

## **UNIT V CRYSTAL PHYSICS 9**

Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

**TOTAL: 45 PERIODS**

### **OUTCOME:**

- The students will understand different moduli of elasticity, their determination and applications.
- The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics
- The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
- The students will gain knowledge on interferometers, lasers and fiber optics
- The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

### **TEXTBOOKS:**

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
2. Arumugam M., "Engineering Physics", Anuradha Publications (2000)

### **REFERENCES:**

1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. (2010).
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, (2007).
3. Markert J.T., Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. (2007).

**COURSE OBJECTIVES**

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

**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: T<sub>g</sub>, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

**UNIT II SURFACE CHEMISTRY AND CATALYSIS****9**

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions- Types of isotherms-Freundlich adsorption isotherm, Langmuir adsorption isotherm. Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation. Industrial applications of catalysts.

**UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY****9**

Photochemistry: Laws of photochemistry-Grothuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-Vis and IR spectroscopy-principles, instrumentation (Block diagram) and applications.

**UNIT IV CHEMICAL THERMODYNAMICS****9**

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation-variation of chemical potential with temperature and pressure.

**UNIT V NANO CHEMISTRY****9**

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Preparation of nanoparticles – sol-gel and solvothermal. Preparation of carbon nanotube by chemical vapour deposition and laser ablation. Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning. Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

**TOTAL : 45 PERIODS****COURSE OUTCOMES**

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

**TEXT BOOKS**

1. Jain P. C. & Monica Jain., "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014



## REFERENCE BOOKS

1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.

<b>GE7151</b>	<b>COMPUTING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>(Common to all branches of Engineering and Technology)</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### OBJECTIVES:

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

### UNIT I INTRODUCTION 9

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

### UNIT II C PROGRAMMING BASICS 9

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

### UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings-String operations – String Arrays - simple programs- sorting- searching – matrix operations.

### UNIT IV POINTERS 9

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

### UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures - Unions

**TOTAL : 45 PERIODS**

### OUTCOMES

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

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort.
- Use programming language to solve problems.

### TEXTBOOKS:

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

## REFERENCES:

1. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, "Programming with C", Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

	<b>ENGINEERING GRAPHICS</b>	<b>L T P C</b>
<b>GE7152</b>		<b>3 2 0 4</b>

## OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

## CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)

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

**14**

## UNIT I PLANE CURVES AND FREE HANDSKETCHING

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

## UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES

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

**14**

## UNIT III PROJECTION OF SOLIDS

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

## UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

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

**15**

## UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems.

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

## COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)

3

Introduction to drafting packages and demonstration of their use.

L=45+T=30, TOTAL: 75 PERIODS

### OUTCOMES:

On Completion of the course the student will be able to

- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, Planes and Solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

### TEXT BOOK:

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50<sup>th</sup> Edition, 2010.

### REFERENCES:

1. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,," Fundamentals of Engineering Drawingwith an introduction to Interactive Computer Graphics for Design and Production",Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P)Limited ,2008.
5. K. V.Natarajan, "A text book of Engineering Graphics", 28<sup>th</sup> Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, " Engineering Drawing", Oxford University Press, 2015

### Publication of Bureau of Indian Standards:

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

### Special points applicable to University Examinations on Engineering Graphics:

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

BS7161

**BASIC SCIENCES LABORATORY**  
(Common to all branches of B.E. / B.Tech Programmes)

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

## PHYSICS LABORATORY: (Any Seven Experiments)

### OBJECTIVE:

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.

- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves, band gap determination and viscosity of liquids.
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
  2. Non-uniform bending - Determination of young's modulus
  3. Uniform bending – Determination of young's modulus
  4. Lee's disc Determination of thermal conductivity of a bad conductor
  5. Potentiometer-Determination of thermo e.m.f of a thermocouple
  6. Laser- Determination of the wave length of the laser using grating
  7. Air wedge - Determination of thickness of a thin sheet/wire
  8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle  
b) Compact disc- Determination of width of the groove using laser.
  9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
  10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
  11. Post office box -Determination of Band gap of a semiconductor.
  12. Spectrometer- Determination of wavelength using gating.
  13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

**TOTAL: 30 PERIODS**

**OUTCOME:**

Upon completion of the course, the students will be able

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

**CHEMISTRY LABORATORY:**

**(Minimum of 8 experiments to be conducted)**

1. Estimation of HCl using  $\text{Na}_2\text{CO}_3$  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 poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

**TOTAL: 30 PERIODS**

**TEXTBOOKS**

1. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014)
2. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).

GE7162

**ENGINEERING PRACTICES LABORATORY**  
(Common to all Branches of B.E. / B.Tech. Programmes)

L T P C  
0 0 4 2

**COURSE OBJECTIVES**

- To provide exposure to the students with hands-on experience on various Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP – A (CIVIL & ELECTRICAL)**

**1. CIVIL ENGINEERING PRACTICES** 15  
**PLUMBING**

- Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

**WOOD WORK**

- Sawing, planing and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

**STUDY**

- Study of joints in door panels and wooden furniture
- Study of common industrial trusses using models.

**2. ELECTRICAL ENGINEERING PRACTICES** 15

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.  
Study of Iron-Box, Fan Regulator and Emergency Lamp

**GROUP – B (MECHANICAL AND ELECTRONICS)**

**3. MECHANICAL ENGINEERING PRACTICES** 15  
**WELDING**

- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations..
- Study and assembling of the following:
  - a. Centrifugal pump
  - b. Mixie
  - c. Air Conditioner.

**DEMONSTRATION ON FOUNDRY OPERATIONS.**

**4. ELECTRONIC ENGINEERING PRACTICES** 15

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio and Low Voltage Power supplies.

**TOTAL : 60 PERIODS**

**COURSE OUTCOMES**

- Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to do wiring for electrical connections and to fabricate electronics circuits.

**OBJECTIVES**

- To enable students acquire proficiency in technical communication.
- To enhance their reading and writing skills in a technical context.
- To teach various language learning strategies needed in a professional environment.

**CONTENTS****UNIT I ANALYTICAL READING****12**

**Listening-** Listening to informal and formal conversations; **Speaking** – Conversation Skills(opening, turn taking, closing )-explaining how something works-describing technical functions and applications;**Reading** –Analytical reading, Deductive and inductive reasoning;**Writing-** vision statement–structuring paragraphs.

**UNIT II SUMMARISING****12**

**Listening-** Listening to lectures/ talks on Science & Technology;**Speaking** –Summarizing/ Oral Reporting, **Reading** – Reading Scientific and Technical articles; **Writing-** Extended definition –Lab Reports – Summary writing.

**UNIT III DESCRIBING VISUAL MATERIAL****12**

**Listening-** Listening to a panel discussion; **Speaking** – Speaking at formal situations; **Reading** – Reading journal articles - Speed reading;**Writing-**data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts- writing critiques

**UNIT IV WRITING/ E-MAILING THE JOB APPLICATION****12**

**Listening-** Listening to/ Viewing model interviews; **Speaking** –Speaking at different types of interviews – Role play practice ( mock interview); **Reading** – Reading job advertisements and profile of the company concerned;**Writing-** job application – cover letter –Résumé preparation.

**UNIT V REPORT WRITING****12**

**Listening-** Viewing a model group discussion;**Speaking** –Participating in a discussion - Presentation;**Reading** – Case study - analyse -evaluate – arrive at a solution;**Writing-** Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

**TEACHING METHODS:**

Practice writing

Conduct model and mock interview and group discussion.

Use of audio – visual aids to facilitate understanding of various forms of technical communication.

Interactive sessions.

**EVALUATION PATTERN:**

Internals – 50%

End Semester – 50%

**TOTAL:60 PERIODS****LEARNING OUTCOMES**

- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

**TEXTBOOK:**

1. Craig,Thaine. **Cambridge Academic English: An integrated skills course for EAP(Student's Book)**Level: Intermediate Cambridge University Press, New Delhi: 2012

## REFERENCES:

1. Laws, Anne. **Presentations**. Hyderabad: Orient Blackswan, 2011.
2. Ibbotson, Mark. **Cambridge English for Engineering**. Cambridge University Press, Cambridge, New Delhi: 2008
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge University Press, 2004.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Bailey, Stephen. **Academic Writing A practical Guide for Students**. Routledge, London: 2004
6. Hewings, Martin. **Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012.

MA7251

MATHEMATICS – II

L T P C  
4 0 0 4

(Common to all branches of B.E. /B.Tech. Programmes in II Semester)

### COURSE OBJECTIVES

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student 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 MATRICES

12

Eigenvalues and Eigenvectors of a real matrix – Characteristic 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 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, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

### UNIT III ANALYTIC FUNCTION

12

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions

$w = z+c$ ,  $az$ ,  $\frac{1}{z}$ ,  $z^2$  - Bilinear transformation.

### UNIT IV COMPLEX INTEGRATION

12

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

### UNIT 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**

### **COURSE OUTCOMES**

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

- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

### **TEXT BOOKS**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9<sup>th</sup> Edition, New Delhi, 2014.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.

### **REFERENCE BOOKS**

1. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3<sup>rd</sup> Edition, 2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
5. Peter V. O'Neil , "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

**PH7257**

### **PHYSICS OF MATERIALS**

(Common to Chemical, Ceramic, Food, Leather, Textile, Apparel, Industrial Biotechnology, Pharmaceutical and PET)

**L T P C**  
**3 0 0 3**

### **OBJECTIVE:**

- To make the students to understand the basics of phase diagrams and various materials preparation techniques
- To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about superconductors
- To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
- To familiarize the students with the theory and applications of magnetic and dielectric materials
- To provide the students a sound platform towards learning about advanced materials and their applications.

### **UNIT I PREPARATION OF MATERIALS**

**9**

Phases - phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions - nucleation – homogeneous and heterogeneous nucleation – free energy of formation of a critical nucleus – Thin films – preparation: PVD, CVD method – Nanomaterials Preparation: wet chemical, solvothermal, sol-gel method.

### **UNIT II ELECTRICAL AND SUPERCONDUCTING MATERIALS**

**9**

Classical free electron theory - expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law - Quantum free electron theory – applications of Schrodinger wave-



equation: particle in a finite potential well – particle in a three-dimensional box- degenerate states – Fermi-Dirac statistics – density of energy states – electron in periodic potential – electron effective mass – concept of hole. Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High  $T_c$  superconductors – Magnetic levitation and SQUIDS.

**UNIT III SEMICONDUCTING MATERIALS 9**

Elemental Semiconductors - Compound semiconductors - Origin of band gap in solids (qualitative) - carrier concentration in metals - carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination of Hall coefficient – LED - Solar cells.

**UNIT IV DIELECTRIC AND MAGNETIC MATERIALS 9**

Dielectric, Paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Ferroelectric materials - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials.

**UNIT V NEW MATERIALS AND APPLICATIONS 9**

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Metallic glasses – Shape memory alloys – Copper, Nickel and Titanium based alloys – grapheme and its properties – Relaxor ferroelectrics - Bio materials – hydroxyapatite – PMMA – Silicone - Sensors: Chemical Sensors - Bio-sensors – Polymer semiconductors – Photoconducting polymers.

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

- acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
- familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
- gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
- realize with theories and applications of dielectric and ferromagnetic materials
- familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

**REFERENCES:**

1. Callister W. D. and Rethwisch, D. G., “Materials Science and Engineering”, 9th Edition, Wiley (2014).
2. Raghavan V., “Materials Science and Engineering”, Prentice Hall of India (2004).
3. Askeland D.R. and Wright, W.J., “Essentials of Materials Science and Engineering”, 3<sup>rd</sup> Edition, Cengage Learning (2014).
4. Pillai, S.O., “Solid State Physics”, New Age International, 7<sup>th</sup> Edition (2015).
5. Viswanathan, B., “Nanomaterials”, Narosa Book Distributors Pvt Ltd. (2011).

**GE7153**

**ENGINEERING MECHANICS**

**L T P C**  
**4 0 0 4**

**OBJECTIVE :**

*Attested*

*Sobhan*  
**DIRECTOR**

Centre For Academic Courses  
Anna University, Chennai-600 025.

The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

**UNIT I STATICS OF PARTICLES 12**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors.

Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

**UNIT II EQUILIBRIUM OF RIGID BODIES 12**

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

**UNIT III DISTRIBUTED FORCES 16**

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

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

**UNIT IV FRICTION 8**

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

**UNIT V DYNAMICS OF PARTICLES 12**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles.

Kinetics- Newton's Second Law of Motion - Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

**L – 45 + T – 15 TOTAL: 60 PERIODS**

**OUTCOMES:**

- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.\

**TEXT BOOK**

1. Beer, F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", McGraw-Hill Education (India) Pvt. Ltd. 10th Edition, 2013.

**REFERENCES**

1. Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
2. J.L. Meriam & L.G. Kraige, Engineering Mechanics: Statics (Volume I) and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
3. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
4. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.
5. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

**AIM**

To introduce students to the principles of Microbiology to emphasize the structure and biochemical aspects of various microbes.

**OBJECTIVE**

- To provide to the students the fundamentals of Microbiology , the scope of microbiology and solve the problems in microbial infection and their control,

**UNIT I INTRODUCTION TO MICROBIOLOGY 9**

History (scientists and discoveries) and scope of microbiology (Primary and secondary metabolites), 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, endospore staining.

**UNIT II MICROBES- STRUCTURE AND REPRODUCTION 9**

Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (cyanophyta, rhodophyta) and fungi (Neurospora), life history of actinomycetes (Streptomyces), yeast (Sacharomyces), mycoplasma (M. pneumoniae) and bacteriophages ( T4 phage,  $\lambda$  phage)

**UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 9**

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) the mathematics of growth-generation time, specific growth rate.

**UNIT IV CONTROL OF MICROORGANISMS 9**

Physical and chemical control of microorganisms Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Disinfection sanitization, antiseptics sterilants and fumigation. Determination of phenol coefficient of disinfectant. Host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms

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

Microbes involved in preservation (Lactobacillus,bacteriocins), spoilage of food and food borne pathogens (*E.coli*, *S.aureus*, *Bacillus*, *Clostridium*). Industrial use of microbes (production of penicillin, alcohol, vitamin B-12); biogas; bioremediation(oil spillage leaching of ores by microorganisms ,pollution control); biofertilizers, biopesticides. Biosensors.

**TOTAL: 45 PERIODS****TEXT BOOKS**

1. Pelczar, M.J. "Microbiology", 5th Edition, Tata McGraw-Hill, 1993.
2. Prescott. Harley, Klein. " Microbiology ": McGraw-Hill Higher Education, 2008
3. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. "General Microbiology." 5th edition, McMillan Press. 1986
4. Ananthanarayanan, R. and C.K. JayaramPaniker, "Textbook of Microbiology",4th Edition, Orient Longman, 1990.
5. Casida, L.E. "Industrial Microbiology", New Age International, 1968.
6. Schlegel, H.G. "General Microbiology", 7th Edition, Cambridge University Press,1993.

**AIM**

To enable students learn the fundamentals of Biochemical Processes and Biomolecules.

**OBJECTIVES**

- To ensure students have a strong foundation in the structure and reactions of Biomolecules.
- To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
- To correlate Biochemical processes with Biotechnology applications.

**UNIT I INTRODUCTION TO BIOMOLECULES****5**

Basic principles of organic chemistry, role of carbon, types of functional groups, biomolecules, chemical nature of water, pH and biological buffers.

**UNIT II STRUCTURE AND PROPERTIES OF IMPORTANT BIOMOLECULES****15**

Carbohydrates (mono, di, oligo & polysaccharides) mutarotation, glycosidic bond, reactions of monosaccharides and reducing sugars Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate.

Lipids: Fatty acids, glycerol, triacylglycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids. Inherited metabolic disorders of Lipid-metabolism-Tay-Saach's disease, Niemann-Pick's disease and Gaucher's disease. Cholesterol, steroids, Bile acids and salts, Gluco-and Mineralo-corticosteroids. Aldosterone, cortisone and synthetic derivative-prednisolone. Androgens-testosterone, Estrogens- estrone, estradiol and progesterone. Prostaglandins and their functions. LDL, HDL and VLDL. Cardiovascular disease and correlation with circulating lipid and lipoprotein concentration

Amino Acids, Peptides, and Proteins. Classification based on side-chain properties. Structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determination of primary structure.

Nucleic acids: Purines, pyrimidines, nucleosides, nucleotides, Chargaff's Rules. Base pairing, A-T and G-C, mRNA, rRNA and tRNA., Watson-Crick structure of DNA. reactions, properties, T<sub>m</sub> and hypochromicity, Measurement of DNA and RNA. Nucleoprotein complexes

**UNIT III METABOLISM CONCEPTS****5**

Functions of Proteins, Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Interconnection of pathways and metabolic regulation.

**UNIT IV INTERMEDIARY METABOLISM AND REGULATION****15**

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

**UNIT V CASE STUDIES****5**

Case study on overproduction of primary and secondary metabolites - glutamic acid, threonine, lysine, methionine, isoleucine, propionic acid and ethanol.

**TOTAL: 45 PERIODS****TEXT BOOKS**

1. Lehninger Principles of Biochemistry 6<sup>th</sup> Edition by David L. Nelson, Michael M. Cox
2. Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3<sup>rd</sup> Rev. Edition, Books & Allied (P) Ltd., 2006.
3. Rastogi, S.C. "Biochemistry" 2<sup>nd</sup> Edition, Tata McGraw-Hill, 2003.
4. Conn, E.E., et al., "Outlines of Biochemistry" 5<sup>th</sup> Edition, John Wiley & Sons, 1987.
5. **Outlines of biochemistry, 5th Edition:** By E E Conn, P K Stumpf, G Bruening and R Y Doi. pp 693. John Wiley and Sons, New York. 1987.

## REFERENCES

1. Berg, Jeremy M. et al. "Biochemistry", 6<sup>th</sup> Edition, W.H. Freeman & Co., 2006.
2. Voet, D. and Voet, J.G., "Biochemistry", 3<sup>rd</sup> Edition, John Wiley & Sons Inc., 2004.
3. Murray, R.K., et al "Harper's Illustrated Biochemistry", 27<sup>th</sup> Edition, McGraw-Hill, 2006.

**IB7262**

**MICROBIOLOGY LABORATORY**

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

## 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, spore /capsule 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 and Yeast
11. Effect of pH, Temperature, UV radiation on Growth Bacteria

**TOTAL : 60 PERIODS**

## Equipment Needed for 20 Students

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

## TEXT BOOKS

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

**IB7261**

**BIOCHEMISTRY LABORATORY**

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

## AIM

To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.) and laboratory analysis of the same in the body fluids.

## EXPERIMENTS

1. General guidelines for working in biochemistry lab (theory)

*Attested*

*Sobhan*  
DIRECTOR

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.

#### 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	

**TOTAL: 60 PERIODS**

#### TEXT BOOKS

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

#### REFERENCES

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

**MA7358**

### **TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS**

**L T P C**  
**4 0 0 4**

#### OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To 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.

#### OUTCOMES :

The students can able to solve the partial differential equations , find the Fourier series analysis and solve the problems by using Fourier transform and Z transform techniques.

#### UNIT I PARTIAL DIFFERENTIAL EQUATIONS

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 – Fourier series 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**

**TEXT BOOKS:**

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Erwin kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 9<sup>th</sup> Edition, , New Delhi, 2014.

**REFERENCES:**

1. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, New Delhi, 2007.
2. Ramana, B.V. “Higher Engineering Mathematics”, Tata McGraw Hill, New Delhi, 11<sup>th</sup> Reprint , 2010.
3. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
4. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, New Delhi, 2007.

**PM7302**

**HUMAN PHYSIOLOGY**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

To develop 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 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, gall bladder, 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 respiratory tract, mechanism and dynamics of respiration, lung volumes, transport of oxygen and carbondioxide, 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**

**TEXT BOOKS**

1. Waugh, Anne and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", X<sup>th</sup> Edition, Churchill – Livingstone / Elsevier, 2006.
2. Ganong, W.F., "Review of Medical Physiology", XXIV<sup>th</sup> 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", III<sup>rd</sup> Edition, Academic Press / Elsevier), 2003.

**REFERENCES**

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

**PM7303**

**PHARMACEUTICAL CHEMISTRY**

**LT P C  
3 0 0 3**

**OBJECTIVES:**

- To inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry
- To 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 STRUCTURE AND PROPERTIES 9**

Molecular orbital theory, hybrid orbitals, polarity of bonds and molecules, dipole moment, resonance, inductive, mesomeric and electromeric effects, intra molecular and inter molecular hydrogen bonding.



**UNIT II CHEMISTRY OF ALIPHATIC AND AROMATIC COMPOUNDS 10**

Characteristics of organic compounds, structure, nomenclature, preparation and reaction mechanism of alkyl and aryl halides (Mechanism of SN1, SN2, E1 and E2), Huckel rule, structures of benzenoid and non-benzenoid compounds, mechanism of aromatic electrophilic and nucleophilic substitution, general mechanism of an aromatic electrophilic substitution reaction. alcohols, ethers, epoxides, amines, aldehydes, ketones, carboxylic acids and functional derivatives of carboxylic acids.

**UNIT III PRINCIPLES OF TEST FOR PURITY IN PHARMACEUTICAL SUBSTANCES 9**

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 12**

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, Anti-microbials topical agents.

**UNIT V PHARMACEUTICAL AIDS AND CO-ORDINATION COMPOUNDS 10**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The student will be able to

- Identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
- Identify and estimate the purity of drugs and its application.
- Involve in the development and synthesis of new drug molecule.

**TEXT BOOKS:**

1. Atherden, L.M. "Bentley and Driver's Textbook of Pharmaceutical Chemistry". Oxford University Press, 8th Edition, 1977.
2. AB.S. Bahl and ArunBahl.A, Textbook of Organic Chemistry 21 Edition, S.Chand andcompany pvt.Ltd, New Delhi.

**REFERENCES:**

1. Indian Pharmacopoeia (I.P.) 2007
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<sup>th</sup> Ed., ELBS longman, 1994.
3. Morrison R.T., Boyd R.N., Organic Chemistry, Prentice- Hall of India, VI<sup>th</sup> ed., (1992)

**PM7305 STOICHIOMETRY AND CHEMICAL PROCESS CALCULATIONS L T P C  
3 0 0 3**

**OBJECTIVE:**

To introduce the basic calculation techniques, both computerized and by hand, for analyzing and designing chemical processing equipment with the help of Data sources containing relevant physical and chemical properties.

**UNIT I STOICHIOMETRY 9**

Introduction – Units and dimensions – Stoichiometric principles – Composition relations – Density and specific gravity.

**UNIT II IDEAL GASES AND VAPOR PRESSURE**

Behavior of ideal gases – Application of ideal gas law – Gaseous mixtures – Volume changes with change in composition – Vapor pressure – Effect of temperature on vapour pressure – Vapor pressure plots – Vapor pressure of immiscible liquids – Solutions.

**UNIT III HUMIDITY AND SOLUBILITY 9**

Humidity – Saturation – Vaporization – Condensation – Wet and dry bulb thermometry – Solubility and crystallization – Dissolution – Solubility of gases.

**UNIT IV MATERIAL BALANCE 9**

Material balance – Processes involving chemical reaction – Combustion of coal, fuel gases and sulphur – Recycling operations – Bypassing streams – Degree of conversion – Excess reactant – Limiting reactant.

**UNIT V ENERGY BALANCE 9**

Thermo chemistry – Calculation of heat of reaction at other temperatures – Hess's law of summation – Heat of formation, reaction, mixing, combustion – Mean specific heat – Theoretical flame temperature.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The student will be able to

- Carry out design calculations for processes involving separation operations.
- Carry out material and energy balance calculations for reaction and separation processes by hand or using a computer package as appropriate.
- Analyze the behavior of recycle processes, performing approximate material balances by hand, and setting up calculations for rigorous solution by computer.

**TEXT BOOKS:**

1. Richard M Felder and Ronald W. Rousseau, Elementary Principles of Chemical Processes, III<sup>rd</sup> Edition, John-Wiley & Sons Inc., 2005
2. Bhatt, B.I. and Vora, S.M., "Stoichiometry", IV<sup>th</sup> Edition, Tata McGraw Hill Publishers Ltd, 2005.
3. Hougen, O.A., Watson, K.M. and Ragatz, R.A., "Chemical Process Principles", Vol.-I, CBS Publishers and Distributors, 1995.

**REFERENCES:**

1. Venkataramani, V. and Anantharaman, N., "Process Calculations", Prentice Hall of India(P) Ltd, 2003.
2. Himmelblau, D., "Basic Principles and Calculations in Chemical Engineering", VI<sup>th</sup> Edition, Prentice Hall of India Ltd, 2000.
3. Chohey, N.P. and Hicks, T.G., "Handbook of Chemical Engineering Calculations", II<sup>nd</sup> Edition, McGraw-Hill Inc, 1984.

**PM7301 CHEMICAL ENGINEERING THERMODYNAMICS FOR PHARMA TECHNOLOGISTS**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

To provide the knowledge on fundamentals of thermodynamics and the operation design of various thermodynamics systems.

**UNIT I FUNDAMENTAL CONCEPTS AND FIRST LAW OF THERMODYNAMICS 9**

Scope of thermodynamics – Basic concepts – Thermodynamic system – State and equilibrium – Process and cycles – Temperature and zeroth law of thermodynamics – Properties of pure substances – First law of thermodynamics – First law analysis of closed systems and control volumes and its application.

**UNIT II ENTROPY AND THE SECOND LAW OF THERMODYNAMICS**

The Clausius inequality – Entropy – Causes of entropy change – Entropy change of

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Anna University, Chennai-600 025.

Pure substances – Thermal energy reservoirs – Heat engines – Perpetual motion machines – Reversible and irreversible processes – The Carnot cycle and principles – The Carnot Heat engine – The second law efficiency – Second law analysis of open and closed systems.

**UNIT III REFRIGERATION, VAPOR AND COMBINED POWER CYCLES 9**

Refrigerators and Heat pumps – The Carnot refrigerator and heat pumps – The reversed Carnot cycle – Ideal and Actual vapor compression Refrigeration cycle – Selection of right refrigerants – Heat pumps – Absorption refrigerator system – The Carnot vapor cycle – Rankine cycle – Cogeneration – Second law analysis of vapor power cycles.

**UNIT IV PVT RELATIONS AND THERMODYNAMIC RELATIONS 9**

PVT relations for gases and liquids – Equations of state – Cubic equations of state – Thermodynamic properties from equations of state – Compressibility factor – Generalized properties of fluids – Law of corresponding state – Acentric factor – gas mixtures. Thermodynamic relations – Maxwell's relations – Estimation of thermodynamic properties – Thermodynamic properties of homogeneous mixtures – Partial molar properties, Fugacity and fugacity coefficients – Lewis and Randall rule – Property changes of mixing, activity – Excess properties, activity coefficients.

**UNIT V PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA 9**

Phase equilibria – Pure component and mixtures – Van Laar, Margules equation – Group contribution method – Gibbs Duhem equation – Consistency tests – Partially miscible and immiscible systems – Azeotropes – Retrograde condensation – Thermodynamic diagrams. Chemical equilibria – Heat effects – industrial reactions – Free energy calculations – Homogeneous and heterogeneous reactions – Equilibrium composition.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The student will be able to

- Demonstrate the knowledge on various laws of thermodynamics and its concepts to assess the feasibility in thermodynamic process.
- Analyze and solve problems in thermodynamic systems and select appropriate thermodynamic processes and solutions to meet the specified needs.

**TEXT BOOKS:**

1. Smith, J.M. and Van Ness, "Introduction to Engineering Thermodynamics", V<sup>th</sup> Edition, McGraw Hill, 1996.
2. Narayanan, K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India, 2002.

**REFERENCES:**

1. Stanley I. Sandler, "Chemical, Biochemical and Engineering Thermodynamics", John-Wiley, IV<sup>th</sup> edition, 2006
2. Hougen and Watson, "Chemical Process Principles" Vol. II, CBS Publishers, 2002.
3. Kyle, "Chemical and Process Thermodynamics", II<sup>nd</sup> Edition, Prentice Hall of India, 2000.
4. Rao, Y.V.C., "Chemical Engineering Thermodynamics", Universities Press, 1997.

**PM7304**

**PHYSICAL PHARMACEUTICS**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To provide the fundamentals such as power characters and rheology.
- To provide the knowledge about the stability.

**UNIT I MICROMERITICS AND POWDER RHEOLOGY**

Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, 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, INTERFACIAL PHENOMENON, VISCOSITY AND RHEOLOGY 10**

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 interface. Newtonian system, Law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers.

## **UNIT III DISPERSION SYSTEMS 10**

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

## **UNIT IV DIFFUSION & DISSOLUTION 5**

Definitions, Steady state diffusion, Procedures and apparatus, Dissolution, Drug release. Complexation and protein binding Metal complexes, organic molecular complexes, inclusion compounds, methods of analysis, protein binding, complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

## **UNIT V KINETICS AND DRUG STABILITY 10**

General considerations and concepts, half-life determination, Influence of temperature, light, catalytic species, solvent and other factors, Accelerated stability study, expiration dating.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

The student will be able to

- Deal the manufacturing problems in pharmaceutical formulations.
- Acquire the knowledge of drug stability and expiry date determination

### **TEXT BOOKS:**

1. Sinko, Patrick J. "Martin's Physical Pharmacy and Pharmaceutical Sciences" V<sup>th</sup> edition, Wolters, Kluwer/ Lippincott Williams & Wilkins Publishing, 2006
2. Manavalan, R. and C. Ramasamy. "Physical Pharmaceutics" Vignesh Publishers, II<sup>nd</sup> Ed., 2011.

### **REFERENCES:**

1. Martin's Physical Pharmacy and Pharmaceutical Sciences, V<sup>th</sup> edition, Patrick J. Sinko (ED), Lippincott Williams & Wilkins 2006.
2. Laura Moore Fox, Remington: The Science and Practice of Pharmacy, XXI<sup>st</sup> Edition, Lippincott Williams and Wilkins, 2005
3. Monihan, Humphery and AbinaGean "The Physicochemical Basis of Pharmaceuticals" Oxford University Press, 2009.

**PM7312**

**PHYSIOLOGY LABORATORY**

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

### **OBJECTIVES**

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

### **LIST OF EXPERIMENTS**

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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. Pippette aids
3. Haemocytometer
4. B.P.meter

#### **TEXT BOOKS:**

1. Goyal R. K., Natvar M.P, and Shah S.A, Practical anatomy, Physiology and Biochemistry, latest edition, Publisher: B.S Shah Prakashan, Ahmedabad.
2. Tortora Gerard J. and Nicholas P. Principles of anatomy and physiology Publisher Harper Collins college New York.

#### **REFERENCES:**

1. Ranade V.G. Text book of practical physiology, Latest edition, Publisher: PVG, Pune
2. Best and Taylor's "Physiological basis of Medical Practice".
3. Guyton A.C. Hall J.E. Text book of Medical Physiology.
4. Chatterjee C.C.. Human Physiology.
5. Cyril A. Keek, Eric Neil and Norman Joels. Samson Wright's Applied Physiology.
6. Park J.E. and Park K. Textbook of Preventive and Social Medicine.

**PM7311**

**PHYSICAL PHARMACEUTICS LABORATORY**

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

#### **OBJECTIVES:**

- To practice the determination of fundamental properties of dosage forms.
- To study the kinetics and stability aspects of preparations.

#### **LIST OF EXPERIMENTS**

- 1) Determination of latent heat, vapor pressure, critical point.
- 2) Studies on polymorphs, their identification and properties.
- 3) Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
- 4) Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
- 5) Determination of surface/interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
- 6) Study of rheological properties of various types of systems using different viscometers.
- 7) Study of different types of colloids and their properties.
- 8) Preparation of various types of suspensions and determination of their sedimentation parameters.
- 9) Preparation and stability studies of emulsions.
- 10) Studies on different types of complexes and determination of their stability constants.
- 11) Determination of half-life, rate constant and order of reaction.

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Completely randomized design – Randomized block design – Latin square design -  $2^2$  - 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**

### TEXT BOOKS:

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4<sup>th</sup> Edition, 3<sup>rd</sup> Reprint, 2008.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8<sup>th</sup> Edition, 2011.

### REFERENCES:

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7<sup>th</sup> Edition, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8<sup>th</sup> Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 3<sup>rd</sup> Edition, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

**PM7404**

**PHARMACEUTICAL ANALYSIS**

**L T P C**  
**3 0 0 3**

### AIM

To provide the student with a basic understanding of the format of the pharmacopoeial monograph and the major physical and instrumental methods used in the monographs to specify standards, the scope, advantages and disadvantages together with a brief account of the regulatory framework such as The Drugs and Cosmetics Act 1940 and an introduction to the ICH Guidelines.

## UNIT I INTRODUCTION, PHYSICAL METHODS, GRAVIMETRY

9

Introduction to Pharmaceutical Analysis, Definition, Significance, Qualitative and quantitative analysis, Drugs and Cosmetics Act 1940, Pharmacopoeia, Typical monograph and ICH Guidelines. Physical methods: Melting point, Boiling point, refractive index, optical rotation, density, specific gravity, Gravimetry, Thermogravimetry - uses, limitations, advantages, and method of determination for each method

## UNIT II ACID-BASE TITRATIONS

9

Introduction, definitions of titration, analyte, acid base theory- Arrhenius, Bronsted-Lowry, Lewis acid, Acid-base strength, conditions for use of titrimetry, precision, accuracy, ion product of water, Henderson-Hasselbalch equation, uses, limitation, pH, buffer, effective range, acid-base indicators, theory of, effective range and choice of, titration curves for acid-base titration, mixed solvents, non-aqueous titration, pharmacopoeial applications .

## UNIT III OTHER TITRATIONS

9

Precipitation titration, Solubility Product, Argentimetric titrations, Mohr's method, Vollhard's method, examples in pharmacopoeia, complexometric titration, indicators for, redox titrations, oxidation, reduction - definitions, half reactions and half equations, common oxidising and reducing agents used in volumetric analysis, redox equivalent weights, reduction potential, significance of reduction potential, standard reduction potentials, titrations with potassium permanganate, iodimetry, iodometry, iodine displacement reactions, phenol estimation, iodine absorbing substance in penicillins

## UNIT IV ULTRAVIOLET SPECTROSCOPY

9

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 - Sources of radiation, wavelength selectors, sample cells, Detectors-Barrier layer cell, Photo tube, Photomultiplier tube, Photodiode. Applications.

## UNIT V CHROMATOGRAPHY

9

Thin Layer Chromatography TLC, Rf, definition, How to run a TLC, Adsorbents, solvents, elutropic series, uses, limit test for impurities using TLC- known impurity, unknown impurity, HPLC High Performance Liquid Chromatography, technique, advantages, basic HPLC, Columns, Detectors, Qualitative analysis and Quantitative Analysis, Packing materials, Normal and reversed phase, Solvents, HPLC terms, retention factor, symmetry factor, resolution, theoretical plate.

**TOTAL: 45 PERIODS**

### TEXT BOOKS

1. Atherden, L.M. "Bentley and Driver's Textbook of Pharmaceutical Chemistry". 8<sup>th</sup> Edition, Oxford University Press, 1977.
2. Siddiqui, Anees A. "Pharmaceutical Analysis". Vol. I & II, CBS, 2006.
3. Parimoo, P. "Pharmaceutical Analysis". CBS, 1998.

### REFERENCES

1. Gennaro, Alfonso R. "Remington : The Science and Practice of Pharmacy" Vol. I & II, XX<sup>th</sup> Edition, Lippincott Williams & Wilkins / B.I. Publication, 2000.
2. Connors, Kenneth A. "A Textbook of Pharmaceutical Analysis". III<sup>rd</sup> Edition, John-Wiley & Sons, 1982.
3. Ohannesian, Lena and Streeter, A.J. "Handbook of Pharmaceutical Analysis". Marcek Dekker, 2002.
4. Stahl, Egon "Thin – Layer Chromatography : A Laboratory Handbook". II<sup>nd</sup> Edition, Springer, 2005.
5. Ermer, Joachim "Method Validation in Pharmaceutical Analysis ; A Guide to Best Practice", Wiley – VCH, 2005.
6. Evans, Gary "A Handbook of Bio analysis and Drug Metabolism", CRC Press, 2004.

**GE7251**

**ENVIRONMENTAL SCIENCE AND ENGINEERING**

**L T P C  
3 0 0 3**

### OBJECTIVES:

**To the study of nature and the facts about environment.**

- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

## 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 – biogeographical 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 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 production 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:**

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

### **TEXT BOOKS:**

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

### **REFERENCES:**

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances

- and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
  3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
  4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.

**PM7403**

**MOLECULAR BIOLOGY AND GENETIC ENGINEERING**

**L T P C**

**4 0 0 4**

**UNIT I CHEMISTRY OF NUCLEIC ACIDS & DNA REPLICATION**

**12**

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff's rule, X-ray diffraction analysis of DNA, Forces stabilize DNA structure, Conformational variants of double helical DNA, Hoogsteen base pairing, Triple helix, Quadruple helix, Reversible denaturation and hyperchromic effect. Tertiary structure of DNA: DNA supercoiling. Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson & Stahl experiment, bi-directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes.

**UNIT II TRANSCRIPTION**

**12**

Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteomics of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification.

**UNIT III TRANSLATION**

**12**

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post translational modifications and its importance.

**UNIT IV BASICS OF RECOMBINANT DNA TECHNOLOGY**

**12**

Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA into host cells and selection methods. Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

**UNIT V SEQUENCING AND AMPLIFICATION OF DNA**

**12**

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Friefelder, David, "Molecular Biology", II<sup>nd</sup> Edition, Narosa Publishing House, 1999.
2. Lewin Benjamin, "Genes IX" Jones and Bartlett, 2008.
3. Weaver, R.F. "Molecular Biology", III<sup>rd</sup> Edition, McGraw Hill, 2005.
4. Primrose, S. Twyman, R. "Principles of Gene Manipulation and Genomics" VII<sup>th</sup> Edition, Blackwell Publishing, 2006.
5. Brown, T.A. "Gene Cloning & DNA Analysis: An Introduction", V<sup>th</sup> Edition, Blackwell Publishing, 2006.

**REFERENCES**

1. Waston, J.D. "Molecular Biology of the Gene", V<sup>th</sup> Edition, Pearson Education, 2004.
2. Walker, J.M. and R. Rapley "Molecular Biology and Biotechnology" IV<sup>th</sup> Edition, Panima, 2002.
3. Glick, B.R. and J.J. Pasternak "Molecular Biotechnology: Principles and Applications of Recombinant DNA", III<sup>rd</sup> Edition, ASM, 2003.

**PM7401**

**FLUID FLOW OPERATIONS**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To provide the basic fundamental knowable about the flow properties of different type of fluids and its momentum balance.
- To provide the knowledge about the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.

**UNIT I                    PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE                    9**

Introduction – Physical properties of fluids – Types of fluids – Fluid statics and its applications- Pressure – Density – Height relationships – Pressure measurement –Units and dimensions– Dimensional analysis – Dimensionless numbers.

**UNIT II                    MOMENTUM BALANCE AND ITS APPLICATIONS                    9**

Kinematics of fluid flow – Stream line – Stream tube – Velocity potential – Newtonian and non-newtonian fluids – Time dependent fluids – Reynolds number experiment and significance –Continuity Equation – Momentum balance – Potential flow – Bernoulli's equation – Correction for fluid friction – Correction for pump work.

**UNIT III                    FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS                    9**

Flow of incompressible fluids in pipes – Laminar and turbulent flow through closed conduits – Velocity profile and friction factor for smooth and rough pipes – Heat loss due to friction in pipes and Fittings – Introduction to compressible flow – Isentropic flow through convergent and divergent nozzles and sonic velocity.

**UNIT IV                    FLOW OF FLUIDS THROUGH SOLIDS                    9**

Form drag – Skin drag – Drag co-efficient – Flow around solids and packed beds – Friction factor for packed beds – Ergun's Equation – Motion of particles through fluids –Motion under gravitational and centrifugal fields – Terminal settling velocity – Fluidization – Mechanism – Types – General properties – Applications.

**UNIT V                    TRANSPORTATION AND METERING                    9**

Measurement of fluid flow – Orifice meter – Venturi meter – Pitot tube – Rotameter –Weirs and notches – Hot wire anemometers – Transportation of fluids – Positive displacement pumps – Rotary and Reciprocating pumps – Centrifugal pumps –Performance and characteristics – Air lift and diaphragm pumps.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The student will be able to

- Understand fundamental concepts in fluids, such as density, viscosity, pressure and temperature.
- Apply the mass, energy and momentum balance equations in fluid flow problems.
- Analyze and solve the problems involving laminar and turbulent frictional flow, fluid drag on particles, packed beds and pumps involving Newtonian and non-Newtonian fluid flow in chemical engineering equipments.

**TEXT BOOKS:**

1. McCabe, W.L., Smith, J.C. and Harriott, P., "Unit operations of Chemical Engineering", VII<sup>th</sup> Edition, McGraw-Hill, 2004.
2. Coulson, J.M., and Richardson, J.F., "Coulson and Richardson's Chemical Engineering", Vol. I, III<sup>rd</sup> Edition, Butterworth Heinemann Publishers, 2004.

**REFERENCES:**

1. Bansal, R.K., "Fluid Mechanics and Hydraulic machines", Laxmi Publications (P) Ltd., 1995.
2. Nevers, N.D., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1991.
3. De Nevers, L., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1994.

**PM7402 FUNDAMENTALS OF HEAT AND MASS TRANSFER IN PHARMACEUTICAL TECHNOLOGY**

**L T P C  
3 0 0 3**

**UNIT I CONDUCTION**

**9**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – Fourier Law of Conduction - General Differential equation of Heat Conduction — Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

**UNIT II CONVECTION**

**9**

Basic Concepts –Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow –Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

**UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**

**9**

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – Heat Exchanger Analysis – LMTD Method and NTU - Effectiveness – Overall Heat Transfer Coefficient – Fouling Factors.

**UNIT IV RADIATION**

**9**

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoffs Law –Black Body Radiation –Grey body radiation -Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation

**UNIT V MASS TRANSFER**

**9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

**TOTAL : 45 PERIODS**

**TEXT BOOKS**

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 1995
2. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 1998.

**REFERENCES**

1. Yadav R "Heat and Mass Transfer" Central Publishing House, 1995.
2. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 1994.
3. Nag P.K, "Heat Transfer", Tata McGraw-Hill, New Delhi, 2002
4. Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2000.
5. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 1998

**PM7411 ANALYTICAL METHODS AND INSTRUMENTATION LABORATORY**

**L T P C  
0 0 4 2**  
*Selvaraj*  
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1. **Standardization** of analytical weights and calibration of volumetric apparatus.
2. **Acid Base Titrations** – Preparation and standardization of acids and bases, some exercise related with determination of acids and bases separately in mixture form, some official assay procedure e.g. boric acid should also be covered.
3. **Oxidation reduction titrations** – Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate, etc., some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, titanous chloride, sodium 2,6,-di chlorophenol indophenol, ceric ammonium sulphate be designed.
4. **Precipitation Titrations** ;Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, titrations according to MohrsVolhards and Fajans methods.
5. **Gravimetric Analysis** :Preparation of Gooch crucible for filtration and use of sintered glass crucible, determination of water of hydration, some exercises related to gravimetric analysis should be covered.
6. **Non-aqueous Titrations** ;Preparation and standardization of perchloric acid and sodium/potassium/lithium methoxides solutions, Estimations of some pharmacopoeial products.
7. **Complexometric titrations** ;Preparations and standardization of EDTA solution, some exercises related to pharmacopoeial assays by complexometric titrations.
8. Separation & identification of amino acids by paper chromatography
9. Separation & identification of alkaloids by TLC
10. UV spectrometric determination of Ibuprofen

#### EQUIPMENTS REQUIRED:

1. Hot air oven
2. pH meter
3. UV-Visible spectrophotometers
4. Weighing balance
5. Water bath

**TOTAL: 60 PERIODS**

#### REFERENCES

1. Atherden, L.M. "Bentley and Driver's Textbook of Pharmaceutical Chemistry". VIII<sup>th</sup> Edition, Oxford University Press, 1977.
2. Siddiqui, Anees A. "Pharmaceutical Analysis". Vol. I & II, CBS, 2006.
3. Parimoo, P. "Pharmaceutical Analysis". CBS, 1998.
4. Higuchi, Tekeru and Brochmann, Einar "Pharmaceutical Analysis". CBS Publishers, 1997.
5. Gennaro, Alfonso R. "Remington: The Science and Practice of Pharmacy" Vol. I & II, XX<sup>th</sup> Edition, Lippincott Williams & Wilkins / B.I. Publication, 2000.
6. Connors, Kenneth A. "A Textbook of Pharmaceutical Analysis". III<sup>rd</sup> Edition, Johnwiley & Sons, 1982.
7. Ohannesian, Lena and Streeter, A.J. "Handbook of Pharmaceutical Analysis". MarcekDekker, 2002.
8. Stahl, Egon "Thin – Layer Chromatography: A Laboratory Handbook". II<sup>nd</sup> Edition, Springer, 2005

**PM7412 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB**

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

#### LIST OF EXPERIMENTS

1. Isolation of total and plasmid DNA from bacteria.
2. Isolation of total DNA from plant and animal cells/tissues.
3. Restriction enzyme digestion of DNA.
4. Agarose gel electrophoresis of nucleic acids.
5. Elution of DNA from Agarose gels.
6. Polymerase Chain Reaction [PCR].
7. Ligation of DNA into expression vector.
8. Competent cell preparation, Transformation & Screening of recombinants.
9. Induction of recombinant protein expression
10. SDS-PAGE.
11. Western blotting.

**REFERENCES**

1. Friefelder, David. "Molecular Biology". II<sup>nd</sup> Edition. Narosa 1987.
2. Ausubel, F.M. et al., "Short Protocols In Molecular Biology". IV<sup>th</sup> Edition, John Wiley, 1999.
3. Sambrook, Joseph et al., "Molecular Cloning : A laboratory Manual". III<sup>rd</sup> Edition. Cold Spring Harbor, 2001.
4. Sambrook, Joseph et al., "The Condensed Protocols : From Molecular Cloning A Laboratory Manual". Asian Books Pvt. Ltd., 2006.

IB7552

CHEMICAL REACTION ENGINEERING

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

- To provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- To provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

**UNIT I SCOPE 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 III IDEAL FLOW AND NON IDEAL FLOW 10**

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

**UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS 9**

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

**UNIT V FIXED 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:**

The student will be able to

- Write the rate equation for any type of reaction.
- Design reactors for heterogeneous reactions and optimize operating conditions.
- 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<sup>rd</sup> Edition. John Wiley. 1999.
2. Fogler H.S. Elements Of Chemical Reaction Engineering. Prentice Hall India. 2002

**REFERENCES:**

1. Missen R.W., Mims C.A., Saville B.A. Introduction to Chemical Reaction Engineering and Kinetics. John Wiley. 1999
2. Dawande, S.D., "Principles of Reaction Engineering", 1<sup>st</sup> Edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., "Coulson Richardson - Chemical Engineering", Vol.III, III<sup>rd</sup> Edition, Butterworth- Heinemann- Elsevier, 2006.

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**AIM**

To know the basics of medicinal chemistry, biochemical and molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties and synthesis of medicinal agents.

**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****15**

Classification, biochemical/molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical 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****15**

Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, design and synthesis of selected drugs belonging to the class of sulphonamides and sulphones, antibiotics like penicillins and cephalosporins, amino glycosides, 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, anti malarials

**UNIT IV MEDICINAL CHEMISTRY OF DRUGS ACTING ON CVS AND RENAL SYSTEMS****12**

structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, design and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers, cardiac glycosides, anti arrhythmic 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****12**

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

**TOTAL: 60 PERIODS****TEXT BOOKS**

1. Ashutoshkar's Medicinal Chemistry.
2. Patric Medicinal chemistry

**REFERENCES**

1. Burger's medicinal chemistry Vol I to IV.
2. W.A. Foye, Medicinal Chemistry
3. Wilson and Giswold, Medicinal Chemistry
4. Indian/British Pharmacopoeia

**OBJECTIVE:**

To provide the basic engineering fundamentals and design concepts of various unit operations such as filtration, centrifugation, crystallization, refrigeration, air-conditioning and evaporation.

**UNIT I MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION 12**

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, Industrial dermatitis, Accident records, etc.

**UNIT II FILTRATION AND CENTRIFUGATION 12**

Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary press, rotary filter, edge filter, etc. Factors affecting filtration, mathematical problems on filtration, optimum-cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimenters.

**UNIT III CRYSTALLIZATION 12**

Characters of crystals like purity, size, shape, geometry, habit, forms, size and factors affecting them. Solubility curves and calculation of yields. Material and heat balances around Swenson Walker crystalliser, Super saturation theory, its limitations, nucleation mechanism and crystal growth. Study of various types of crystallisers. Caking of crystals and its prevention and numerical problems on yields. Wet Granulation and Dry Granulation

**UNIT IV HUMIDITY CONTROL, REFRIGERATION AND AIR-CONDITIONING 12**

Basic concepts, definition, wet bulb and adiabatic saturation temperatures, psychometric chart and measurement of humidity, application of humidity measurement in pharmaceutical industry. Equipments for dehumidification operations, principle and applications of refrigeration and air conditioning.

**UNIT V EVAPORATION 12**

Basic concepts of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators and Mathematical problems on evaporation.

**TOTAL : 60 PERIODS**

**OUTCOMES:**

The student will be able to

- Understand the various categories of materials used in pharmaceutical industry.
- Understand the fundamental concepts of filtration, centrifugation, crystallization, refrigeration and air-conditioning, apply their applications in pharmaceutical industry.

**TEXT BOOKS:**

1. McCabe WL, Smith J.C and Harriott "Unit operations of Chemical Engineering" McGraw Hill International Book Co. London 2004.
2. Girish K.Jani, "Pharmaceutical Engineering I, Unit Operation I" B.S.ShahPrakashan,India, 2006.

**REFERENCES:**

1. Badger, W.L and Banchemo, J.T "Introduction to Chemical Engineering" Tata McGrawHill, 2002
2. Ballaney, "Refrigeration and Air conditioning" Tata McGraw Hill, 2000
3. Coulson, J.M. and Richardson, J.F."Chemical Engineering" III<sup>rd</sup> Edition, ButterworthHeineman Publication, 2001.

**PM7502**

**PHARMACOLOGY AND CHEMOTHERAPY**

**L T P C  
4 0 0 4**

**AIM**

To know in detail the classification, therapeutic use, mechanism of action, metabolism, adverse effects of medicinal agents pertaining to nervous system, cardiovascular system, urinary system and respiratory system



**UNIT I PHARMACOLOGICAL PRINCIPLES 9**

Sources of drugs, dosage forms and routes of drug administration, mechanism of action of drugs. Combined effect of drugs, factors modifying drug action, tolerance and dependence. Absorption, Distribution, Metabolism and Excretion of drugs. Principles of basic and clinical pharmacokinetics. Adverse drug reactions. Drug interactions, Bioassay of drugs and biological standardisation.

**UNIT II DRUGS OF AUTONOMIC NERVOUS SYSTEM AND CENTRAL NERVOUS SYSTEM 15**

Autonomic and somatic nerve transmission, parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, neuron blocking agents, ganglionic agonists and antagonists agents, neuromuscular blocking agents, local anaesthetic agents.

Nerve conduction/transmission in the C.N.S, general anaesthetics, sedatives, hypnotics, anti-anxiety agents and centrally acting muscle relaxants, Psychopharmacological agents – Anti-psychotics, antidepressants, neuroleptics, anti-manics and hallucinogens, thymoleptics, anti-epileptic drugs, Anti-parkinsonism drugs, analgesics, antipyretics, anti-inflammatory (NSAIDs) and anti-gout drugs, narcotic analgesics and antagonists, C.N.S. stimulants, drug addiction and drug abuse.

**UNIT III DRUGS OF CARDIOVASCULAR SYSTEM AND RENAL SYSTEM 12**

Cardiac glycosides, anti-hypertensive drugs, anti-anginal and vasodilator drugs including calcium channel blockers and beta adrenergic antagonists, Anti-arrhythmic drugs, anti hyper lipidemic drugs, Drugs used in the therapy of shock. Fluid and electrolyte balance, Diuretics and Anti-diuretics,

**UNIT IV DRUGS OF GASTROINTESTINAL TRACT AND RESPIRATORY SYSTEM 12**

Antacids, anti-secretory and anti-ulcer drugs, Laxatives and Anti-diarrhoeal drugs, Appetite stimulants and suppressants, Emetics and anti-emetics. Anti-asthmatic drugs including bronchodilators, leukotriene inhibitors, anti-tussives and expectorants, Respiratory stimulants. Histamine and anti histamine.

**UNIT V 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 immuno suppressive agents

**TOTAL : 60 PERIODS**

**TEXT BOOKS**

1. Lippincott's Illustrated Reviews: Pharmacology by Karen Whalen, Lippincott Williams and Wilkins; VI<sup>th</sup> International edition, 2014
2. Satoskar, Pharmacology and Therapeutics, Popular Prakashan Ltd, 2015
3. Tripathi, K.D. Medical Pharmacology, VII<sup>th</sup> edition, 2013
4. Mycek M.J., Gerlmet S.B and Perper M.M. Pharmacology, Lippincott's Illustrated
5. Reviews, Lippincott Company, Philadelphia.

**REFERENCES**

1. Rang, M.P, Dale M.M, Reter J.M-Pharmacology.
2. Goodman and Gilman's, The Pharmacological basis of therapeutics.
3. Ghosh M.N, Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
4. B. Lammer, Chronopharmacology
5. Katzung, B.G., Basic and Clinical Pharmacology, Prentice Hall International.

**PM7512 UNIT OPERATIONS IN PHARMA INDUSTRIES LAB**

**OBJECTIVE:**

To gain the practical knowledge on fluid flow operations and Heat Transfer

**LIST OF EXPERIMENTS**

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

*Attested*

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1. To 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 overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
11. To determine overall heat transfer coefficient of double pipe heat exchanger by counter flow.
12. To determine overall heat transfer coefficient of shell and tube heat exchanger.
13. To determine overall heat transfer coefficient of plate type heat exchanger by parallel flow.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

The student will demonstrate ability to

- Select and operate the suitable instruments for the measurement of flow rate and rate of heat exchange.
- Differentiate laminar and turbulent flows
- Calculate and analyse the performance of various pumps and heat exchangers.

**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

**TEXT BOOKS:**

1. McCabe, W.L., Smith, J.C. and Harriott, P., "Unit operations of Chemical Engineering", VII<sup>th</sup> Edition, McGraw-Hill, 2004.
2. Coulson, J.M., and Richardson, J.F., "Coulson and Richardson's Chemical Engineering", Vol. I, III<sup>rd</sup> Edition, Butterworth Heinemann Publishers, 2004.
3. McCabe, W.L., Smith, J.C. and Harriot. P., "Unit Operations of Chemical Engineering", VI<sup>th</sup> Edition, McGraw-Hill Book Co., 2001.

**REFERENCES:**

1. Bansal, R.K., "Fluid Mechanics and Hydraulic machines", Laxmi Publications (P) Ltd., 1995.
2. Nevers, N.D., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1991.
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", III<sup>rd</sup> Edition, McGraw Hill Book Company, 1983.
6. Geankoplis, C.J., "Transport Processes and Unit Operations", III<sup>rd</sup> Edition, Prentice Hall of India Pvt. Ltd, 2000.

**PM7511      MEDICINAL CHEMISTRY AND PHARMACOLOGY LABORATORY**

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

**OBJECTIVE**

To study the methods involved in the synthesis of prototype medicinal agents

*Attested*

**Part I Medicinal Synthetic Chemistry Experiments**

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1. Study on stereo-chemistry of some selected drugs with models and in-silico viewer
2. Synthesis of anti-inflammatory/analgesic and their its analysis (Eg. Paracetamol, aspirin).
3. Synthesis of antimicrobial drugs and its analysis (Eg. Hexamethylenetetramine)
4. Synthesis of anticonvulsant drugs involving minimal steps (Eg. phenytoin) and its analysis.
5. Synthesis of sulphonamide drugs (Eg. Suphacetamide) and its analysis
6. Synthesis of anthelmintic drugs and its analysis (Eg. Benzimidazoles)
7. Synthesis of antiseptic organic compounds (Eg. Iodoform) and its analysis

#### Equipments required:

1. Weighing balance
2. pH meter
3. Rotary evaporator
4. Refluxing and distillation units
5. Hot air oven
6. UV-Visible spectrophotometers

#### OUTCOME

Students will be able to experimentally evaluate the synthetic outlines require for drugs synthesis

#### TEXT BOOKS

1. A Text Book of Medicinal Chemistry Vol. I and II by Surendra N. Pandeya, S.G. Publisher, 6, Dildayal Nagar, Varanasi -10.
1. Pharmaceutical Chemistry drug Synthesis Vol. I and II by H. J. Roth and A. Kleemann.

#### REFERENCE BOOKS

1. Wilson and Gisvold's Text book of Organic, Medicinal and Pharmaceutical Chemistry,
2. Lippincott-Raven Publishers-New York, Philadelphia.
3. William.O.Foye, Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd., New Delhi.
4. Indian Pharmacopoeia

### Part II Pharmacology Experiments

#### OBJECTIVE

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

**OUTCOME** Students will be familiar with various animal handling techniques and to study the pharmacological effects in different *in-vitro*, *in-situ*, *in-vivo*, *in-silico* organ systems

1. Evaluation of pyrogens by *in vitro* LAL test (Limulus ameocyte lysate) test
2. Bioassay experiments - study of effects of various drugs on isolated frogs tissues (heart, muscle etc.,) e.g Ach, adrenaline, effect of adrenergic and cholinergic blockers, effect of ions (through audiovisual demonstration)
3. Introduction to humane handling of animals for research (Eg. Mice, Rats, Jirds/Gerbils, rabbits)
4. Study of physiological salt solutions and laboratory appliances used in experimental pharmacology.
5. Routes of drug administration in animal models (through audiovisual demonstration)
6. Experiments to study analgesic/anti-inflammatory effects of drugs
7. Experiments to study local/general anaesthetic effects of drugs
8. Experiments to study antiparasitic drugs (*in-vitro* /*in-vivo* methods using nematodes)
9. Experiments to study anticancer drugs by cytotoxic assay (MTT assay)

#### Equipments Required :

1. Animal House facility
2. UV-Visible spectrophotometers
3. Simulation softwares

#### REFERENCES

1. The Pharmacological basis of therapeutics – Goodman and Gilman's.
2. Pharmacotherapy – DiPiro.

TOTAL: 60 PERIODS

Attested

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3. Pharmacology – Katzung.
4. Fundamentals of experimental pharmacology by M.N.Ghosh.
5. Handbook of experimental pharmacology by S.K.Kulkarni.
6. Text book of In vitro practical pharmacology by IanKitchen.
7. Pharmacological experiments on intact preparations by Churchill Livingstone.
8. Hand book of clinical pharmacokinetics- Gibaldi and Prescott.
9. Principles of drug action by Goldstein, Amaow and Kalman.
10. Clinical pharmacology by Molmon and Morrelli.
11. Clinical trials and tribulations by Allen E. Cato.
12. Drug interactions by Ivan H. Stockley.
13. Text book of therapeutics- drug, disease and management by Herfindal and Gourley.

**GE7652**

**TOTAL QUALITY MANAGEMENT**

**L T P C**  
**3 0 0 3**

**AIM**

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

**OBJECTIVES**

- To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand 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--The Deming Philosophy, Quality council, Quality statements and Strategic planning-- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5s and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

**UNIT III TQM TOOLS & TECHNIQUES I**

**9**

The seven traditional tools of quality – New management tools – Six-sigma Process Capability– Bench marking – Reasons to bench mark, Bench marking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Bench Marking – FMEA – Intent of FMEA, FMEA 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:**

Ability to apply TQM concepts in a selected enterprise.

Ability to apply TQM principles in a selected enterprise.  
Ability to apply the various tools and techniques of TQM.  
Ability to apply QMS and EMS in any organization.

**TEXT BOOK:**

1. Dale H. Besterfield, Carol B. Michna, Glen H. Besterfield, Mary B. Sacre, Hemant Urdhwarshie and Rashmi Urdhwarshie, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCE BOOKS:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
3. Suganthi, L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Janakiraman, B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

**FT7651**

**CREATIVITY, INNOVATION AND NEW FOOD  
PRODUCT DEVELOPMENT**

**LT P C  
3 0 0 3**

**OBJECTIVES:**

To study the various issues related to Creativity, Innovation and New Product Development.

**UNIT I INTRODUCTION 9**

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques

**UNIT II PROJECT SELECTION AND EVALUATION 9**

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

**UNIT III NEW PRODUCT PLANNING 9**

Design of proto type - testing - quality standards - marketing research - introducing new products

**UNIT IV NEW PRODUCT DEVELOPMENT 9**

Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

**UNIT V MODEL PREPARATION & EVALUATION 9**

Creative design - Model Preparation - Testing - Cost evaluation - Patent application

**TOTAL: 45 PERIODS**

**OUTCOMES:**

To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

**TEXT BOOKS:**

1. Twiss, Brian. "Managing Technological Innovation", Pitman Publishing Ltd., 1992.
2. Watton, Harry B. "New Product Planning", Prentice Hall Inc., 1992.

**REFERENCES:**

1. Nystrom, Harry "Creativity and Innovation", John Wiley & Sons, 1979.
2. Khandwalla, N. – "Fourth Eye (Excellence through Creativity) - Wheeler Publishing", 1992.

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IB7551

BIOPROCESS ENGINEERING

LT P C  
3 0 0 3

**OBJECTIVES:**

- To provide the knowledge on fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization.
- To provide the concept of basic fermentation processes and its control systems during scale up operations.

**UNIT I INTRODUCTION TO ENZYMES 9**

Classification of enzymes. Mechanisms of enzyme action; Principles of catalysis – collision theory, transition state theory; role of entropy in catalysis. Enzyme Kinetics- Single substrate reactions; Estimation of Michaelis–Menten parameters, Multi substrate reactions -Enzyme Immobilization and kinetics.

**UNIT II STERILIZATION KINETICS 9**

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment- batch and continuous.

**UNIT III METABOLIC STOICHIOMETRY AND ENERGETICS 9**

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

**UNIT IV KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION UNSTRUCTURED KINETIC MODELS 9**

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms. Types of reactor- Air Lift Reactor, Bubble Column Reactor, Immobilized enzyme reactors- packed bed, fluidized bed, membrane reactors.

**UNIT V BIOREACTOR SCALE – UP 9**

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – Mass transfer Coefficient - methods for the determination of mass transfer coefficients; mass transfer correlations. Power requirements of Bioreactors. Scale-up considerations on heat transfer oxygen transfer, power consumption and impeller tip speed.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The student will be able to

- Understand the fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization
- Understand the concept of basic fermentation processes and its application during scale up operations.

**TEXT BOOKS:**

1. Shuler, M.L. and Kargi, F. "Bioprocess Engineering: Basic Concepts", II<sup>nd</sup> Edition, PHI, 2002.
2. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals" II<sup>nd</sup> Edition, McGraw – Hill, 1988.

**REFERENCES:**

1. Wiseman, Alan "Handbook of Enzyme Biotechnology", III<sup>rd</sup> Edition, Ellis Harwood Publications, 1999.
2. Moser, Anton. "Bioprocess Technology: Kinetics and Reactors", Springer –Verlag, 1988.



4. Allen, Loyd V. et al. "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems" IX<sup>th</sup> Ed., WoltersKluwer/LippinCott Williams & Wilkins, 2011.
5. H. A. Liberman, L. Lachman, and J. B. Schwartz: Pharmaceutical dosage forms: Tablets, Vol. 1,2 and 3, II<sup>nd</sup> Edition Marcel Dekker, 1989.

#### REFERENCES :

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

**HS7551**

**EMPLOYABILITY SKILLS**

**L T P C  
3 0 0 3**

#### COURSE DESCRIPTION

This course aims to help the students acquire the employability skills necessary for the workplace situations. It also attempts to meet the expectations of the employers by giving special attention to language skills, presentation skills, group discussion skills and soft skills. This will be achieved through expert guidance and teaching activities focusing on employability skills.

#### COURSE OBJECTIVES

- To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills
- To help them improve their reading skills, writing skills, and soft skills necessary for the workplace situations
- To make them employable graduates

#### CONTENTS

##### **UNIT I READING AND WRITING SKILLS 9**

Reading: skimming & scanning strategies – note making skills – interpreting visual material (charts & tables) – critical reading – fast reading necessary for reading letters & files - preparing job applications - writing covering letter and résumé - applying for jobs online - email etiquette – writing official letters (placing an order, letters to consumers, etc. ) writing reports – collecting, analyzing and interpreting data

##### **UNIT II SOFT SKILLS 9**

Hard skills & soft skills – soft skills: self-management skills & people skills - training in soft skills - persuasive skills – sociability skills –interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability - stress management – motivation techniques – life skills -

##### **UNIT III PRESENTATION SKILLS 9**

Preparing slides with animation related to the topic – organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentation

##### **UNIT IV GROUP DISCUSSION SKILLS 9**

Participating in group discussions – understanding group dynamics - brainstorming the topic – questioning and clarifying –GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD - mock GD

##### **UNIT V INTERVIEW SKILLS 9**

Interview etiquette – dress code – body language – mock interview –attending job interviews – answering questions confidently – technical interview – telephone/Skype interview - practice in different types of questions – one to one interview & panel interview – FAQs related to job interview- Emotional and cultural intelligence.

**TOTAL: 45 PERIODS**

**DIRECTOR**

Centre For Academic Courses  
Anna University, Chennai-600 025.



## LEARNING OUTCOMES

- Students will be able to make presentations and participate in group discussions with high level of self-confidence.
- Students will be able to perform well in the interviews
- They will have adequate reading and writing skills needed for workplace situations

## REFERENCES:

1. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
2. Dabreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
3. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
4. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
5. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

## EXTENSIVE READING

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 2013.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

## WEB RESOURCES

1. [www.humanresources.about.com](http://www.humanresources.about.com)
2. [www.careerride.com](http://www.careerride.com)
3. <https://bemycareercoach.com/softskills>

PM7611

BIOPROCESS ENGINEERING LABORATORY

L T P C  
0 0 4 2

## OBJECTIVES:

- To provide the concept of design and procedures to evaluate the performance of the bioreactor in bioprocess.
- To provide the basic concepts of an enzyme immobilized processes in bioprocess.

## LIST OF EXPERIMENTS

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – Michelis Menton parameter, effect of temperature and pH
4. Enzyme immobilization – Gel entrapment, Cross linking
5. Preparation of bioreactor, Utilities for bioreactor operation
6. Thermal death kinetics
7. Batch sterilization design
8. Batch cultivation, Estimation of KLa – Dynamic gassing method, Exhaust gas analysis – Carbon balancing, Gas balancing
9. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
10. Estimation of KLa – sulphite oxidation method
11. Estimation of overall heat transfer coefficient

TOTAL: 60 PERIODS

## OUTCOMES:

- The student will be able to apply the knowledge of biocatalysis in scaling up the commercial processes using bioreactors.
- The student will also be able to produce, analyze and interpret data from bioprocesses.

## LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Bio reactor (Fermentor)-lab scale
2. Microbial shaker incubator

3. Cooling centrifuge
4. Refrigerator
5. Incubator

#### REFERENCES:

1. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals" II<sup>nd</sup> Edition, McGraw – Hill, 1988.
2. Lee, James M. "Biochemical Engineering", PHI, U.S.A. Stanbury, P.F. et al.
3. "Principles of Fermentation Technology", II<sup>nd</sup> Edition, Butterworth – Heinemann /Elsevier, 1995.
4. El-Mansi, E.M.T. et al., "Fermentation Microbiology and Biotechnology", II<sup>nd</sup> Edition, CRC / Taylor & Francis, 2007.
5. Peppler, H.J. and D. Perlman " Microbial Technology" (vol. I Microbial Processes and Vol. I Fermentation Technology)" II<sup>nd</sup> Edition, Academic Press / Elsevier, 2004.

#### PM7612 TECHNOLOGY OF DOSAGE FORMS LABORATORY

L T P C  
0 0 4 2

#### LIST OF EXPERIMENTS

1. Pre formulation studies on prepared granules
2. Preparation and evaluation of suspensions
3. Preparation and evaluation of emulsions
4. Preparation and evaluation of creams
5. Preparation and evaluation of ointments
6. Preparation and evaluation of injections
7. Manufacture and evaluation of granules
  - ordinary compressed tablet- wet granulation
  - tablets prepared by direct compression
  - soluble tablet
  - chewable tablet
8. Formulation and filling of hard gelatin tablets
9. Manufacture of parenterals
  - Ascorbic acid injection
  - Calcium gluconate injection
  - Sodium chloride injection
  - Dextrose and sodium chloride injection/infusion
10. Preparation of microcapsules
  - Non-solvent method
  - Salt-addition method

TOTAL: 60 PERIODS

#### LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Water bath
2. Mortar and pestle
3. Blender
4. Mixer
5. Magnetic stirrer
6. Pharmaceutical sieves
7. Capsule filling machine manual
8. Tablet punching machine manual
9. Cooling centrifuge
10. Refrigerator
11. Air dryer
12. Incubator

#### REFERENCES

1. Pharmaceutical dosage forms: Tablets volume – 3 by Liberman and Lachman
2. Pharmaceutical dosage forms: Parenteral medications Vol-1, 2 by Liberman and Lachman.
3. Pharmaceutical dosage forms: Disperse systems Vol-1, by Liberman and Lachman.
4. Remington's Pharmaceutical Sciences (RPS).
5. Modern Pharmaceutics by Banker and Gilberts.

6. Theory and Practice of Industrial Pharmacy by Lachman.
7. Hard Capsules by Ridgway. K. Pharmaceutical Press, London.
8. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi.
9. Novel Drug Delivery System by Y.W. Chein.
10. Biopharmaceutics and Pharmacokinetics – An introduction by Robert. E. Notari.

**PM7702 REGULATORY ISSUES IN PHARMACEUTICAL INDUSTRY AND DRUG VALIDATION**

**L T P C  
3 0 0 3**

**OBJECTIVES**

- To develop the knowledge on various legal regulations and governing bodies involved in the trade and practice of pharmaceutical and biopharmaceutical industries
- To enrich beginners in the principles involved in the practice of GMP, biosafety and ethical guidelines

**UNIT I REGULATORY ASPECTS 10**

Drugs & Cosmetics Act - Schedules particularly M, NPPA, Aspects of GMP, Magic Remedies Act, Prevention of Food Adulteration Act Pharmacopoeias, Drug control, FDA, ICH

**UNIT II GOOD MANUFACTURING PRACTICE FOR PHARMACEUTICALS 5**

Introduction, WHO guidelines, practice of GMP- Procedure (SOP'S), Building, Equipment, Personnel, Components, Documentation, Containers, Labeling, Laboratory Control, Distribution Records, Recovery & Reprocessing

**UNIT III INTELLECTUAL PROPERTY RIGHTS AND ETHICAL ISSUES IN PATENTING LIFE FORMS 9**

What are patents, know-how, copyright, trademark, service mark, design, Conditions for patentability; Indian Patent Act; Opposition and Infringements of patents; Case study on patenting indigenous products (e.g. Neem, turmeric), DNA, Microbes, Transgenic Plants and Animals Industrial property, TRIPS, WTO, treaties, Budapest Convention. Application process for a patent and the post application process.

**UNIT IV ETHICAL ISSUES IN HEALTH AND DISEASE, TRANSGENIC TECHNOLOGY 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 Xeno transplantation; Eugenics and Euthanasia.

**UNIT V BIOSAFETY, BIODIVERSITY AND ETHICS OF GMO, TRANSGENICS 9**

Genetically modified foods; genetically modified organisms; effect on biodiversity; guidelines for testing, transplantation and release-Cartagena Protocol on Biosafety Considerations; Transgenic animals for food and drugs; Terminator technology, GURTS and farmer's rights; Environmental Issues; DBT, NIH and Paul Berg guidelines on the use and release of transgenics. 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

**OUTCOMES:**

- The student will be able to understand the legal requirements of product development and manufacturing.
- The student will also be able to understand the ethical responsibility involved in industrialization of pharmaceutical products

**TOTAL: 45 PERIODS**

## TEXT BOOKS

1. Malik, Vijay "Drugs and Cosmetics Act – 1940", 11th Edition, Eastern Book Co., 1998. "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. Abraham, John and Smith, Helen Lawton, "Regulation of the Pharmaceutical Industry", Palgrave / Macmillan, 2003.
2. Weinberg, Sandy "Good Laboratory Practice Regulations", III<sup>rd</sup> Rev. Edition, Marcel Dekker Inc., 2003.
3. Gad. Shayne C. "Drug Safety Evaluation", Wiley-Interscience, 2002.
4. Thomas, J.A. and Fuchs, R.L. "Biotechnology and Safety Assessment", III<sup>rd</sup> Edition, Academic Press, 2002.

## PM7703 TECHNOLOGY OF SEMI SOLID DOSAGE FORMS AND DISPERSIONS L T P C 3 0 0 3

### OBJECTIVES:

- To provide the knowledge on the principles of semi solid dosage form formulation and development
- To inculcate the concepts involved in trouble shooting and improvement of semi-solid dosage forms

### UNIT I INTRODUCTION TO MONPHASIC SYSTEMS 8

Preformulation, formulation, evaluation, large scale manufacture and packaging along with focus on equipments for liquid dosage forms; monophasic solution for oral applications – syrups, elixirs, Liquids for cutaneous application – Lotions, liniments, paints and collodions. Layout design and Unit operations related to above dosage forms

### UNIT II INTRODUCTION TO BIPHASIC SYSTEMS 9

Definitions – colloids, phases, interfaces, emulsions – Properties and Production, micro emulsions, vesicles, and liposomes, foams, Biphasic suspensions and emulsions Topicals formulations: ointments, creams, gels suppositories, study of physical/physicochemical properties, study of chemical properties of emulsion and suspensions and their influence on formulation

### UNIT III PRODUCTION AND CHARACTERIZATION EMULSIONS AND SUSPENSIONS 8

Manufacture and properties of colloidal suspensions and dispersions, rheology, HLB calculation, solubility parameters,  $\log p$ , LSER, M numbers, Blenders, manufacturing equipments for suspensions and emulsions, cosmetics emulsions and formulations, packaging and stability studies

### UNIT IV ADDITIVES AND FORMULATION 12

Types of additives used, vehicles, stabilizers, preservatives, emulsifying agents, solubilizers, pigments, colors and dyes, flavours, manufacturing, packaging and evaluation of solutions, suspensions and emulsions; Definitions, types, mechanisms of drug penetration through skin, factors influencing penetration, semisolid bases and their selection. General formulation/manufacture of semisolids, clear gels, evaluation and packaging

### UNIT V PHARMACEUTICAL AEROSOLS 8

Definition, propellants, general formulation, manufacturing, packaging methods, pharmaceutical applications and evaluation

**TOTAL: 45 PERIODS**

### OUTCOMES:

The student will be able to

- Understand the principle of manufacturing liquid, semi-solid formulations
- Understand and appreciate the various strategies of manufacture of emulsions and suspensions based dosage forms

## TEXT BOOKS

1. Formulation Technology: Emulsions, Suspensions, Solid Forms, Hans Mollet, Arnold Grubenmann, WILEY-VCH Verlag GmbH, 2001
2. Lachman, Leon et al. "The Theory and Practice of Industrial Pharmacy" III<sup>rd</sup> Ed., Varghese Publishing House, 1987.
3. Aulton, Michael E. "Pharmaceutics: The Science of Dosage Form Design" II<sup>nd</sup> Ed., Churchill Livingstone, 2002.
4. Allen, Loyd V. et al. "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems"

## REFERENCES

1. Remington's Pharmaceutical Sciences (RPS).
2. Modern Pharmaceutics by Banker and Gilberts.
3. Theory and Practice of Industrial Pharmacy by Lachman

PM7701

**BIOPHARMACEUTICS AND PHARMACOKINETICS**

**L T P C**

**3 0 0 3**

## OBJECTIVES:

- To provide the knowledge on the principles of physicochemical properties of drugs, dosage forms and routes of administration
- To inculcate the concepts involved in the relationship between the drug, its dosage form and the route by which it is administered governs bioavailability

### UNIT I INTRODUCTION TO BIOPHARMACEUTICS

7

Definition and Role in Product Development, Explanation of the Terms: Bioavailability, and Bioequivalence, Equivalence Types: Chemical, Clinical, Therapeutic, Generic, and Pharmaceutical Alternatives. Bio-equivalency testing studies

### UNIT II PRINCIPLES OF DRUGS DISSOLUTION

11

Dissolution of solids: Mechanisms and Models of Dissolution, Factors influencing Dissolution Rate (in vitro Release), Quantitative Study of Dissolution- Methods, In-vitro Dissolution & Interpretation of Dissolution Data; Dissolution of Tablets & Capsules. Disintegration & Factors affecting DT; In vitro- In vivo correlations.

### UNIT III PRINCIPLES OF DRUG ABSORPTION AND BIO-AVAILABILITY

11

Physico- Chemical Factors: Lipid Solubility, Dissociation & pH, Complexation & Surface -active agents. Pharmaceutical Factors: Dosage Form Types and Formulation Variables Biological Factors: Passage of Drugs through Natural Membranes, Gastric Emptying & Intestinal Transition. Blood Flow, G.I. -Metabolism & Degradation, Interactions with Food & Co-administered Drugs, Disease State and Route of Administration.

### UNIT IV PHARMACOKINETICS

11

Principles of Pharmacokinetics, Concepts of Compartmental Model, Characteristics of One Compartment Model and One Compartment Model - based Pharmacokinetic Derivations (involving the concepts of (a.) Experimentally Determined Rates, (b) Methods of Residuals and (c.) Trapezoidal Rule for the following modes of Drug Administration: Intra-Venous Administration (Plasma Level & Urinary Excretion Data)-Single Dose, Absorption Based Administration (Single Dose) - Absorption Rate Constant ( $k_a$ ), Elimination Rate Constant ( $K$ ) & Elimination Half life ( $t_{1/2}$ ), AUC,  $C_{max}$ , and  $t_{max}$ . Apparent Volume of Distribution ( $V_d$ ) & Renal Clearance ( $Q$ ).

### UNIT V MULTIPLE DOSAGE REGIMENS

5

Concept, Accumulation, Persistent and elimination factors. Calculation of dosage regimen following repetitive IV and oral administration

**TOTAL: 45 PERIODS**

## OUTCOMES:

The student will be able to

- Understand the principle of pharmacokinetics and bio availability
- Understand and learn the strategies to improve the same during dosage form development

## TEXT BOOKS

1. Brahmankar, D.H. and Sunil B.Jaiswal "Biopharmaceutics and Pharmacokinetics: A Treatise" VallabhPrakashan, 1995.
2. Kulkarni, J.S. et al. "Biopharmaceutics and Pharmacokinetics", CBS Publishers, 2006.
3. Chatwal, G.R. "Biopharmaceutics and Pharmacokinetics" Himalaya Publishing House, 2003.
4. Jambhekar, Sunil S. and Philip J.Breen "Basic Pharmacokinetics" Pharmaceutical Press, 2009.

## REFERENCES

1. Gibaldi: "Biopharmaceutics & Clinical Pharmacokinetics," 3rd ed., Lea Febiger, 1984.
2. Swarbrick, Ed.,: "Current Concepts in Pharmaceutical Sciences ( Bio-pharmaceutics)," Lea &Febiger, 1970.
3. Rowland &Tozer: "Clinical Pharmacokinetics (Concepts & Applications)," 3rd ed., Lea & Febiger – Waverly, 1995.
4. Notari: "Biopharmaceutics & Clinical Pharmacokinetics (an introduction)," 4th ed. (Revised & Expanded), Marcel Dekker, 1987.
5. Shargel& Yu: "Applied Biopharmaceutics & Pharmacokinetics," 4th ed., Appleton & Lange, 1999.
6. Gibaldi&Perrier : "Pharmacokinetics," 2nd ed. (Revised & Expanded), Marcel Dekker (series in Text-Books & Monographs: Swarbrick, Ed., vol.15), 1982.
7. Welling &Tse, Eds: "Pharmacokinetics," 2nd ed., Marcel Dekker, 1995.

**PM7704**

## **TECHNOLOGY OF STERILE PRODUCT**

**L T P C**  
**3 0 0 3**

### **OBJECTIVES:**

- To provide the knowledge on the principles of parenteral dosage form formulation
- To present the concepts involved in the manufacture of sterile products

### **UNIT I INTRODUCTION TO PARENTERAL PRODUCTS**

**12**

Pre formulation factors, routes of administration, water for injection, pyrogenicity, non-aqueous vehicles, isotonicity and methods of its adjustment. Formulation details, containers and closures and their selection; Prefilling treatment, washing the container and closers, preparation of solution and suspension, filling, closing of ampoules, vials infusion fluids, lyophilization, preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products.

### **UNIT II ASEPTIC TECHNIQUES IN PARENTERALS**

**9**

Aseptic techniques: Source of contamination, methods of prevention, design of aseptic area, laminar flow bench, air handling units, services and maintenance; Stability evolution of sterile pharmaceutical dosage forms; special precautions on blood products, glandular products, medical sutures, ligatures

### **UNIT III EAR NASAL AND OPHTHALMIC DRUG DELIVERY**

**12**

Nasal and ocular drug delivery overview, membrane transport processes in the eye, nasal and ocular drug transfer following systemic drug administration, ocular pharmacokinetics and pharmacodynamics ocular penetration enhancers, corneal collagen shields for ocular drug delivery, the noncorneal route in ocular drug delivery, ocular iontophoresis, mucoadhesive polymers in ophthalmic drug delivery, dendrimers, new experimental therapeutic approaches for degenerative diseases of the retina, gene, oligonucleotide, and ribozyme therapy in the eye

### **UNIT IV FORMULATION ADDITIVES**

**5**

Buffers, density modifiers, isotonicity modifiers, viscosity enhancers, preservatives irrigations additives

### **UNIT V PARENTERAL REGULATIONS AND VALIDATIONS**

**7**

cGMP regulations of parenteral drugs, Risk assessment and mitigation in aseptic processing, Development challenges and validation of fill and finish processes for bio-therapeutics, Excipients for parenteral dosage forms: regulatory considerations and controls, Parenteral product specifications and stability, The management of extractables and leachables in pharmaceutical products, Process analytical technology and rapid microbiological methods, Quality assurance

**OUTCOMES:**

The student will be able to

- Understand the principle of manufacturing parenteral products
- Understand and appreciate the various strategies of manufacture and regulations of sterile products

**TEXT BOOKS**

1. Pharmaceutical Dosage Forms Parenteral Medications, Third Edition Volume 3, Sandeep Nema, John D. Ludwig, Informa Healthcare is a trading division of Informa UK Ltd
2. Lachman, Leon et al. "The Theory and Practice of Industrial Pharmacy" III<sup>rd</sup> Ed., Varghese Publishing House, 1987.
3. Aulton, Michael E. "Pharmaceutics: The Science of Dosage Form Design" II<sup>nd</sup> Ed., Churchill Livingstone, 2002.
4. Ophthalmic Drug Delivery Systems Second Edition, Revised and Expanded, Ashim K. Mitra, 2003 Marcel Dekker
5. Allen, Loyd V. et al. "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems"

**REFERENCES**

1. Remington's Pharmaceutical Sciences (RPS).
2. Modern Pharmaceutics by Banker and Gilberts.
3. Theory and Practice of Industrial Pharmacy by Lachman

**PM7711**

**DRUG DELIVERY SYSTEMS LABORATORY**

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

**OBJECTIVE**

Understand and analyse the factors influencing the formulation of novel drug delivery Systems, choose 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

**OUTCOME**

On successful completion students able to

- Comprehend various classes of excipients involved in formulation of novel drug delivery systems.
- Formulate and evaluate appropriate novel drug delivery formulations in a practical setting in response to defined criteria.
- Perform various quality control tests for the marketed products.

**REFERENCES**

*Attested*

*Sobhan*  
**DIRECTOR**

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

**PM7713**

**MEDICINAL NATURAL PRODUCTS LABORATORY**

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

### OBJECTIVE

The lab course is to teach the main concepts, definitions, terminology in Medicinal Natural Products and to study features of various medicinally important plants and natural products.

Standardization of plant drugs using following methods

(a) Morphology, microscopic quantitative microscopy, details microscopic study of drugs

Macroscopic Identification-1: Adhatoda, Datura, Cinnamon, Clove, Coriander

Macroscopic Identification-2 Arjuna, Liquorice, Ashwagandha, Turmeric, Cardamom

Microscopic Identification-1: Adhatoda, Datura, Tulsi or suitable specimens

Microscopic Identification-2: Arjuna, Liquorice, Ashwagandha or suitable specimens

(b) Physical constants like: specific gravity, swelling factor, ash values, extractive values, refractive index, optical rotation, etc for the above drugs. Analysis of natural fibres used for pharmaceutical applications: Cotton, Silk, Wool, Jute

(c) Phytochemical methods identification tests for various classes of phytoconstituents, Extraction and isolation of active principles such as alkalis, glycosides, tannins, carbohydrates resin, essential oils, fats etc. from natural drugs (4-5 drugs) and evaluation of isolated material by chromatography and spectroscopy.

### Equipments Required

Microscope, Soxlet apparatus, water bath, camera lucida, photochemical reagents, chromatographic plates and matrices

**TOTAL: 60 PERIODS**

### OUTCOME

The students will be familiar with pharmaceutically relevant natural product terminologies, medicinal and photochemical importance of various plants and natural products.

### REFERENCES

1. Kokate, C.K. "Practical Pharmacognosy", 4th Edition, Vallabh Prakashan, 1994.
2. Sharma, Varun Dutt "Pharmacognosy : Practical Note book", CBS Publishers, 2007

**PM7012**

**PHARMACOGNOSY**

**L T P C**  
**3 0 0 3**

### OBJECTIVE

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

Definition, history, scope and development of pharmacognosy. Sources and Classification of drugs : Biological, marine, geographical and plant tissue cultures as sources of drugs. Alphabetical, morphological, taxonomical, pharmacological and chemical Classification. Cultivation, collection, processing and storage of crude drugs. Factors influencing cultivation of medicinal plants, types of



soil and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants.

**UNIT II** **9**

Quality control of crude drugs : Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.

**UNIT III** **9**

An Introduction to chemical constituents of drugs : their isolation, classification and properties & systematic pharmacognostic study of following:

a) Carbohydrates and derived products : Agar, Gum Acacia, Gum tragacanth, Honey, Isapgol, pectin, Starch.

b) Lipids: Bees wax, Castor oil, Coca butter, Cod-liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Rice bran oil, shark liver oil and wool fat.

c) Resins and resin combinations: Colophony, Podophyllum, Jalap, Cannabis, Capsicum, Myrrh, Asafoetida, Balsam of Peru, Balsam of Tolu, Benzoin, Turmeric.

d) Tannins and tannins containing drugs: Gambir, black catechu, gall and myrobalan.

e) Volatile oils: General methods of obtaining volatile oils from plants. Study of volatile oils of Mentha, Coriander, Cinnamon, Cassia, Caraway, Dill, Clove, Fennel, Nutmeg,

Cardamom, Lemon grass oil, Eucalyptus, Sandalwood, palmarosa and citronella.

**UNIT IV** **9**

Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing glycosides. Saponins: glycyrrhiza, ginseng, dioscorea, sarsaparilla and senega. Cardioactive sterols : digitalis, squill, strophanthus and thevitia. Anthraquinone cathartics: Aloe, Senna, rhubarb and cascara. Psoralea, Ammi, gentian, chirata, quassia.

**UNIT V** **9**

Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups containing Alkaloids : Quinine, reserpine, morphine, papaverine, ephedrine, ergot, Belladonna, vinca alkaloids, atropine, Cinchona, Ipecac, Rauwolfia, Nuxvomica.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Evans, W.C. "Trease and Evans Pharmacognosy", XV<sup>th</sup> Edition, Saunders / Elsevier, 2005.
2. Kokate, C.K. et al., "Pharmacognosy", 39<sup>th</sup> Edition, Nirali Prakashan, 2007.
3. Wallis, T.E. "Textbook of Pharmacognosy", 5<sup>th</sup> Edition, CBS Publishers, 1985.

**REFERENCES**

1. Gennaro, A.R. "Remington : The Science and Practice of Pharmacy", Vol. I & II. 20<sup>th</sup> Edition, B.I. Publications Pvt. Ltd. / Lippincott Willisams & Wilkins, 2004.
2. Mohammed Ali, "Textbook of Pharmacognosy", II<sup>nd</sup> Edition, CBS Publishers, 1994.
3. Kalia, A.N. "Textbook of Industrial Pharmacognosy", CBS Publishers, 2005.

**PM7002**

**CLINICAL RESEARCH AND REGULATIONS**

**L T P C**

**3 0 0 3**

**UNIT I DRUG DEVELOPMENT MODULE** **12**

Drug development overview, Phases of clinical research, Pre-clinical (Non-clinical) development. Discovery and selection of compounds, Toxicology, Pharmacology Clinical Development programmes; Basics of clinical research statistics

**UNIT II CLINICAL RESEARCH MODULE I**

Understanding the evolving role of the Clinical Trial Administrator (CTA)/Clinical Project Assistant (CPA); Good Clinical Practice (GCP) and international harmonisation

Case Report Forms; Protocols; Informed Consent; Ethics Committees / Institutional Boards. Role of the Sponsor including the Clinical Research Associate/Monitor

**UNIT III CLINICAL RESEARCH MODULE II 8**  
Clinical trial set up; Trial Master Files and study filling, Data Management. Review of the EU Clinical Trial Directive; How to prepare for Regulatory Inspections or Audit; Fraud in clinical research

**UNIT IV ADVANCED CLINICAL RESEARCH MODULE 9**  
Project Management; How to develop a proactive approach to supporting clinical trials Building a successful working relationship with your manager(s) and the rest of the clinical research team; Team effectiveness: working as an effective clinical research team; Working in partnership with CROs .Legal aspects of clinical research; Laboratory tests Communication skills, Cross-cultural communication with other offices and departments internationally. Time management and optimising your effectiveness

**UNIT V REGULATORY AFFAIRS AND SAFETY MODULE 9**  
Regulatory requirements for international clinical research - Regulatory requirements for Biotechnology products, medical devices and veterinary products; Health economics; Safety reporting; Responding to drug safety alerts Post marketing surveillance

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Matoren, Gary M. "The Clinical Research Process in the Pharmaceutical Industry", Marcel Dekker, 1984.
2. Abraham, John "Regulation of the Pharmaceutical Industry", Palgrave, 2003.
3. Blaisdell, Peter, "Twenty – First Century Pharmaceutical Development", Interpharm Press, 2001.

**REFERENCE**

1. Gad, Shayne C. "Drug Safety Evaluation", John – Wiley & Sons, 2002.

**PM7001 CHEMISTRY OF NATURAL PRODUCTS L T P C  
3 0 0 3**

**OBJECTIVES**

To learn, classify and understand chemistry and structural aspects of medicinal compounds from various natural sources and relate to 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 8**

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, cardinolides and bufadienolides, digoxin and digitoxin, introduction to scillaren A and ouabain.

**UNIT III ALKALOIDS 12**

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, Phenanthrine alkaloids, Indole alkaloids, Imidazole alkaloids, Alkaloidamines, Glycoalkaloid, Xanthine alkaloid

**UNIT IV TERPENES AND FLAVONOIDS 8**  
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,  $\beta$ -Sitotsterol, bile acids, ergosterol, diosgenin, solasodine, hecogenin

**UNIT V STUDY OF TRADITIONAL DRUGS 8**  
Classification of indigenous drugs traditional drugs, common vernacular names, botanical source, chemical constituents, uses and marketed formulations with ingredients like – Amla, Satavari, Bhilwua, bael, bach, rasna, punarnava, gokhru, shankhapusphi, brahmiadusa, arjuna, lahsun, guggul, gymnema, neem ,tulsi, Shilajit and Spirulina

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Chemistry of Organic Natural Products (Vol.-1 & 2) by O.P. Agarwal.
2. Organic Chemistry of Natural Products (Vol.-1 & 2) by Gurdeep Chatwal.
3. Organic Chemistry (Vol.-2) by I.L. Finar.

**REFERENCES**

1. Pharmacognosy by Brady and Tyler.E.
2. Pharmacognosy by G.E. Trease&W.C.Evans.

**PM7015 SPECIAL TOPICS IN MEDICINAL CHEMISTRY LT P C  
3 0 0 3**

**UNIT I PRODRUGS AND METABOLIC CHANGES OF DRUGS 6**  
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 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 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 anti-thyroid drugs, medicinal chemistry of Diagnostic drugs and reagents:

**UNIT III MEDICINAL CHEMISTRY OF ANTIHISTAMINIC AGENTS, ANTIULCER AGENTS, ASTHMA AND EICOSANOIDS 12**  
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, LIFESTYLE 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 6**

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**

**TEXT BOOKS**

1. Ashutoshkar's Medicinal Chemistry.
2. Patric Medicinal chemistry

**REFERENCES**

1. Burger's medicinal chemistry Vol I to IV.
2. W.A. Foye, Medicinal Chemistry
3. Wilson and Giswold, Medicinal Chemistry
4. Indian/British Pharmacopoeia

**PM7016**

**SPECIAL TOPICS IN PHARMACOLOGY**

**L T P C**  
**3 0 0 3**

**AIM**

To know in detail the classification, therapeutic use, mechanism of action, metabolism, adverse effects of medicinal agents pertaining to Endocrine System, Haemopoietic system and drugs for dermatology, ocular and Protozoal, Helminthic And also know the principles of Immunopharmacology and toxicology.

**UNIT I DRUGS ACTING ON THE ENDOCRINE SYSTEM 9**

Hypothalamic and pituitary hormones, Thyroid hormones and anti-thyroid drugs, Parathormone, Calcitonin and Vitamin D, Insulin, Oral hypoglycaemic 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 DRUGS ACTING ON THE HAEMOPOIETIC SYSTEM 9**

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

**UNIT III MISCELLANEOUS DRUGS 9**

Dermatological Pharmacology. Ocular Pharmacology. Chemotherapy of parasitic infection, Protozoal infection; Amebiasis, Giardiasis, Trichomoniasis, Trypanosomiasis, Leishmaniasis, and Other Protozoal Infections. Chemotherapy of Helminth Infections.

**UNIT IV PRINCIPLES OF TOXICOLOGY 9**

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 9**

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**

**TEXT BOOKS**

1. Satoskar, Pharmacology and Therapeutics
2. Tripathi, K.D. Medical Pharmacology
3. Mycek M.J., Gerlnet S.B and Perper M.M. Pharmacology, Lippincott's Illustrated
4. Reviews, Lipincott Company, Philadelphia.

Attested  
*Sobhan*  
DIRECTOR  
Centre For Academic Courses  
Anna University, Chennai-600 025.

## REFERENCES

1. Rang, M.P, Dale M.M, Reter J.M-Pharmacology.
2. Goodman and Gilman's, The Pharmacological basis of therapeutics.
3. Ghosh M.N, Fundamentals of Experimental Pharmacology, Scientific Book Agency,
4. B. Lammer, Chronopharmacology
5. Katzung, B.G., Basic and Clinical Pharmacology, Prentice Hall International.

CH7751

TRANSPORT PHENOMENA

L T P C

3 0 0 3

### AIM

To give an overview of mass, momentum and energy transport, present the fundamental equations and illustrate how to use them to solve problems.

### OBJECTIVES

To describe mass, momentum and energy transport at molecular, microscopic and macroscopic level, to determine velocity, temperature and concentration profiles

### 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 NONISOTHERMAL 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 effect, 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**

### TEXT BOOKS

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

### REFERENCES

1. Welty, J. R., Wilson, R. W., and Wicks, C. W., "Fundamentals of Momentum Heat and Mass

- Transfer", 3<sup>rd</sup> Edn. John Wiley, New York, 1984.
2. Slattery, J. S., "Advanced Transport Phenomena", Cambridge University Press, London, 1992.

**PM7003 COLLOIDS AND INTERFACIAL PHENOMENA L T P C  
3 0 0 3**

**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-Lipophile balance. Phase inversion temperature, Association colloids such as micelles, Ionic and non-ionic surfactants. Kraft temperature, Critical micelle concentration, Micro emulsions

**TOTAL: 45 PERIODS**

**TEXT BOOK AND REFERENCES**

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
3. Hiemenz P. C., Rajagopalan R., "Principles of Colloid and Surface Science", Third Edition, Marcel Dekker, 1997

**PM7004 COMPUTER AIDED DRUG DESIGN L T P C  
3 0 0 3**

**UNIT I STEREOCHEMISTRY AND DRUG DESIGN 9**

Structurally Rigid Groups – Conformation – Configuration.

**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.

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

Partitional parameters – partition coefficients – hepo substituent constants – electronic parmeters  
– Hammet constant steric parameters – Hansch analysis

**UNIT IV DOCKING 9**  
Docking ligands to macromolecules – Docking algorithms - Dock – AUTODOCK

**UNIT V MOLECULAR SIMULATIONS 9**  
Molecular dynamic simulations – GROMACS – GROMOS – AMBER

**TOTAL: 45 PERIODS**

#### TEXT BOOKS

1. Cohen, N.C. "Guide Book on Molecular Modeling on Drug Design", Academic Press Elsevier, 2006.
2. Eliel, E.L. "Stereo Chemistry of Organic Compounds", John Wiley, 1994.
3. Leach, Andrew R. "Molecular Modeling and Applications", II<sup>nd</sup> Edition, Pearson / Dorling Kindersley (India) Pvt. Ltd., 2010.

#### 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" JohnWiley – Interscience, 2005.

**PM7005 EXPERIMENTAL DESIGN AND BIOSTATISTICS L T P C**  
**3 0 0 3**

#### OBJECTIVES

To define, learn, and understand the principles of experimental design; To 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 measures of 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; Kruskalwallis and Friedman two way anova tests. Spearman rank correlation; Statistical techniques in pharmaceuticals: Experimental design in clinical trials; Parallel and crossover designs; Statistical test for bioequivalence; Dose response studies; Statistical quality control.

**TOTAL: 45 PERIODS**

## 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 by Oxford University Press Inc.

**PM7006 FUNDAMENTALS OF MATERIAL SCIENCE AND ENGINEERING L T P C**  
**3 0 0 3**

The course is aimed to impart basic knowledge about crystal structures, phase diagrams and properties of materials.

## OBJECTIVES

On completion of the course the students are expected to

- Have a basic understanding about crystal structures and various laws related to structures.
- Have learnt about various properties.
- Have basic knowledge about phase diagrams

## UNIT I CRYSTAL 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**

## REFERENCES

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, New Delhi.
3. Schewmon, 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.
5. Am.Ceram.Soc, Inc., Westerville Ohio, USA.
6. Arzamasov, B., Materials Science, 1989, Mir Publishers, Moscow.



7. Weidmann, G., P.Lewis and N.Reid, Structural Materials, 1990, Butterworths, London.
8. William D Callister.Jr, Materials Science & Engineering, 2000, John Wiley & Sons

**PM7007**

**FUNDAMENTALS OF MOLECULAR PATHOLOGY**

**L T P C  
3 0 0 3**

**UNIT I OVERVIEW 5**

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.

**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) 16**

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: Enterotoxigenic E.coli(ETEC), labile & stable toxins, Entero- pathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Entero-haemorrhagic E.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Entero aggregative E.coli (EAEC). Shigella: Entry, macrophage apoptosis, induction of macro pinocytosis, 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, parasitophorous vacuoles, and knob protein transport, Anti malarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

**UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS 8**

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 sero typing. 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**

**TEXT BOOKS**

1. Chandrasoma, Prakrama and Clive R.Taylor "Concise Pathology", III<sup>rd</sup> Ed., Mc Fraw-Hill, 2001.
2. Stevens, Han and James Lowe "Pathology" II<sup>nd</sup> Ed., Mosby 2000.

**REFERENCES**

1. Kumar, Vinay, Abdul K. Abbas and Nelson Fausto "Robbins and Cotran Pathologic Basis of Disease" 17th Ed., Saunders, 2004.
2. Cook, D.J. "Cellular Pathology" II<sup>nd</sup> Ed., Scion, 2006
3. Iglewski B.H and Clark V.L "Molecular basis of Bacterial Pathogenesis", Academic Press, 1990.

4. Peter Williams, Julian Ketley & George Salmond, "Methods in Microbiology: Bacterial Pathogenesis, Vol. 27", Academic Press, 1998.
5. Recent reviews in Infect. Immun., Mol. Microbiol., Biochem. J., EMBO etc
6. Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", McGraw Hill, III<sup>rd</sup> Edition, 2001.
7. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

**PM7008                      FUNDAMENTALS OF POLYMER SCIENCE AND ENGINEERING                      L T P C  
3 0 0 3**

**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 <sup>1</sup>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 POLYMERISATION                      9**

Kinetics of poly condensation reactions – copolymerization – co-polymer equation – copolymer compositions from <sup>1</sup>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 polymerisation

**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 poly condensation.

**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. Poly dispersity 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**

**TEXT BOOK AND REFERENCES**

1. V.R.Gowarikar, N.V.Viswanathan and JayadevSreedhar, Polymer Science,Wiley Eastern Limited, Madras (2006).
2. F.N. Billmayer, Text Book of polymer Science, 3rd Edn. John Wiley & Sons, New York(2002).
3. George Odian, Principles of Polymerisation, 3rd Edn, McGraw Hill Book Company, NewYork (2003).
4. M.S.Bhatnagar, " A Text Book of Polymers ( chemistry and Technology of polymers), Voll, II & III, 1st Edn., S.Chand and Company, New Delhi (2007).
5. R.S. Young, Introduction to Polymers, Chapman and Hall Ltd., London (1999).

**PM7009                      INTRODUCTION TO BIOMATERIALS AND TISSUE ENGINEERING**

**UNIT I                      INTRODUCTION**

**L T P C**  
**3 0 0 3**  
**9**  
*Sobhan*  
**DIRECTOR**  
Centre For Academic Courses  
Anna University, Chennai-600 025.

Surface Chemistry of materials, Tissue Reaction, Wound Kinetics, biocompatibility, Various Techniques used for sterilization

**UNIT II TYPES OF MATERIALS AND THEIR TESTING 9**

Metals, Ceramics, treated natural materials. Testing with Tissue Culture, Testing with Soft Tissues and Testing at non Thrombogenic surface

**UNIT III BIOMEDICAL IMPLANTS 9**

Cardiac Implants, Orthopedic Implants, Neural and Neuro Muscular Implants, Trans cutaneous Implants, Intraocular lenses

**UNIT IV FUNDAMENTALS OF TISSUE ENGINEERING 9**

Tissue Exchange and Tissue Development, objectives of Tissue engineering, Element of Tissue development. Cell growth and differentiation, Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent. Cell delivery and recirculation, Delivery molecular agents in tissue engineering, control releaser agents in time and space. Cell interaction with polymer cell, cell interaction with polymer in suspension, cell interaction with gels.

**UNIT V APPLICATIONS OF TISSUE ENGINEERING 9**

Artificial organs, synthetic components, Replacement in Tissue structure or Functional Tissue engineering cartilage, Skin, and nerve regeneration.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. W. Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue – Oxford University Press inc New York 2004.
2. Larry L. Hench and Julian R. Jones, Biomaterials, Artificial organs and Tissue Engineering, 2005.
3. Bernhard O. Palsson, Sangeeta N. Bhatia, "Tissue Engineering" Pearson Publishers, 2009.
4. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. .Fundamentals of Tissue Engineering and Regenerative Medicine. 2009.

**REFERENCES**

1. J.H.U. Brown (Ed), Advances in Bio Medical Engineering, Academic Press 1975.
2. Andrew F. Von Racum, Hand Book of Bio Medical Evaluation, Mc-Millan Publishers, 1980.
3. Jacob Cline, Hand Book of Bio Medical Engineering, Academic Press in Sandiego, 1988.
4. Jonathan Black, Biological Performance of Materials- Fundamentals of bio compatibility, IV<sup>th</sup> Edition, CRC Press 2005.
5. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; An Introduction to Materials in Medicine, II<sup>nd</sup> Edition, Elsevier Academic Press, San Diego, 2004.

**PM7010**

**MOLECULAR MODELING AND DRUG DESIGN**

**L T P C  
3 0 0 3**

**OBJECTIVES**

To learn, and understand the principles of ligand properties and prerequisites of computer aided ligand design; To plan and select in-silico approaches and tools; To execute effectively and analyse results of in-silico docking experiments for research in drug development

**UNIT I INTRODUCTION TO THE DRUG DISCOVERY/DEVELOPMENT 9**

Definition of Drug Discovery, Stages of drug discovery, Strategic Issues in drug discovery and Development, Chemistry, ligand sources – Natural, (Plants, Animals, Microorganisms), synthetic and semi-synthetics, graphical and structure viewers, structure file formats, protein databases, validation, advantage and limitations of various models, chemiinformatic databases

**UNIT II CRYSTALLOGRAPHY METHODS OF MODEL DEVELOPMENT 9**

Overview of protein crystallography, protein crystals, diffraction data, electron density data, phases, judging the molecular models, other diffraction methods for model building, tools for studying macromolecules

**UNIT III EMPIRICAL FORCE FIELDS MOLECULAR MECHANISMS**

Bond Stretching-Angel Bending -Torsional terms -Out of Plane bonding motions-Electrostatic interactions- Van Der Waals interactions-Effective pair Potentials-Hydrogen Bonding-Simulation of liquid water

**UNIT IV COMPUTER SIMULATION METHODS 12**

Calculation of thermodynamic properties-Phase space-Practical aspects of computer simulation-Boundaries monitoring Equilibrium-Long range process-Analysing results of simulation and estimating errors; molecular dynamics simulate on methods, simulation- Constant dynamics-Time dependent properties-Molecular Dynamics at constant temperature and pressure, Monte Carlo Simulation Methods

**UNIT V MOLECULAR MODELLING METHODS 6**

Molecular modelling in drug discovery-Deriving and using 3D Pharma cores-Molecular docking-Structure Based methods to identify lead components-Denovo ligand design

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. A.R.Leach, "Molecular Modelling Principles and Applications", Longman, 1996.
2. J.M. Haile, "Molecular Dynamics Simulation Elementary Methods", John Wiley and Sons, 1997.
3. Crystallography made crystal clear by Gale Rhodes

**REFERENCES**

1. COOT manuals
2. CCPSi suite manuals
3. GROMOS 95 Manual, BIOMOS Switzerland, 1995.
4. HYPERCHEM Manual typercube Canada, 1995.

**PM7011**

**NUTRACEUTICALS**

**L T P C  
3 0 0 3**

**OBJECTIVES**

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

**UNIT I INTRODUCTION AND SIGNIFICANCE 6**

Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes

**UNIT II ANALYSIS OF PHYTOCHEMICALS 11**

Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, Chitin; Carotenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

**UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY 11**

In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources

**UNIT IV ROLE IN HEALTH AND DISEASE 11**

Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

**UNIT V SAFETY ISSUES**

6

Health Claims, regulations and safety issues- International and national.

**TOTAL: 45 PERIODS****TEXT BOOKS**

1. Bisset, Normal Grainger and Max WichH "Herbal Drugs and Phytopharmaceuticals", 2<sup>nd</sup> 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,

**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).
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.

PM7013

**PRINCIPLES OF BIOENGINEERING**L T P C  
3 0 0 3**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 polymer layers; approaches to patterning those materials as well as cells)

**UNIT III MEMS APPLICATIONS**

9

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

**UNIT IV MICROFLUIDICS AND NANOFUIDICS**

9

**Microengineering fluid flows:** Introduction to microfluidics and Nanofluidics, properties of biological 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, micro scaffolds, cellular co-cultures Micro fabrication 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****TEXT BOOK AND REFERENCES**

1. Robert P. Lanza, Robert Langer Joseph, Vacanti, "Principles of Tissue Engineering" Second Edition

- Ferrari, Mauro (eds) BioMEMS and Biomedical Nanotechnology Volume I
- Steven S. Saliterman, Fundamentals of BioMEMS and Medical Microdevices

**PM7017**

**VACCINE TECHNOLOGY**

**L T P C**  
**3 0 0 3**

**AIM**

To develop understanding and provide scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of bio-molecules 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, Rationale 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, sub unit 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, Targetting 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**

**TEXTBOOKS**

- Male, David et al., "Immunology", VII<sup>th</sup> Edition, Mosby Publication, 2007.
- Kindt, T.J. et al., "Immunology", VI<sup>th</sup> Edition, W.H. Freeman, 2007.
- Janeway, C.A. et al., "Immunology : The Immune Systems in Health and Diseases", VI<sup>th</sup> Edition, Garland Science, 2005.
- 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 Methods for Antibody and Nucleic Acid probes, Volume 1, Cold Spring Harbor Ed Harlow, David Lane, Antibodies Laboratory Manual, Cold Spring Harbor, Laboratory Press, 1993.
2. Coico, R. et al., "Immunology : A Short Course", V<sup>th</sup> Edition, Wiley – Liss, 2003.
3. Parham, Peter "The Immune System", II<sup>nd</sup> Edition, Garland Science, 2005.
4. Abbas, A.K. et al., "The Cellular and Molecular Immunology", VI<sup>th</sup> Edition, Sanders / Elsevier, 2007.
5. Weir, D.M. and Stewart, John "Immunology", VIII<sup>th</sup> Edition, Churchill Pvt. Ltd., 2000.

**GE7073**

**FUNDAMENTALS OF NANOSCIENCE**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

To learn about basis of nanomaterial science, preparation method, types and application

**UNIT I INTRODUCTION 8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- 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, TiO<sub>2</sub>, MgO, ZrO<sub>2</sub>, NiO, nanoalumina, CaO, AgTiO<sub>2</sub>, 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, Nanobiotechnology: nanoprobe in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Upon completing this course, the students

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

**TEXT BOOKS**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd 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.

**CH7072**

**INSTRUMENTATION AND PROCESS CONTROL**

**L T P C**  
**3 0 0 3**

### AIM

To familiarize the students with concepts of process dynamics and control leading to control system design.

### OBJECTIVE

To 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, liquid weight and weight flow rate, 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**

### TEXT BOOKS

1. Stephanopoulos, G., "Chemical Process Control", Prentice Hall of India, 2003.
2. Coughnour, D., "Process Systems Analysis and Control", 2nd Edn., McGraw Hill, New York, 1991.

### REFERENCES

1. Marlin, T. E., "Process Control", 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 2nd Edn., John Wiley, New York, 1997.

**IB7071**

**BIOCONJUGATE TECHNOLOGY AND APPLICATIONS**

**L T P C**  
**3 0 0 3**

### UNIT I FUNCTIONAL TARGETS

**9**

Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycol conjugates – modification of nucleic acids and oligo nucleotides.

### 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 – Homo bifunctional cross linkers – Hetero bifunctional 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**

**TEXT BOOK AND REFERENCE**

1. Bioconjugate Techniques , G.T. Hermanson, Academic Press, 1999

**IB7072 BIOLOGICAL SPECTROSCOPY L T P C  
3 0 0 3**

**OBJECTIVES:**

- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications

**UNIT I OPTICAL ROTATORY DISPERSION 5**

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins .

**UNIT II NUCLEAR MAGNETIC RESONANCE 10**

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – multi dimensional nmr spectroscopy – determination of macromolecular structure by nmr – magnetic resonance imaging.

**UNIT III MASS SPECTROMETRY 10**

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

**UNIT IV X-RAY DIFFRACTION 10**

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 V SPECIAL TOPICS AND APPLICATIONS 10**

Electron microscopy – transmission and scanning electron microscopy – scanning tunnelling and atomic force microscopy – combinatorial chemistry and high throughput screening methods.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of this course, the student would be able understand Basics of optical rotary dispersion methods and nuclear magnetic resonance

- Principles and applications of mass spectrometry and X-ray diffraction
- About the microscopic techniques and applications
- And apply the spectroscopic techniques for various biological applications

## TEXT BOOKS

1. Banwell, Colin N. and E.M. McCash. "Fundamentals of Molecular Spectroscopy" IV<sup>th</sup> Edition, Tata McGraw-Hill, 1994.
2. Aruldas, G. "Molecular Structure and Spectroscopy". II<sup>nd</sup> Edition, Prentice Hall of India, 2007.
3. Pavia, D.L., G.M. Lampman and G.S. Kriz. "Introduction to Spectroscopy:" III<sup>rd</sup> Edition, Thomson, Brooks/ Cole, 2001.
4. Williams, Dudley H. and Ian Fleming. "Spectroscopic Methods in Organic Chemistry". V<sup>th</sup> Edition, Tata McGraw-Hill, 1995.

## 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.

PM7014

PROTEIN STRUCTURE, FUNCTION AND PROTEOMICS

L T P C  
3 0 0 3

### UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 9

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls 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 9

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 9

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes.

### UNIT IV STRUCTURE-FUNCTION RELATIONSHIP 9

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eucaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans membrane segments, prediction, bacterio rhodopsin 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 9

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.

**TOTAL: 45 PERIODS**

## TEXTBOOKS

1. Voet D. and Voet G., Biochemistry, Third edn. John Wiley and Sons, 2001
2. Branden C. and Tooze J., Introduction to Protein Structured, II<sup>nd</sup> Edition, Garland Publishing, NY, USA, 1999
3. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
4. Moody P.C.E. and Wilkinson A.J. Protein Engineering, IRL Press, Oxford, UK, 1990.

## REFERENCES

1. Voet D. and Voet G., Biochemistry, Third edn. John Wiley and Sons, 2001
2. Branden C. and Tooze J., Introduction to Protein Structured, Second Edition, Garland Publishing, NY, USA, 1999
3. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
4. Moody P.C.E. and Wilkinson A.J. Protein Engineering, IRL Press, Oxford, UK, 1990.

**IB7751**

**BIOINFORMATICS**

**L T P C**  
**3 2 0 4**

### UNIT I

**15**

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

### UNIT II

**15**

Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

### UNIT III

**15**

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, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

### UNIT IV

**15**

Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

### UNIT V

**15**

Basics of PERL programming for Bioinformatics: Data types: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

**TOTAL : 75 PERIODS**

### TEXT BOOKS

1. Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by
4. R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
5. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
6. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilly Media

### REFERENCE BOOK

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak, MITPress.

<b>IB7752</b>	<b>DOWNSTREAM PROCESSING</b>	<b>L T P C</b> <b>3 0 0 3</b>
<b>UNIT I</b>	<b>OVERVIEW OF DOWNSTREAM PROCESSING</b>	<b>10</b>
Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts.		
<b>UNIT II</b>	<b>PHYSICAL METHODS OF SEPARATION</b>	<b>6</b>
Unit operations for solid-liquid separation - filtration and centrifugation.		
<b>UNIT III</b>	<b>ISOLATION OF PRODUCTS</b>	<b>12</b>
Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.		
<b>UNIT IV</b>	<b>PRODUCT PURIFICATION</b>	<b>12</b>
Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques.		
<b>UNIT V</b>	<b>FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS</b>	<b>5</b>
Crystallization, drying and lyophilization in final product formulation.		
		<b>TOTAL: 45 PERIODS</b>

#### TEXT BOOKS

1. Belter, P.A., Clussler, E.L. "Bioseparation – Downstream Processing & Biotechnology". John – Wiley Interscience, 1998.
2. Asenjo, Juan A. "Separation Processes in Biotechnology". Taylor & Francis / CRC, 1990.
3. Scopes, R.K. "Protein Purification: Principles and Practice". Narosa Publication, 1994.

#### 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.

<b>IB7073</b>	<b>METABOLIC ENGINEERING</b>	<b>L T P C</b> <b>3 0 0 3</b>
<b>UNIT I</b>	<b>INTRODUCTION TO EXAMPLES OF PATHWAY MANIPULATION - QUALITATIVE TREATMENT</b>	<b>9</b>
Enhancement of Product Yield and Productivity, Extension of substrate Range, Extension of Product spectrum and Novel products, Improvement of Cellular properties, Xenobiotic degradation.		
<b>UNIT II</b>	<b>MATERIAL BALANCES AND DATA CONSISTENCY</b>	<b>9</b>
Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations, analysis of over determined systems- identification of gross measurement errors. Introduction to MATLAB®		
<b>UNIT III</b>	<b>METABOLIC FLUX ANALYSIS</b>	<b>9</b>
Theory, over determined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling, applications of metabolic flux analysis.		
<b>UNIT IV</b>	<b>METABOLIC CONTROL ANALYSIS</b>	<b>9</b>
Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Determination of flux control coefficients, MCA of linear pathways, branched pathways, theory of large deviations		

## **UNIT V ANALYSIS OF METABOLIC NETWORKS 9**

Control of flux distribution at a single branch point, Grouping of reactions, case studies, extension of control analysis to inter metabolite, optimization of flux amplifications, consistency tests and experimental validation.

**TOTAL: 45 PERIODS**

### **TEXT BOOKS**

1. Metabolic Engineering: Principles and Methodologies Gregory N. Stephanopoulos ,
2. Aristos A. Aristidou, Jens Nielsen, Academic Press 1998
3. Metabolic Engineering Sang Yup Lee E. Terry Papoutsakis Marcel Dekker.inc 1998
4. Nielsen J and Villadsen J. (1994) Bioreaction Engineering Principles. New york:PlenumPress

### **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.
3. Johnson (eds). Springer, P.O. Box 17, 3300 AA Dordrecht, The Netherlands. 2007.
4. Systems Modeling in Cellular Biology: From Concepts to Nuts and Bolts Edited by Zoltan Szallasi, JorgStelling and VipulPeriwal MIT Press Cambridge 2006

**GE7071**

**DISASTER MANAGEMENT**

**L T P C  
3 0 0 3**

### **OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

## **UNIT I INTRODUCTION TO DISASTERS 9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

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

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

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

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

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

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



- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

**IB7753**

**IMMUNOLOGY**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To discuss the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- To 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 10**

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 10**

Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions

**UNIT III IMMUNITY AGAINST PATHOGENS AND TUMORS 10**

Inflammation; protective immune responses to virus, bacteria, fungi and parasites; tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy

**UNIT IV IMMUNE TOLERANCE AND HYPERSENSITIVITY 8**

Immune tolerance, Immuno deficiencies; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Auto immune disorders and diagnosis

**UNIT V APPLIED IMMUNOLOGY 7**

Monoclonal antibodies, engineering of antibodies; Classification of Vaccines, methods of vaccine development, immunodiagnostic methods (Immuno diffusion ELISA, FACS), immuno modulatory drugs

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students after completing the course would be aware of immune system structure and functions.
- The students would be aware of immunity to various pathogens
- The students would be aware of the principles behind the production of therapeutic/diagnostic molecules.
- The students would be aware of the concepts and mechanism behind tumour development, allergy and hypersensitivity reactions.

**TEXT BOOKS:**

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., XII<sup>th</sup> edition 2011. 52
2. Kuby J, Immunology, WH Freeman & Co., 7th Edition 2012.
3. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006.

**REFERENCES:**

1. Coico, Richard "Immunology: A Short Course" VI<sup>th</sup> Edition. John Wiley, 2008.
2. Khan, Fahim Halim "Elements of Immunology" Pearson Education, 2009.

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**OBJECTIVES:**

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

**UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9**

**Global Trends Analysis and Product decision** - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - **Introduction to Product Development Methodologies and Management** - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

**UNIT II REQUIREMENTS AND SYSTEM DESIGN 9**

**Requirement Engineering** - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling** - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

**UNIT III DESIGN AND TESTING 9**

**Conceptualization** - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design** - Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping** - Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

**UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance** -Maintenance and Repair – Enhancements - **Product EoL** - Obsolescence Management – Configuration Management - EoL Disposal

**UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9**

**The Industry** - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials** - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

**TOTAL: 45 PERIODS****OUTCOMES:**

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

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context



- Work independently as well as in teams
- Manage a project from start to finish

**TEXTBOOKS:**

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

**REFERENCES:**

1. Hiriappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

