DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

PERAMBALUR - 621212

REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM

B.Tech PHARMACEUTICAL TECHNOLOGY

CURRICULUM & SYLLABI

DEPARTMENT OF PHARMACEUTICAL TECHNOLOGY

(Applicable to students admitted from the Academic year 2023 – 2024 and subsequently under Choice Based Credit System)

Discussed in BOS - 4 meeting Dated: 12.09.2024 / Pharmaceutical Technology
Ratified & Approved in Academic Council

VISION MISSION OF THE INSTITUTUION

Vision:

An active and committed centre of advanced learning focused on research and training in the fields of Engineering, Technology and Management to serve the nation better.

Mission:

- To develop eminent scholar with a lifelong follow up of global standards by offering UG,PG and Doctoral Programmes.
- To pursue Professional and Career growth by collaborating mutually beneficial partnership with industries and higher institutes of research.
- To promote sustained research and training with emphasis on human values and leadership qualities.
- To contribute solutions for the need based issues of our society by proper ways and means as dutiful citizen.

DEPARTMENT OF PHARMACEUTICL TECHNOLOGY

About the Department:

The department of Pharmaceutical Technology was established in the year 2019. Under this UG programme, the total sanctioned student intake is 60. The department has highly committed and enthusiastic faculty members and is supported by trained technical non-teaching staff. Guest lectures, workshops, Industrial visits, In-plant training, seminars, symposia, and other personality development programmes are carried out to furnish to the pursue of today's society as well as student professionals.

The department had started Department Association named as PHARMA in the year of 2020. The Department had planned to start STUDENT CHAPTER and to encourage the students to join as student member in the various professional societies like Indian Pharmaceutical Association (IPA), The International Society For Pharmaceutical Engineering (ISPE), Association of Pharmaceutical Research (APR) and Society of Pharmaceutical Education and Research (SPER) that provide students, the industrial environment which is much needed for real life training and creates a very close interaction with many leading industries experts in the country and research laboratories.

Vision:

To become a pharmaceutical department of academic excellence with a strong emphasis on research, development, and education; to create novel solutions for business challenges; and to push the boundaries of pharmaceutical for the good of society.

Mission:

- To provide high-quality technical training in the many pharmaceutical fields.
- To continually improve and enrich the instructional process.
- To create a space where students may grow holistically and become more ethical, creative, and inventive professionals.
- To encourage the development of technology and products for the society's subsistence and well-being.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Make use of their excellent technical skills, strong sense of teamwork, and high standards of professional ethics to pursue higher education and research in reputable national and worldwide institutes
PEO 2	Act as a bridge between technology, process, and product; support pharmaceutical's field and related fields.
PEO 3	Demonstrate professional responsibility in a variety of pharmaceutical areas for the long- term advancement of society

PROGRAM OUTCOMES (POs)

PO	Graduate Attribute
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles ofmathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, andneed for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations,

	and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1	Develop active pharmaceutical ingredients, drug intermediates and pharmaceutical products.
PSO 2	Apply data driven decisions and predictive analytical tools in smaller and larger molecule producing industries
PSO 3	Identify technical issues related to the design, manufacturing of chemicals & pharmaceuticals and provide effective interdisciplinary solutions.

PEO's – PO's & PSO's MAPPING:

PEO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
I.	3	2	2	2		3		3		3			2		3
II.	2	3	3	3	3		3			3	3		2	2	
III.			2			3	3		3		3	3			3

DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE (AUTONOMOUS)
PERAMBALUR – 621 212.
B.TECH. PHARMACEUTICAL TECHNOLOGY
REGULATIONS 2023
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IP3151	Induction Programme	-	-	-	-	-	-
2.	U23HST11	Communicative English	HSC	3	0	0	5	3
3.	U23MAT12	Matrices and Calculus	BSC	3	1	0	6	4
4.	U23PHT13	Physics for Engineers and Technologists	BSC	3	0	0	5	3
5.	U23CYT14	Chemistry for Engineering and Technology	BSC	3	0	0	5	3
6.	U23GET16	Engineering Graphics	ESC	2	0	4	6	4
7.	GE3152	Heritage of Tamils/ தமிழர் மரபு	HSC	1	0	0	2	1
PRACTICALS								
8.	U23BSP11	Physics and chemistry laboratory	BSC	0	0	4	4	2
9.	U23HSP12	English laboratory	HSC	0	0	2	2	1
10.	U23GEP14	Engineering Practices Laboratory	ESC	0	0	4	4	2
TOTAL				**15**	**1**	**14**	**39**	**23**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23HST21	Professional English	HSC	3	0	0	4	2
2.	U23MAT22	Statistics and Numerical Methods	BSC	3	1	0	6	4
3.	U23GET15	Problem Solving and Python Programming	ESC	3	0	0	5	3
4.	U23EET25	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	5	3
5.	U23PTT21	Biochemistry	PCC	3	0	0	5	3
6.	U23PHT26	Physics of Materials	BSC	3	0	0	5	3
7.	GE3252	Tamils and technology/ தமிழரும் தொழில்நுட்பமும்	HSC	1	0	0	1	1
PRACTICALS								
8	U23HSP22	Communication Laboratory	EEC	0	0	4	3	2
9.	U23GEP13	Problem Solving and Python Programming Laboratory	ESC	0	0	4	3	2
10.	U23PTP21	Biochemistry Laboratory	PCC	0	0	4	3	2
TOTAL				**19**	**1**	**12**	**40**	**25**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23MAT31	Transforms and Partial Differential Equations	BSC	3	1	0	6	4
2.	U23PTT31	Chemical Process Calculations	PCC	3	0	0	5	3
3.	U23PTT32	Microbiology and Immunopathology	PCC	3	0	0	5	3
4.	U23PTT33	Pharmaceutical Chemistry	PCC	3	0	0	5	3
5.	U23PTT34	Physical Pharmaceutics	PCC	3	0	0	5	3
6.	U23PTT35	Human Anatomy and Physiology	PCC	3	0	0	5	3
PRACTICALS								
7.	U23PTP31	Microbiology Laboratory	PCC	0	0	3	3	1.5
8.	U23PTP32	Physical Pharmaceutics Laboratory	PCC	0	0	3	3	1.5
9.	U23GE3361	Professional Development	EEC	0	0	2	2	1
TOTAL				**18**	**1**	**8**	**39**	**23**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23PTT41	Applied Chemical Engineering Thermodynamics	PCC	3	0	0	5	3
2.	U23CET32	Fluid Mechanics	PCC	3	0	0	5	3
3.	U23PTT43	Molecular Biology and Genetic Engineering	PCC	3	0	0	5	3
4.	U23PTT44	Pharmacology and Chemotherapy	PCC	3	0	0	5	3
5.	U23PTT45	Pharmaceutical Analysis	PCC	3	0	0	5	3
6.	U23GET41	Environmental Sciences and Engineering	HSMC	3	0	0	5	2
PRACTICALS								
7.	U23PTP41	Pharmaceutical Chemistry Laboratory	PCC	0	0	3	3	1.5
8.	U23PTP42	Physiology and Pharmacology Laboratory	PCC	0	0	3	3	1.5
TOTAL				**18**	**0**	**6**	**36**	**20**

SEMESTER V

S.	COURSE	COURSE TITLE	CATE-	PERIODS PER WEEK	TOTAL	

NO.	CODE		GORY	L	T	P	CONTACT PERIODS	CREDITS
THEORY								
1.	U23PTT51	Pharmaceutical Dosage Forms	PCC	3	0	0	5	3
2.	U23PTT52	Unit Operations in Pharmaceutical Industries	PCC	3	1	0	6	4
3.	U23PTT53	Technology of Semisolid Dosage Form	PCC	3	0	0	5	3
4.		Professional Elective – I	PEC	3	0	0	5	3
5.		Professional Elective – II	PEC	3	0	0	5	3
6.		Professional Elective – III	PEC	3	0	0	5	3
PRACTICALS								
7.	U23PTP51	Dosage Forms Laboratory	PCC	0	0	3	3	1.5
8.	U23PTP52	Nano Pharmaceutical Laboratory	PCC	0	0	3	3	1.5
9.	U23PTP53	Industrial Training/ Internship/Workshop	EEC	-	-	-	2	1
TOTAL				**18**	**1**	**3**	**39**	**23**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23BTT42	Heat And Mass Transfer Operations	PCC	3	0	0	5	3
2.	U23PTT62	Instrumental Techniques In Drug Analysis	PCC	3	0	0	5	3
3.		Professional Elective – IV	PEC	3	0	0	5	3
4.		Open Elective – I	OEC	3	0	0	5	3
5.		Open Elective – II	OEC	3	0	0	5	3
6.	U23GET61	Human values and Ethics	HSMC	3	0	0	4	2
PRACTICALS								
7.	U23PTP61	Heat And Mass Transfer Laboratory	PCC	0	0	3	3	1.5
8.	U23PTP62	Instrumental Techniques In Drug Analysis Laboratory	PCC	0	0	3	3	1.5
9.	U23PTT63	Internship/Workshop*	EEC	0	-	-	2	1
TOTAL				**18**	**0**	**6**	**37**	**21**

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23PTT71	Chemistry of Natural Products	PCC	3	0	0	5	3
2.	U23PTT72	Novel Drug Delivery Systems	PCC	3	0	0	5	3
3.		Professional Elective – V	PEC	3	0	0	5	3
4.		Open Elective – III	OEC	3	0	0	5	3
5.		Open Elective – IV	OEC	3	0	0	5	3
6.		Elective- Management	HSMC	3	0	0	5	3
PRACTICALS								
7.	U23PTP71	Chemistry of Natural Products Laboratory	PCC	0	0	3	3	1.5
8.	U23PTP72	Novel Drug Delivery Systems Laboratory	PCC	3	0	0	3	1.5
9.	U23PTP73	Industrial Training /Internship /Mini Project II*	EEC	-	-	-	2	1
TOTAL				**18**	**0**	**3**	**38**	**22**

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23PTP81	Project Work/Internship	EEC	0	0	20	20	10
TOTAL				0	0	20	20	**10**

ELECTIVE – MANAGEMENT COURSES

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23GET71	Principles of Management	HSMC	3	0	0	5	3
2.	U23GET72	Total Quality Management	HSMC	3	0	0	5	3
3.	U23GET73	Engineering Economics and Financial Accounting	HSMC	3	0	0	5	3
4.	U23GET74	Human Resource Management	HSMC	3	0	0	5	3
5.	U23GET75	Knowledge Management	HSMC	3	0	0	5	3
6.	U23GET76	Industrial Management	HSMC	3	0	0	5	3

Vertical I Drug Design & Development	Vertical II Formulation and Manufacturing Technology	Vertical III Quality Control and Quality Assurance	Vertical IV Pharmaceutical Industrial Management
Medicinal Chemistry	Technology of Fine Chemicals and Bulk Drugs	Regulatory Toxicology	Pharmaceutical Production Management
Bioinformatics and Cheminformatics	Pre formulation Technology	Quality Assurance in Pharmaceutical Industries	Pharmaceutical Supply Chain Management
Protein Structure, Function and Proteomics	Manufacturing Technology of Dosage Forms	Audits and regulatory compliance	Safety and Disaster Management
Computer Aided Drug Design	Industrial Process and Scale up Techniques	Validation in Pharmaceutical Industries	Management Information System
Biological Spectroscopic techniques	Vaccine Technology	Quality Management system	Industrial Psychology And Human Resource Management
Pharmaceutical Nanotechnology	Pharmaceutical Packaging Technology	Product development and technology transfer	Project Management for Pharmaceutical Technology

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: DRUG DESIGN &DEVELOPMENT

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23PTV11	Medicinal Chemistry	PEC	3	0	0	5	3
2.	U23PTV12	Bioinformatics And Cheminformatics	PEC	3	0	0	5	3
3.	U23PTV13	Protein Structure, Function And Proteomics	PEC	3	0	0	5	3
4.	U23PTV14	Computer Aided Drug Design	PEC	3	0	0	5	3
5.	U23PTV15	Biological Spectroscopic techniques	PEC	3	0	0	5	3
6.	U23PTV16	Pharmaceutical Nanotechnology	PEC	3	0	0	5	3

VERTICAL II: FORMULATION ANDMANUFACTURING TECHNOLOGY

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23PTV21	Technology Of Fine Chemicals And Bulk Drugs	PEC	3	0	0	5	3
2.	U23PTV22	Pre Formulation Technology	PEC	3	0	0	5	3
3.	U23PTV23	Manufacturing Technology Of Dosage Forms	PEC	3	0	0	5	3
4.	U23PTV24	Industrial Process And Scale Up Techniques	PEC	3	0	0	5	3
5.	U23PTV25	Vaccine Technology	PEC	3	0	0	5	3
6.	U23PTV26	Pharmaceutical Packaging Technology	PEC	3	0	0	5	3

VERTICAL III: QUALITY CONTROL AND QUALITY ASSURANCE

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23PTV31	Regulatory Toxicology	PEC	3	0	0	5	3
2.	U23PTV32	Quality Assurance In Pharmaceutical Industries	PEC	3	0	0	5	3
3.	U23PTV33	Audits And Regulatory Compliance	PEC	3	0	0	5	3
4.	U23PTV34	Validation In Pharmaceutical Industries	PEC	3	0	0	5	3
5.	U23PTV35	Quality Management System	PEC	3	0	0	5	3
6.	U23PTV36	Product Development And Technology Transfer	PEC	3	0	0	5	3

VERTICAL IV: PHARMACEUTICALINDUSTRIAL MANAGEMENT

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	U23PTV41	Pharmaceutical Production Management	PEC	3	0	0	5	3
2.	U23PTV42	Pharmaceutical Supply Chain Management	PEC	3	0	0	5	3
3.	U23PTV43	Safety And Disaster Management	PEC	3	0	0	5	3
4.	U23PTV44	Management Information System	PEC	3	0	0	5	3
5.	U23PTV45	Industrial Psychology And Human Resource Management	PEC	3	0	0	5	3
6.	U23PTV46	Project Management For Pharmaceutical Technology	PEC	3	0	0	5	3

OPEN ELECTIVES

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23PTO01	Clinical Research and Pharmacovigilance	OEC	3	0	0	5	3
2.	U23PTO02	Molecular Pharmaceutics	OEC	3	0	0	5	3
3.	U23PTO03	Advanced Pharmacology	OEC	3	0	0	5	3
4	U23PTO04	Clinical Immunology And Vaccinology	OEC	3	0	0	5	3
5	U23PTO05	Advanced Molecular Techniques	OEC	3	0	0	5	3
6	U23PTO06	Principles Of Drug Discovery	OEC	3	0	0	5	3
7	U23PTO07	Herbal Technology	OEC	3	0	0	5	3
8	U23PTO08	Introduction to Drug Science	OEC	3	0	0	5	3
9	U23PTO09	Dietary Supplements and Nutraceuticals	OEC	3	0	0	5	3

10	U23PTO10	Basic Laboratory Animal Science	OEC	3	0	0	5	3
11	U23PTO11	Remedial Biology	OEC	3	0	0	5	3
12	U23PTO12	Pharmaceutical Microbiology	OEC	3	0	0	5	3

SUMMARY

B.TECH. PHARMACEUTICAL TECHNOLOGY											
S. No.	**SUBJECT AREA**	**CREDITS PER SEMESTER**								**CREDIT TOTAL**	**%**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
1.	**HSMC**	**5**	**3**	**-**	**2**	**-**	**2**	**3**	**-**	**15**	9.5
2.	**BSC**	**12**	**7**	**4**	**-**	**-**	**-**	**-**	**-**	**23**	13.6
3.	**ESC**	**6**	**8**	**-**	**-**	**-**	**-**	**-**	**-**	**14**	8.2
4.	**PCC**	**-**	**5**	**18**	**18**	**13**	**9**	**9**		**72**	42.6
5.	**PEC**	**-**	**-**	**-**	**-**	**9**	**3**	**3**	**-**	**15**	8.9
6.	**OEC**	**-**	**-**	**-**	**-**	**-**	**6**	**6**	**-**	**12**	7.1
7.	**EEC**	**-**	**2**	**1**	**0**	**1**	**1**	**1**	**10**	**16**	10.1
Total		**23**	**25**	**23**	**20**	**23**	**21**	**22**	**10**	**167**	**100**

IP3151 **INDUCTION PROGRAMME**

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

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

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

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

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

(i) Physical Activity
This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

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

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

(iv)Literary Activity

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

(v) Proficiency Modules

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

(vi) Lectures by Eminent People

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

(vii) Visits to Local Area

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

(viii) Familiarization to Dept./Branch & Innovations

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

(ix) Department Specific Activities

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

U23HST11 **COMMUNICATIVE ENGLISH**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To enhance students listening ability for academic and Professional purposes.
2. To learn to use basic grammatical structures in suitable contexts.
3. To help students acquire the ability to speak effectively in English in real life situations.
4. To help learners use language effectively in professional contexts.
5. To develop student's ability to read and write complex texts, summaries, articles, definitions, paragraph user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 9

Define communication. Kinds of communication. Quintessential of communication in technical progression. Key characteristics of an effective communicator- listening, attitude modification, way of response with appropriate language, tone modulation. Listening- Listening to TV news, Guest lectures. Speaking- Answering the Questions. Reading - Reading brochures and technical magazines (technical context), telephone messages / social media messages relevant to technical contexts and emails, Writing-Reading comprehension, Parts of Speech.

UNIT II READING QUEST 9

Listening- listening and responding to video lectures/talks. Speaking- Day today conversations. Reading –Edison of India-GD Naidu "The Great Inventor". Writing- Emails / Informal Letters - Inviting, Congratulating & Thanking, Punctuations.

UNIT III LANGUAGE RESOURCE GROWS CRITICAL JUDGEMENT 9

Listening- listening to specific task-focused audio tracks. Speaking- summary of Robert Frost "Stopping by woods on a snowy evening". Reading – Reading advertisements, gadget reviews; user manuals. Writing – Essay Writing: Analytical essay: Narrative Essay, Developing Hints, Usage of tenses in sentence formation. Voices.

UNIT IV LANGUAGE IN LIFE SKILL 9

Listening- Listening to speech of Great Scholars. Speaking- mechanics of presentation. Reading – Newspaper articles, power point presentation. Writing – Checklist, Jumbled sentences-Rearrange the sentences in correct order, WH-Questions-Form questions by using statements, Prefixes and Suffixes.

UNIT V IMPROVING SPEAKING &READING 9

Listening- listening to situational based dialogues; Speaking- Stating intention to do something-Expressing opinion-asking people to repeat themselves. Reading – Summary of O.Henry's "The last Leaf". Writing – Dialogue Writing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to:

CO1 : Remember appropriate words in a situational conversation.
CO2 : Gain understanding of basic grammatical structures and use them in right context.
CO3 : Read and infer the denotative and connotative meanings of technical texts.
CO4 : Write Dialogue, Letter and paragraphs on various topics.
CO5 : Make the students prepare effective notes for main sources available.

CO6 : Enhance them to give operational talk.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

		L	T	P	C
U23MAT12	**MATRICES AND CALCULUS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES

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

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To familiarize the students with differential calculus.
3. To familiarize the student with functions of several variables
4. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
5. To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems

UNIT I MATRICES 12

Introduction – Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley Hamilton theorem – Diagonalization of the matrices by Orthogonal Transformations – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 12

Limit of a function – Continuity – Derivatives – Differentiation rules – Implicit differentiation – Logarithmic differentiation – Maxima and Minima of functions of one variable.

UNIT III MULTIVARIABLE CALCULUS 12

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

UNIT IV MULTIPLE INTEGRAL AND THEIR APPLICATIONS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNITV ORDINARY DIFFERENTIAL EQUATIONS 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Use the matrix algebra methods for solving practical problems.

CO2 : Use both the limit definition and rules of differentiation to differentiate functions.

CO3: Apply differential calculus tools in solving various application problems.

CO4: Able to use differential calculus ideas on several variable functions.

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

CO6 Solve the ordinary differential equations using different techniques for that model engineering problems.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23PHT13	PHYSICS FOR ENGINEERS AND TECHNOLOGISTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To make the students to gain the knowledge in elastics and plastic nature of the materials in the presence and absence of load.
2. To understand the students to know the application of the sound waves in different fields.
3. To motivate the students towards the applications of photo electric phenomena.
4. To know the physical principle of LASER, the working of LASER applications.
5. To understand the propagation of light in optical fibers and its applications.

UNIT I ELASTICITY 9

Introduction- Elasticity - plasticity– Hooke's law - relationship between three Modulii of elasticity (Qualitative) – stress & strain diagram and its uses -Poisson's ratio - factors affecting elasticity - twisting ouple of wire - Torsion Pendulum: theory and experiment.

Beam: Internal bending moment – Cantilever: theory and experiment – Young's Modulus: uniform and non – uniform bending (Qualitative) – I-shaped girders- advantages and applications.

UNIT II ULTRASONICS 9

Introduction – classification of sound- properties of infrasonic, audible and ultrasonics - production: Magnetostriction and Piezoelectric methods – determination of velocity of sound in liquid (Acoustic Grating Method) – general applications – industrial application: Non - Destructive Testing: pulse echo system through transmission and reflection modes. ultrasonic scanning methods – medical application: sonogram.

UNIT III MODERN PHYSICS 9

Introduction –Black Body Radiation – Classical and Quantum Laws of Black Body Radiation - Photon and its Properties - Wave Particle Duality and Matter waves – De - Broglie Wavelength - Schrodinger's Time Independent and Time Dependent Wave Equations - Physical Significance of The Wave Function. Application: Particle in One Dimensional Box - Normalization Process – Photo Electric Effect – Laws Governing the Photoelectric Effect – Einstein's Formula - Derivation – Applications: Solar Cell – Solar Water Heater – Photo resistor (LDR).

UNIT IV LASERS 9

Lasers: Introduction - Properties of Laser-Spontaneous and Stimulated Emission Process - Einstein's Theory of Matter Radiation Interaction & A and B Coefficients; Amplification of Light By Population Inversion – Pumping Methods - Types of Lasers: Solid-State Laser (Homo And Hetero Junction Semiconductor Lasers), Gas Laser (CO_2), Applications: Laser Cutting and Welding, LIDAR and Barcode Scanner.

UNIT V FIBER OPTICS AND APPLICATIONS 9

Optical Fiber: Structure - advantages- Principle [TIR]–Propagation Phenomena in optical fiber - Expression For Acceptance Angle and Numerical Aperture – Relation between Refractive Index of Core, Numerical Aperture and Fractional Index Change – Fabrication: Double Crucible Method - Types: Material, Mode, Refractive Index - Applications: Optical Fiber Communication System – fiber optic sensors (Displacement and pressure sensors) – Medical Endoscope.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Differentiate the elastic and plastic nature of the materials.
CO2 : Know the experimental techniques in both production and applications of ultrasonic waves.
CO3: Gain knowledge in the basics of quantum mechanics concepts.
CO4: Develop new devices based on LASER source.
CO5: Understand the advantages of optical fiber than metal wire.
CO6: Demonstrate the some useful experiments based on optical fibre

TEXT BOOKS:

1. Dr. P.Mani, "Engineering Physics", Dhanam Publications, 2013.
2. Dr. G. Senthilkumar, "Engineering Physics", VRB Publishers, 2017.
3. K. Thyagarajan, Ajoy Ghatak, "Lasers Fundamentals and Applications" II nd Edition, Springer, 2010.
4. D.K. Bhattacharya, Poonam Tandon," Engineering Physics", Oxford HED Publishers, 2017.

REFERENCE BOOKS:

1. Marikani, "Engineering Physics", PHI, New Delhi, 2013.
2. Bhattacharya & Bhaskaran, "Engineering Physics", Oxford Publications, 2012.
3. R Murugeshan, Kiruthiga, Sivaprasath S, "Modern Physics", Chand Publishing, 2021.
4. S. Rajivgandhi & A. Ravikumar, " Engineering Physics I", RK Publications, 2023
5. Sathyaprakash, "Quantum Mechanics", Pragati Prakashan, Meerut, 2016.

U23CYT14	CHEMISTRY FOR ENGINEERING & TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To inculcate sound understanding of water quality parameters and water treatment techniques.
2. Impart knowledge on the basic principles and preparatory methods of nanomaterial.
3. To introduce the basic concepts and applications of phase rule and composites.
4. To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5. Tofamiliarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER TREATMENT 9

Water: Sources , impurities, Parameters. Types of water Hardness of water -types – expression of hardness – units – Estimationof hardness of water by EDTA. Desalination - Reverse Osmosis. Boiler troubles: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process.

UNIT II ELECTRO AND NANO CHEMISTRY 9

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf by Poggendorff's compensation principle. Single electrode potential – Nernst equation – reference electrodes -types–Calomel electrode - electrolysis of water.

Nanomaterials:Basics of Nano Chemistry: Distinction between molecules, nanomaterials and bulkmaterials. Preparation of nanomaterials- laser ablation method and Chemical VapourDeposition(CVD). Application of Nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule terms with examples. water system; Reduced phase rule Two component system: lead-silver system – Composites , Need , Constitution: Matrix materials, Applications and Reinforcement and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS & COMBUSTION 9

Fuels –Classification-Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.

UNITV ENERGY SOURCES AND STORAGE DEVICES 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.

CO2 : Apply the basic knowledge of Corrosion and various electrodes.

CO3: Know the economically and new methods of synthesis nano materials.

CO4: Apply the knowledge of phase rule and composites for material selection requirements.

CO5: Understand the concepts ofsuitable fuels for engineering processes and applications.

CO6: Have the knowledge of different forms of energy resources and apply them for suitable applicationsin energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
4. J.Manivel , "Engineering Chemistry" R.K.Publishers, 1st Edition 2022.

REFERENCE BOOKS:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.

U23GET16	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

COURSE OBJECTIVES

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

1. To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing national standards related to technical drawings.
3. Develop proficiency in 2D drafting using drawing tools.
4. Learn sectional views and assembly drawing techniques.
5. Enhance visualization skills for improved problem-solving and communication in engineering.

UNIT I PLANE CURVES AND ORTHOGRAPHIC PROJECTION 6+12

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimension. 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- Freehand sketching of multiple views from pictorial views of objects.

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

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

UNIT III PROJECTION OF SOLIDS 6+12

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

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

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

UNITV ISOMETRIC PROJECTION 6+12

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

TOTAL: 30+40=90 PERIODS

COURSE OUTCOMES:

At the end ofthe course thestudentswouldbeableto

CO1 : Identify the significance of graphics in engineering applications.

CO2 : Project straight lines inclined to both principal planes and determine true lengths

and inclinations.

CO3: Apply orthographic projection techniques to project solids.

CO4: Apply the principles of development to prisms, pyramids, cylinders, and cones.

CO5: Combine two solid objects in simple vertical positions using isometric projection.

CO6: Utilize the isometric scale effectively.

TEXT BOOKS:

1. Natrajan K.V., ―A text book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., ―Engineering Graphics‖, New Age International (P) Limited, 2008

REFERENCE BOOKS:

1. Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., ―Engineering Drawing‖, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., ―Engineering Drawing‖ (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. andDuff,John M., ―Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
6. N S Parthasarathy and Vela Murali, ―Engineering Graphics‖, Oxford University, Press, New Delhi, 2015.

GE3152	HERITAGE OF TAMILS/ தமிழர் மரபு	L	T	P	C
		1	0	0	1

UNIT I/myF1 **LANGUAGE AND LITERATURE** **3**

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

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

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

UNIT III **FOLK AND MARTIAL ARTS** **3**

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

UNIT IV **THINAI CONCEPT OF TAMILS** **3**

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

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

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

TOTAL: 15 PERIODS

REFERENCE BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
   Tamil Nadu)
7. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)

(Published by: The Author)

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

தமிழர் மரபு

பாடத்திட்டம்

அலகு1: மொழி மற்றும் இலக்கியம்:

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

அலகு2: மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக்கலை

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

அலகு3: நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:

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

அலகு4: தமிழர்களின் திணைக்கோட்பாடுகள்:

தமிழகத்தின் தாவரங்களும் , விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு- சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும் , கல்வியும் - சங்க கால நகரங்களும் துறை முகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு:5 இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:

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

U23BSP11 **PHYSICS AND CHEMISTRY LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES

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

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear and concise manner.
3. To learn problem solving skills related to physics principles and interpretation of experimental data.
4. To determine error in experimental measurements and techniques used to minimize such error.
5. To make the student as an active participant in each part of all lab exercises.
6. To inculcate experimental skills to test basic understanding of water quality parameters, as, acidity, alkalinity, chloride.
7. To Induce the students to analyze the hardness of water
8. To induce the students to familiarize with electroanalytical techniques such as, pH metry, conductometry in the determination of impurities in aqueous solutions.

LIST OF EXPERIMENTS

1. Torsion pendulum - Determination of rigidity modulus of wire and moment of inertia of regular disc.
2. Non - Uniform bending–Determination of Young's modulus.
3. Laser – (i) Determination of the wavelength of the laser using grating.
   (ii) Determination of size of the particles using laser source.
4. Air wedge – Determination of thickness of a thin sheet/wire.
5. Determination of Band gap of a semiconductor using PN junction kit.
6. To study the V-I Characteristics of Light Dependent Resistor (LDR).
7. Determination of types and amount of alkalinity in water sample.
8. Determination of total, temporary & permanent hardness of water by EDTA method.
9. Determination of chloride content of water sample by Argentometric method.
10. Determination of strength of given hydrochloric acid using pH meter.
11. Determination of strength of acids in a mixture of acids using conductivity meter.
12. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	PH meter	5
2.	Conductivity meter	10
3.	Common Apparatus(Pipette, Burette, Conical Flask, Porcelain tile, Dropper)	15

COURSE OUTCOMES:

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

CO1 : Understand the functioning of various physics laboratory equipment.

CO2 : Observe and tabulate experimental data.

CO3: Solve problems individually and collaboratively.

CO4: To analyse the quality of water samples with respect to their acidity, alkalinity

CO5: To determine the amount of hardness in the water

CO6: To quantitatively analyse the impurities in solution by electroanalytical techniques

U23HSP12 **ENGLISH LABORATORY**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

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

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

LIST OF EXPERIMENTS

1 Listening for general information-specific details.
2 Conversation: Introduction to classmates.
3 Speaking - making telephone calls-Self Introduction.
4 Talking about current and temporary situations & permanent and regular situations.
5 Listening to podcasts, anecdotes / stories / event narration.
6 Event narration; documentaries and interviews with celebrities.
7 Events-Talking about current and temporary situations & permanent and regular situations.
8 Engaging in small talk.
9 Describing requirements and abilities- Picture description.
10 Discussing and making plans.
11 Talking about tasks- progress- positions -directions of movement.
12 Talking about travel preparations and transportation.
13 Listening to debates/ discussions.
14 Making prediction talking about a given topic.
15 Describing processes.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	**30**
2.	Server	**1**
3.	Head phone	**30**
4.	Audio mixture	**1**
5.	Collar mike	**1**
6.	Television	**1**
7.	Speaker set with amplifier	**1**
8.	Power point projector and screen	**1**
9.	Cordless mike	**1**

COURSE OUTCOMES:

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

CO1 : Identify and comprehend complex academic texts.

CO2 : Interpret accurately and fluently in formal and informal communicative contexts.

CO3: Demonstrate their opinions effectively in both oral and written medium of communication.

CO4: Plan travelogue and construct paragraphs on various aspects.

CO5: Develop journal reading skills and small talk.

CO6: Utilizing technical terms and making power point presentations.

U23GEP14 ENGINEERING PRACTICES LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

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

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

GROUP – A (CIVIL AND MECHANICAL)

PART I CIVIL ENGINEERING PRACTICES PLUMBING WORK: 30

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

WELDING WORK:

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

BASIC MACHINING WORK:

a) Turning
b) Drilling
c) Tapping

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.

SHEET METAL WORK:

a) Making of a square tray

WOOD WORK:

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

PART II ELECTRICAL & ELECTRONICS 30

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

ELECTRONICS

1. Study of Electronic components and equipments – Resistor, colour coding

measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.

2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL = 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15Sets.
2. Carpentry vice (fitted to work bench) 15Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5each
5. Power Tools: (a) Rotary Hammer 2 Nos (b) Demolition Hammer 2 Nos (c) Circular Saw 2 Nos (d) Planer 2 Nos (e) Hand Drilling Machine 2 Nos (f) Jigsaw 2Nos

MECHANICAL

Arc welding transformer with cables and holders 5 Nos.

1. Welding booth with exhaust facility 5Nos.
2. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5Sets.
3. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2Nos.
4. Centre lathe 2Nos.
5. Hearth furnace, anvil and smithy tools 2Sets.
6. Moulding table, foundry tools 2Sets.
7. Power Tool: Angle Grinder 2Nos
8. Study-purpose items: centrifugal pump, air-conditioner One each

ELECTRICAL

1. Assorted electrical components for house wiring 15Sets
2. Electrical measuring instruments 10Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1No.
5. Power Tools:
   a) Range Finder 2Nos
   b) Digital Live-wire detector 2Nos

ELECTRONICS

1. Soldering guns 10Nos.
2. Assorted electronic components for making circuits 50Nos.
3. Small PCBs 10Nos.
4. Multimeters 10Nos.

Study purpose items: Telephone, FM radio, low-voltage power supply.

COURSE OUTCOMES:

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

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

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

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

CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components onPCB.

CO5: Apply fundamental engineering principles to analyze and solve real-world problems.

CO6: Demonstrate proficiency in using engineering tools and equipment.

U23HST21	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

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

1. To engage learners in meaningful language activities to improve their reading and writing skills.
2. To learn various reading strategies and apply in comprehending documents in professional context.
3. To help learners understand the purpose, audience, contexts of different types of writing.
4. To enable students write letters and reports effectively in formal and business situations.
5. To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT I PREPARATORY DOCUMENTATIONS 9

Listening- Listening to formal conversations and Participating**. Speaking-** speaking about one's family. **Reading –** Summary of W.W Jacobs "The monkey's paw". **Writing –** Subject verb Agreement, Numerical -Adjectives, Kinds of sentences**,** Writing reviews (book / film), writing Instructions, Writing Recommendation.

UNIT II LECTURA ENRICHMENT AND PASSAGE COMPOSE 9

Listening- listening to lectures on academic topics; **Speaking-** Asking for and giving directions. **Reading -** Reading longer technical texts; **Writing -** Compound words, Homophones and Homonyms, Cause and Effect expressions. Essay Writing, Writing Letter to the Editor (complaint, acceptance, Requesting, Thanking).

UNIT III ANALYTICAL SKILL 9

Listening- Watching videos/documentaries and responding to questions based on them. **Speaking –**Speaking about ones favourite place**. Reading –** Summary of the poem – John keats "Ode to a Nightingale". **Writing-** Purpose statement, Extended Definitions. Writing Job/ Internship application – Cover letter & Resume.

UNIT IV REPORT WRITING 9

Listening- Listening to class room lectures/talks on engineering/technology. **Speaking–** Introduction to technical presentations. **Reading –** Newspaper articles; **Writing –** Comparative Adjectives Direct and Indirect speech**.** Report Writing- Fire Accident Report, Road Accident, Feasibility Report).

UNITV ENABLING LINGUA IDEALITY & INFORMATION 9

Listening- TED/Ink talks. **Speaking –** Making presentation on a given topic. **Reading –**Company profiles, Statement of Purpose, (SOP), **Writing –** Relative Clauses, If conditions, Cause and Effect. Chart Interpretations - Bar Chart, Pie Chart, Flow Chart & Tables.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Compare and contrast products and ideas in technical texts.
CO2 : Identify cause and effects in events, industrial processes through technical texts.
CO3 : Analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.
CO4 : Motivate students to write reports and winning job applications.
CO5 : Recall and comprehend different discourses and genres of texts.
CO6 : Making the students to become virtuous presenters.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23MAT22	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. This course aims at providing the necessary basic concepts of a few statistical tools and give procedures for solving different kinds of problems occurring in engineering and technology.
2. To acquaint the knowledge of classifications of design of experiments in the field of agriculture.
3. To introduce the basic concepts of solving algebraic and transcendental equations.
4. To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
5. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 12

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

UNIT II DESIGN OF EXPERIMENTS 12

Introduction – Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Gauss Jordan method — Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen Value of a matrices by power method and jacobi's method for Symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 12

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

UNITV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2 : Apply the basic concepts of classifications of design of experiments in the field of agriculture.

CO3:	Solve the algebraic and transcendental equations.
CO4:	Understand the knowledge of numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO5:	Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.
CO6:	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Burden,R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi , 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi,12th Edition, 2020.
5. Spiegel.M.R.,Schiller.J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.

U23GET15	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

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

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

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

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

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

UNIT IV LISTS, TUPLES, DICTIONARIES 9

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

UNITV FILES, MODULES, PACKAGES 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23EET25	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. the basics of electric circuits and analysis
2. The impart knowledge in domestic wiring
3. The impart knowledge in the basics of working principles and application of electrical machines
4. Analog devices and their characteristics
5. The functional elements and working of sensors and transducers

UNIT I ELECTRICAL CIRCUITS 9

Basic circuit components -Ohms Law Kirchhoff's Law – Instantaneous Power – Inductors - Capacitors– Independent and Dependent Sources-steady state solution of DC circuits-Nodal analysis, Mesh analysis-Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

UNIT II AC CIRCUITS 9

Introduction to AC circuits–waveforms and RMS value–power and power factor, single phase and three-phase balanced circuits–Three phase loads-housing wiring, industrial wiring, and materials of wiring. safety precautions and First Aid.

UNIT III ELECTRICAL MACHINES 9

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

UNIT IV ANALOG ELECTRONICS 9

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

UNITV SENSORS AND TRANSDUCERS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Compute the electric circuit parameters for simple problems.
CO2 : Explain the concepts of domestics wiring.
CO3: Explain the concepts of protective devices.
CO4: Explain the working principle and applications of electrical machines.
CO5: Analyze the characteristics of analog electronic devices.
CO6: Explain the types and operating principles of sensors and transducers

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020.
2. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4. James A Svoboda, Richard C. Dorf, Dorf's Introduction to Electric Circuits, Wiley,2018

REFERENCE BOOKS:

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

U23PTT21	BIOCHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. learn the fundamentals of Biochemical Processes and Biomolecules
2. Acquire knowledge on bioenergetics
3. Understand the knowledge on biochemistry of diseases
4. Able to explain the enzyme actions in the human body
5. Understand the role of vitamins in biochemical process

UNIT I BIOCHEMICAL ORGANIZATION 9

Scope of clinical biochemistry, component of the cell, structure and biochemical functions, membrane structure and functions, transport through biological cell membrane, transport mechanism, the concept of free energy.

UNIT II BIOMOLECULES 9

Carbohydrates – classification, properties. Starch, glycogen, dextrin, insulin, cellulose, metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis, citric acid cycle and its biological significance, role of sugar in nucleotide biosynthesis and pentose phosphate pathway. Lipids – Classification, properties- sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, oxidation of fatty acids, α , β oxidation and biosynthesis of cholesterol and porphyrin Proteins and amino acids – Classification, properties, essential and non-essential amino acids, biosynthesis of amino acids. Nucleic acids –genetic code, nucleic acids, and structure of DNA and RNA, purine biosynthesis and pyrimidine biosynthesis.

UNIT III BIOENERGETICS 9

High energy compounds, respiratory chain, ATP cycle, Calculation of ATP during oxidation of glucose and fatty acids. General concept of oxidation and reduction, electron transport chain, oxidative phosphorylation, uncouplers and theories of biological oxidation, chemiosmotic hypothesis

UNIT IV MACROMOLECULES, VITAMINS, HORMONES, ENZYMES 9

Structure of haemoglobin, immunoglobulins and nucleoprotein, classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme, chemical nature and properties, hormones, Enzyme classification and their properties, mechanism of action, enzyme induction and inhibition, coenzyme significance and enzymes of clinical importance.

UNITV BIOCHEMISTRY OF CLINICAL DISEASES 9

Diabetes mellitus, atherosclerosis, Renal failure and obesity, hormonal disorders, aging, inborn errors of metabolism organ function tests.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Gain knowledge on various biomolecules

CO2 : Acquire knowledge on bioenergetics

CO3: Get knowledge on biochemistry of diseases

CO4: Explain the enzyme actions in the human body

CO5: Discuss the role of vitamins in biochemical process

TEXT BOOKS:

1. Lehninger A.L., Nelson D.L. and Cox M.M. “Principles of Biochemistry”. CBS Publishers and Distributers
2. Thomas M. Devlin. “Textbook of Biochemistry with clinical correlations”. Wiley Liss Publishers

REFERENCE BOOKS:

1. Burtis & Ashwood W.B. Tietz “Textbook of Clinical chemistry”. Saunders Company.
2. Lubert Stryer W.H. “Biochemistry”. Freeman and company, New York.
3. Donald Voet & Judith G. Voet. “Biochemistry”. John Wiley and Sons, Inc.
4. Rama Rao. “Textbook of Biochemistry .
5. Deb. “Textbook of Biochemistry”.

U23PHT26 **PHYSICS OF MATERIALS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To make the students to understand the basics of crystallography and its importance in studying materials properties.
2. To expand their knowledge in applications of magnetic and superconducting materials in small scale industries.
3. To inculcate an idea of significance of new materials, nanostructures ensuing nano device applications.

UNIT I CONDENSED MATTER PHYSICS 9

Introduction - Lattice - Unit Cell - Seven Crystal Systems -Bravai's Lattices - Lattice Planes - Calculation of Number of Atoms per Unit Cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP Structures. Miller Indices – Derivation for Inter-Planar Spacing in terms of Miller Indices-Crystal Growth Techniques: Melt Growth Technique (Bridgman and Czochralski Techniques).

UNIT II MAGNETIC AND SUPER CONDUCTING MATERIALS 9

Magnetic Materials: Dia, Para and Ferromagnetic Materials and Its Properties – Ferromagnetic Domains – Wiess Theory of Ferromagnetism – Hysteresis - B-H Curve Studies – Soft and Hard Magnetic Materials- Applications.

Super Conducting Materials: Properties – Type I and Type II Super Conductors – London equations – Applications: Magnetic Levitated Train – Magnetic Resonance Imaging.

UNIT III MODERN ENGINEERING MATERIALS 9

Shape Memory Alloys – Structures – Properties – Applications. Metallic Glasses – Preparation and Applications. Ceramics – Types - Properties and Applications.

Nano Materials – Types – Properties and Applications – Preparation Techniques: Electrodeposition – Pulsed Laser Deposition. CNT – Structure – Types – Properties - Applications

UNIT IV INSTRUMENTATION PHYSICS 9

X – rays – Production – Diffraction of X – rays – Laue'e experiment – Bragg's law – Bragg's X – ray Spectrometer – Diffraction methods – Laue method – Rotating Crystal method – Powder Crystal method.

Optical microscope – Electron microscope – Scanning electron microscope – Transmission electron microscope – EDAX – FTIR.

UNITV RADIOACTIVE MATERIALS 9

Nucleus: Classification, Properties – Radioactivity – Alpha, Beta and Gamma rays – Properties – Laws of disintegration – Half-life period – Mean life -Neutron and its properties.

Artificial radioactivity – Applications and hazards of nuclear radiations – Detectors of Nuclear radiations: Solid State detectors – Proportional Counter – Geiger-Muller Counter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Know basics of crystallography and its importance for varied materials properties.

CO2 : Gain knowledge on the magnetic and superconductor properties of materials and their applications.

CO3: Illustrate the SMA and metallic glasses.
CO4: Gain knowledge in the development of instruments.
CO5: Get knowledge about radioactive materials.
CO6: Understand the concept of detectors and counters.

TEXT BOOKS:

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019
2. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition),2009.
3. Dr. P. Mani, "Physics for Electronics Engineering" Dhanam Publications, 2017.
4. Dr. G. Senthilkumar, "Engineering Physics II" VRB Publishers, 2013.

REFERENCE BOOKS:

1. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
2. S. Rajivgandhi, Dr. I. Cicil Ignatius & A. Ravikumar, " Engineering Physics II", RK Publications, 2023
3. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.
4. Dr. G. Senthilkumar, A. Ravikumar & S. Rajivgandhi, " Engineering Physics II", VRB Publishers, 2023

GE3252	TAMILS AND TECHNOLOGY/ தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

UNIT I/ WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries

UNIT II DESIGN AND CONSTRUCTIO N TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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

UNITV SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

TOTAL: 15 PERIODS

REFERENCE BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text

Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

`

GE3252 - தமிழரும் தொழில்நுட்பமும்

L T P C
1 0 0 1

அலகு 1: நெசவு மற்றும் பானைத் தொழில்நுட்பம். 3

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

அலகு 2: வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம். 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ரூ சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோவில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம்; மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டி~; காலத்தில் சென்னையில் இந்தோ- சாரோசெனிக் கட்டிடக் கலை.

அலகு 3: உற்பத்தித் தொழில்நுட்பம். 3

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

அலகு 4: வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம். 3

அணை,ஏரி,குளங்கள்,மதகு – சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடைபராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல்- பெருங்கடல்குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு 5: அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி – கணினித்தமிழ் வளர்ச்சி – தமிழ்நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம்; - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின்நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

U23HSP22 **COMMUNICATION LABORATORY**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

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

1. To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
2. To be able to communicate effectively through writing.
3. Encouraging plan designing and decision making.
4. Understanding and writing technical instruction.
5. To understand the value of letter writing with correct format.

LIST OF EXPERIMENTS:

1. Speaking-Role Play Exercises Based on Workplace Contexts.
2. Talking about competition.
3. Discussing progress toward goals-talking about experiences.
4. Discussing likes and dislikes.
5. Discussing feelings about experiences.
6. Discussing imaginary scenarios.
7. Writing short essays.
8. Speaking about the natural environment.
9. Describing communication system.
10. Describing position and movement- explaining rules.
11. Understanding technical instructions-Writing: writing instructions.
12. Speaking: describing things relatively-describing clothing.
13. Discussing safety issues (making recommendations) talking about electrical devices.
14. Describing controlling actions.
15. Writing a job application (Cover letter + Resume).

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	30
2.	Server	1
3.	Head phone	30
4.	Audio mixture	1
5.	Collar mike	1
6.	Television	1
7.	Speaker set with amplifier	1
8.	Power point projector and screen	1
9.	Cordless mike	1

COURSE OUTCOMES:

At the end of the course the students would be able to:

CO1 : Distinguish their technical competency through language skill.

CO2 : Predict context effectively in-group discussions held in a formal / semi-formal discussions.

CO3: Understanding candidates' key characteristics.

CO4: Finding personality traits by sharing and comparing thoughts and ability.

CO5: Understanding the value of ethics.(rules and regulations).
CO6: Construct emails and effective job applications**.**

U23GEP13	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

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

LIST OF EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to:

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

U23PTP21	BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. learn and understand the principles behind the qualitative estimation of bio molecules (proteins, carbohydrates, lipids, metabolites etc.,)
2. learn and understand the laboratory analysis in the body fluids.
3. learn and understand the principles behind the quantitative estimation of bio molecules (proteins, carbohydrates, lipids, metabolites etc.,)
4. Evaluate the chloride, ammonia and creatinine in urine
5. Understand the quantitative estimation of blood glucose and serum chloesterol

LIST OF EXPERIMENTS

1. Preparation and measurement of pH of standard buffers (phosphate, carbonate, borate, TRIS etc,)
2. Qualitative analysis of carbohydrates (monosaccharide, disaccharides, polysaccharides etc.,)
3. Enzymatic hydrolysis of glycogen by a and ß amylase
4. Qualitative analysis of proteins
5. Qualitative analysis of lipids (triglycerides, cholesterol, phospholipids etc.,)
6. Quantitative analysis of proteins (Lowry‟s method, Bradford, UV)
7. Quantitative analysis of carbohydrates (Benedict‟s method etc.,) lipids
8. Quantitative analysis of lipids (Benedict‟s method etc.,)
9. Quantitative estimation of blood glucose
10. Acid hydrolysis and action of salivary amylase on starch
11. Estimation of chloride, glucose, ammonia and creatinine in urine.
12. Quantitative estimation of serum cholesterol by Libermann Burchard‟s method

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Autocalve	1
2.	Hot Air Oven	1
3.	Incubators	2
4.	Light Microscopes	4
5.	Incubator Shaker	1
6.	Colorimeter	2
7.	Laminar Flow Chamber	2
8.	Test tubes	200
9.	Beakers – 50 ml, 100 ml, 250 ml one each per student	20
10.	Beakers - 500 ml and 1000 ml atleast 5 per batch of 20 students	5
11.	Watch glasses one per student	20
12.	Petridishes as required, glass cuvettes as	20

	Needed	
13.	Burette – one per student	20
14.	Glass pipette – one each in 0.5 ml, 1 ml, 5 ml and 10 ml with suitable pipette aid	20
15.	TLC plate as required for the experiment	20
16.	Chemicals: glucose, fructose, galactose, maltose, starch, amino acids, DNA, RNA, lipids and commercial enzymes as required	20

COURSE OUTCOMES:

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

CO1 : Correlate molecular structure and interactions present in proteins, nucleic acids, carbohydrates and lipids

CO2 : Recognize the laboratory analysis in the body fluids.

CO3: Estimate the quantitative and qualitative analysis of bio molecules (proteins, carbohydrates, lipids, metabolites etc.,)

CO4: Adapt methods for biochemical analysis.

CO5: Perform good biochemical laboratory practices.

CO6: Understand the applicability of biochemical methods to realistic solution

U23MAT31	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. To introduce the basic concepts of PDE for solving standard partial differential equations.
2. To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
3. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
4. To acquaint the student with Fourier transform techniques used in wide variety of situations.
5. To enable the students to study the Laplace transforms and some applications to solve the differential equations.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Solution of homogeneous linear partial differential equations of higher order with constant coefficients of both homogenous and non – homogenous type.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions–Half range sine series and cosine series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation — One dimensional equation of heat conduction — Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms — Properties — Transforms of simple functions — Convolution theorem — Parseval's identity.

UNITV 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 second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand how to solve the given standard partial differential equations.

CO2 : Able to solve various types of partial differential equations.

CO3: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.

CO4:	Appreciate the physical significance of Fourier series techniques in solving One and two dimensional heat flow problems and one dimensional wave equations.
CO5:	Understand the mathematical principles on transforms would provide them the ability to formulate and solve some of the physical problems of engineering.
CO6:	Use the method of Laplace Transform to solve initial value problem for Linear differential equations with constant coefficients.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers , New Delhi ,2018.
2. Kreyszig E, "Advanced Engineering Mathematics", 10th Edition, John Wiley,New Delhi,India,2016.

REFERENCE BOOKS:

1. Andrews. L.C and Shivamoggi .B, "Integral Transforms for Engineers "SPIE Press,1999.
2. Bali. N.P and Manish Goyal, "A Text book of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd ,2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pears on Education, New Delhi,2016.
4. Narayanan. S.,Manicavachagom Pillay. T.K and Ramanaiah. G "Advanced Mathematics for Engineering Students",Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd,NewDelhi,2018.

		L	T	P	C
U23PTT31	**CHEMICAL PROCESS CALCULATIONS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

1. Learn about the basic calculation techniques used in process industries
2. Learn the laws about the behaviour of gases, liquids and solids,
3. Analysing and designing chemical processing equipment with the help of data sources containing relevant physical and chemical properties
4. Impart knowledge on laws of chemistry and its application.
5. Understand to solve the mass and energy balance equations.

UNIT I UNITS AND DIMENSIONS 9

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

UNIT II IDEAL GASES AND VAPOUR PRESSURE 9

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

UNIT III HUMIDITY AND SOLUBILITY 9

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

UNIT IV MATERIAL BALANCE 9

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

UNITV ENERGY BALANCE 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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

CO2 : Comprehend the different gas laws, and students would be able to solve the problems on stoichiometry quantity of gaseous substances in industry.

CO3: Know the various measurements of humidity and clear about applying humidity charts, psychometric charts, and concepts of vaporization and vapor

pressure laws

CO4: Analyze the behaviour of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.

CO5: Attain the energy balance concepts necessary for solution of energy balance of different chemical engineering processes in industries

CO6 Independently develop a stoichiometry problem solving ability in a number of useful mathematical and chemical operations

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23PTT32	MICROBIOLOGY AND IMMUNOPATHOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the students to know the structure and biochemical aspects of various microbes.
2. To solve the problems in microbial infection and their control.
3. Know the applications of microbes in industries and in environmental aspects.
4. Have knowledge on immune systems and the system related diseases.
5. Understand the current applications of biotechnology to environmental quality evaluation, monitoring and remediation of contaminated environments.

UNIT I INTRODUCTION 9

Microbes: Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages- Examination of microorganisms- Light and electron microscopy, Principles of various staining techniques

UNIT II MICROBIAL NUTRITION, GROWTH AND METABOLISM 9

Nutritional requirements of bacteria-different media used for bacterial culture, growth curve and different methods to quantify bacterial growth, aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules; Primary metabolites, secondary metabolites and their applications, production of penicillin, alcohol, vitamin B-12.

UNIT III CONTROL OF MICROORGANISMS 9

Physical and chemical control of microorganisms, host-microbe interactions, anti-bacterial, antifungal and anti-viral agents, mode of action and resistance to antibiotics, clinically important microorganisms.

UNIT IV INTRODUCTION TO IMMUNOPATHOLOGY 9

Natural and artificial immunity; T-Cells; B-Cells; Hypersensitivity and its types, antibody and cell mediated tissue injury: opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection- Auto- immune disorders.

UNITV TECHNQUES IN IMMUNOPATHOLOGY 9

Basic concepts and classification, SLE-Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immunoelectrophoresis, RIA and ELISA, monoclonal antibodies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Upon completion of the course, the students would be able to understand about Microorganisms and examination of microorganisms

CO2 : Structural organization of microorganisms

CO3: Nutritional requirements of microorganisms, their growth and metabolism Control of microorganisms

CO4: Develop knowledge of the main immunological techniques used in research and diagnostics.

CO5: Metabolites, bioremediation, biofertilizers, biopesticides and biosensors

CO6: Synthesize a number of products valuable to human beings.

TEXT BOOKS:

1. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India, 2012
2. Prescott L.M., Harley J.P., Klein DA, Microbiology, 11th Edition, Wm. C. Brown Publishers, 2019.

REFERENCE BOOKS:

1. Ananthanarayanan & Panicker, ―Microbiology‖ Orientblackswan, 2017 10th edition.
2. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, ―Pathologic Basis of Diseases‖, 7th edition,WB Saunders Co. 2005
3. Sell, S., Max, E. E., & Berkower, I. Immunology, immunopathology and immunity (No. QR181 S44 2001). Washington, DC: ASM press. 2001.
4. Warrington, R., Watson, W., Kim, H. L., & Antonetti, F. R., An introduction to immunology and immunopathology. Allergy, Asthma & Clinical Immunology, 7(1), 1-8. (2011).

U23PTT33	PHARMACEUTICAL CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry.
2. To provide the basic functional group identification, molecular rearrangement, chemical bonding with their reaction mechanism.
3. To provide the fundamental principles involved in the identification, preparation of pharmaceutical aids
4. To apply the principle of coordination compounds in pharmaceutical substances
5. Knowledge about the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.

UNIT I STRUCTURE AND PROPERTIES 9

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

UNIT II CHEMISTRY OF ALIPHATIC, AROMATIC AND HETEROAROMATIC COMPOUNDS 9

Characteristics of organic compounds, structure, nomenclature, preparation and reaction mechanism of alkyl and aryl halides (Mechanism of SN1, SN2, E1 and E2), Huckel's rule, structures, synthesis, properties and chemical reactions of benzenoid and nonbenzenoid compounds, mechanism of aromatic electrophilic and nucleophilic substitution. General principles of heterocyclic synthesis – Methods of preparation and reactions of Pyridines – Pyrroles – Thiophenes – Furans – Quinolines – Isoquinolines

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 and lead with suitable examples.

UNIT IV STUDY OF ORGANIC REACTIONS AND MOLECULAR REARRANGEMENTS 9

Hoesch reaction, Formylation reactions, Gattermann Reaction, Gattermann-Koch reaction,Vilsmeier reaction, Reimar-Tiemann reaction, Wolff rearrangement, Schmidt reaction.Curtiusre arrangement, Catalytic dehydrogenation, Meerwein-Ponndorf-Verley, NaBH4, Clemmenson,Sandmeyer, Ullmann, Azo coupling, Deamination, Benzidine rearrangement

UNITV PHARMACEUTICAL AIDS AND CO-ORDINATION COMPOUNDS 9

Preparation and properties of various agents such as –Sodium bisulphate, Sodium metabisulphate, 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, Penicilamine,1,10-Phenanthroline.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Identify the functional groups in pharmaceutical substances.

CO2 : Make predictions of chemical bonding along with their reaction mechanism.

CO3: Identify and estimate the purity of drugs and its application

CO4: Apply the knowledge in the development of new drugs

CO5: Synthesis new drug molecule with special reference to organic, inorganic and coordination chemistry.

CO6: Interpret the properties of various agents used in pharmaceutical aids.

TEXT BOOKS:

1. Francis A. Carey (Author), Richard J. Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms 5th Edition, Springer Publishers, 2000.
2. N V Chenchu Lakshmi, Pharmaceutical Inorganic chemistry: Theory and practice, 1stEdition, Pearson Education India,2012.

REFERENCE BOOKS:

1. Michael B. Smith, Jerry March, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6thEdition, Wiley,2007
2. Lutz F. Tietze, TheophilEicher, Ulf Diederichsen, Andreas Speicher, Reactions and Syntheses in the Organic Chemistry Laboratory, 1st Edition, Wiley – VCH,2007
3. P. L. Soni, Vandna Soni, Coordination Chemistry: Metal Complexes, 1st Edition, CRC Press, 2013.
4. R.K. Sharma, Text Book of Coordination Chemistry, 1stEdition, Discovery Publishing House Pvt. Ltd. 201.

U23PTT34	PHYSICAL PHARMACEUTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To acquire the fundamental principles and concepts involved in pharmaceutical powders, liquid flow, dispersions, drug diffusion, dissolution, complexation and protein binding.
2. To provide the knowledge about kinetics and drug stability
3. To understand of physicochemical properties of drugs including solubility, distribution, adsorption, and stability.
4. Analyze the chemical stability tests of various drug products
5. Have basic knowledge of pharmaceutical suspensions and colloids.

UNIT I MICROMERITICS AND POWDER RHEOLOGY 9

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

UNIT II SURFACE AND INTERFACIAL PHENOMENON, VISCOSITY AND RHEOLOGY 9

Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and 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 on viscosity, non-Newtonian systems, plastic, pseudoplastic, dilatant, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers

UNIT III DISPERSION SYSTEMS 9

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

UNIT IV DIFFUSION, DISSOLUTION, COMPLEXATION &PROTEIN 9

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

UNITV KINETICS AND DRUG STABILITY 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Know the fundamental properties of pharmaceutical solids
- **CO2 :** Understand the surface, interfacial phenomena and the rheology of liquids.
- **CO3:** Understand the principles, characters and applications of pharmaceutical dispersions.
- **CO4:** Understand the physical properties of solutions, buffers, isotonicity, disperse systems and rheology.
- **CO5:** Acquire the knowledge about drug diffusion, dissolution, complexation and protein binding.
- **CO6:** Be familiar with the degradation pathways, stabilization of drugs and their expiry date Calculation

TEXT BOOKS:

1. Manavalan, R. and Ramasamy. C. "Physical Pharmaceutics" 2nd Ed., Vignesh Publishers, 2015.
2. C.V.S. Subrahmanyam, Text book of physical pharmaceutics, 3rdEdn., Vallabhprakashan, 2015.

REFERENCE BOOKS:

1. Alfred N. Martin, Patrick J. Sinko, Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, sixth edition, Lippincott Williams & Wilkins, 2011.
2. David B. Troy, Paul Beringer, Remington: The science and practice of pharmacy, 21st Edition, Lippincott Williams and Wilkins, 2006
3. Humphrey Moynihan and Abinacrean "Physicochemical Basis of Pharmaceuticals" Oxford University Press, 2009
4. Hadkar. U. B., Physical Pharmacy, NiraliPrakashan; 12th edition, 2017

U23PTT35	HUMAN ANATOMY AND PHYSIOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Learn organs and structures involving in system formation and functions.
2. Understand all systems in the human body.
3. Explain the patho physiology of underlying common diseases
4. Learn about various physiological conditions in detail
5. Identify the various tissues and organs associated with the different organ systems.

UNIT I SKELETAL AND MUSCULAR SYSTEM 9

Skeletal system: Bone types and functions – Joint Types of Joint Cartilage and functions. Muscular: Parts of Muscle – Physiology and properties of skeletal muscle, smooth muscle, cardiac muscle, Physiology of muscular contraction, excitability and contractibility, isotonic and isometric contractions, refractory period, tonicity, electromyography.

UNIT II HEAMATOLOGY 9

Composition and functions of blood, functions of plasma proteins, reaction of blood, coagulation of blood, coagulation factors, functions of bone marrow, erythropoiesis, functions of haemoglobin, blood groups and Diseases.

UNIT III RESPIRATORY SYSTEM 9

Functions of respiratory system, role of ciliated epithelium, pleural cavity and intra pleural pressure, mechanism of breathing, resistance to breathing, pulmonary volumes, mechanism of gaseous exchange, control of respiration.

UNIT IV CARDIOVASCULAR SYSTEM 9

Introduction to circulation, functions of circulation, anatomical considerations of heart, cardiac impulse, cardiac cycle, heart sounds, electrocardiogram, heart rate, cardiac output, blood pressure, factors influencing blood pressure, blood velocity, functions of pulmonary circulation, coronary circulation, nervous control and reflex control of blood flow.

UNITV ENDOCRINE AND REPRODUCTIVE SYSTEM 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Understand the knowledge about skeletal and muscular systems and their functions in the human body
CO2 :	Explain the composition, functions of blood and blood diseases
CO3:	Learnt and performed the haematological tests parameters, blood pressure recording, heart rate, pulse and respiratory volumes.
CO4:	Describe the mechanism and regulation of respiratory system.
CO5:	Elaborate the working of cardiovascular system and its regulation process.
CO6:	Explain the endocrine glands, reproductive systems and its clinical disorders

TEXT BOOKS:

1. Guyton, A.C. and Hall, J.E., "Textbook of Medical Physiology", 11th Edition, Saunders, 2006.
2. Stuart Ira Fox. "uman physiology". 12th ed. Mac Graw Hill. 2011.

REFERENCE BOOKS:

1. Carola, R., Harley J.P. and No back C.R., "Human Anatomy & Physiology", 2nd Edition, McGraw
   – Hill, 1992.
2. Vander, A.J., Sherman J.H. and Luciano D.S., "Human Physiology: The Mechanisms of Body Function", 5th Edition, McGraw – Hill, 1990.
3. Waugh, Anne and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", 10th Edition, Churchill – Livingstone / Elsevier), 2006.
4. Sembulingam K., "Essentials of Medical Physiology", 5th Edition, Jaypee publications.
5. CC Chatterjee."Human Physiology" Volume I and II. Medical Allied Agency, Kolkata, Special Edition, 2011.

U23PTP31	MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. To understand the concepts of microbial culture techniques
2. To demonstrate various techniques to learn the morphology, identification and propagation of microbes
3. To gain knowledge on the importance of microbes in the day to day life
4. To ensure the cultivation and cultivation of microbes
5. To evaluate and understand the biochemical characteristics of microorganisms

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid:Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms., Microscopic identification of Yeast/mould
6. Staining Techniques Simple, Differential- Gram's Staining, 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

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Autoclave	1
2.	Hot Air Oven	1
3.	Incubators	2
4.	Light Microscopes	4
5.	Incubator Shaker	1
6.	Colorimeter	2
7.	Lamina Flow Chamber	2
8.	Petri dish, Test tubes, microscopic slides, Inoculation loop, Gas burner	30
9.	Bacterial culture media, Yeast culture media, 70% ethanol, antibiotics, Crystal violet, Iodine, Safranin, India ink (capsule staining), Immersion oil	1

COURSE OUTCOMES:

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

CO1:	Understand the advanced technical information pertaining to laboratory bio-safety.
CO2 :	Understand the preventive measures from pathogenic microorganism.
CO3:	Know the various aseptic techniques and sterilization methods.
CO4:	Develop the knowledge on working and care of Microscope.
CO5:	Develop the minimum skills to work on several important techniques for the study of Microorganisms in the laboratory.
CO6:	Perform the microbial assay of antibiotics.

U23PTP32	PHYSICAL PHARMACEUTICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. To practice the determination of fundamental properties of dosage forms of powders and dispersions.
2. To study the kinetics and stability aspects of pharmaceuticals
3. To analyze the chemical stability tests of various drug products
4. Develop the knowledge on Preparation of various types of pharmaceutical buffers
5. Understand the shelf life of a pharmaceutical products

LIST OF EXPERIMENTS

1. Studies on polymorphs, their identification and properties.
2. Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
3. Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
4. Determination of surface/interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
5. Study of rheological properties of various types of systems using different viscometers.
6. Study of different types of colloids and their properties.
7. Preparation of various types of suspensions and determination of their sedimentation parameters
8. Preparation and stability studies of emulsions.
9. Studies on different types of complexes and determination of their stability constants
10. Studies on protein binding of drugs
11. Determination of half-life, rate constant and order of reaction.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.
13. Determination of shelf life of a product based on Arrhenius principle

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Optical Microscope	5
2.	Stage Micrometer	5
3.	Eye piece micrometer	5
4.	Stalagmometer	10
5.	Ostwald's Viscometer	10
6.	Brookfield viscometer	1
7.	Tapped density apparatus	3
8.	Andreason pipette	3
9.	Sieve shaker with sieve sets of different sizes	1
10.	Pycnometer, Funnel, Beakers, Measuring cylinders, Desiccator, Mortar and pestle	30

COURSE OUTCOMES:

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

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

CO2 : Plan and carry out the stability studies

CO3: Determine the stability of various dosage forms.

CO4: Calculate the rate constants and determine the various order of reactions involved in pharmaceutical systems and process.

CO5: Learn the various types of pharmaceutical buffers

CO6: Determine the shelf life of a product based on Arrhenius principle

U23GE3361	PROFESSIONAL DEVELOPMENT	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

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

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

LIST OF EXPERIMENTS

1. **MS WORD:** **10 Hours**

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

2. **MS EXCEL:** **10 Hours**

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

3. **MS EXCEL:** **10 Hours**

   Select slide templates, layout and themes

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of this course the student will be able to

CO1: Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements

CO2: Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding

CO3: Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

CO4: Able to utilize the tools in professional bodies.

CO5: Able to use media elements in organization of content, presentability, aesthetics

CO6: To enhance the overall quality of presentations.

U23PTT41	APPLIED CHEMICAL ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. learn about the behavior of fluids
2. learn about the laws of thermodynamics
3. learn about thermodynamic property relations
4. Understand the concepts of activity coefficient.
5. To predict the Thermodynamic consistency of phase equilibria**.**

UNIT I CONCEPTS OF THERMODYNAMICS 9

Scope of thermodynamics, basic concepts and definitions, Equilibrium state and phase rule, Energy, Work, Temperature and Zeroth Law of Thermodynamics, reversible and irreversible process, Ideal gas- Equation of State involving ideal and real gas, Law of corresponding states, Compressibility chart, First Law of Thermodynamics and its consequences

UNIT II LAWS OF THERMODYNAMICS 9

Joule's experiment, internal energy, enthalpy, Application of first Law of Thermodynamics for Flow and nonflow processes-Limitations of the first Law, statements of second Law of Thermodynamics and its Applications, Heat Engine and Heat Pump

UNIT III THERMODYNAMIC POTENTIALS 9

Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation, partial molar properties, ideal and non-ideal solutions, standard states definition and choice

UNIT IV ACTIVITY COEFFICIENT 9

Activity coefficient-composition models, Gibbs-Duhem equation, effect of pressure and temperature on activity co-efficient, activity and property change of mixing, excess properties of mixtures.

UNITV PHASE EQUILIBRIA 9

Thermodynamic consistency of phase equilibria, phase equilibria in single and multicomponent systems, Duhem's theorem, vapor-liquid equilibria and non-ideal solutions-Chemical reaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the basic concepts, laws and different process related to chemical engineering thermodynamics.

CO2 : Identify the laws related to chemical engineering thermodynamics, thermodynamic principles, flow process and its thermodynamic application

CO3: Understand the thermodynamic potential, its correlation and analyze and distinguish between ideal and non-ideal solution.

CO4: Understand and demonstrate the activity coefficient and activity property of solution.

CO5: Demonstrate the Chemical and phase equilibria equations

CO6: Understand the interrelationships between different thermodynamic properties and become familiar with the Thermodynamic plots.

TEXT BOOKS:

1. Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, 7th Edition, Wiley India, New Delhi, 2009.
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004
3. Smith, J.M., Van Ness, H.C. and Abbott, M.M "Chemical Engineering Thermodynamics", 7th Edition, McGraw Hill, New York, 2005

REFERENCE BOOKS:

1. S. I. Sandler, Chemical, Biochemical and Engineering Thermodynamics, Wiley New York, 2006
2. Y V C Rao, "Chemical Engineering Thermodynamics", Universities Press, Hyderabad 2005.
3. Pradeep ahuja," Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).
4. Gopinath Halder," Introduction to Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).

U23CET32	FLUID MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Provide the basic fundamental knowledge about the flow properties of different types of fluids and its momentum balance.
2. Provide the knowledge about the various transporting and flow measurement and fluid machineries
3. Develop the knowledge on principle of dimensional homogeneity
4. Understand the flow and flow conditions in detail
5. Able to analyze the flow measurements

UNIT I FUNDAMENTAL CONCEPTS 9

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

UNIT II FLUID STATICS 9

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

UNIT III DIMENSIONAL ANALYSIS 9

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

UNIT IV FLOW IN PIPES 9

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

UNITV FLOW MEASUREMENT 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 :	Understand the fluid properties, apply the knowledge and equipments to determine the pressure by different techniques.
CO2 :	Ability to solve and analyze the mathematical model associated with physical fluid-flow system and its applications.
CO3:	Describe the different flow pattern in various fluid ducts like pipes and fittings
CO4:	Understand the fluid flow properties through solids and its application.
CO5:	Know the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.
CO6:	Understand the interrelationships between different fluid flow properties and become familiar with the graphs to utilize these properties during various

manufacturing processes

TEXT BOOKS:

1. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991).
2. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition“, John Wiley, 2006

REFERENCE BOOKS:

1. White, F.M., “Fluid Mechanics “, IV Edition, McGraw-Hill Inc., 1999.
2. James O Wilkes and Stacy G Bike, “Fluid Mechanics for Chemical Engineers’ Prentice Hall PTR (International series in Chemical Engineering) (1999)
3. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, 2005
4.

U23PTT43	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Expose students to application of recombinant DNA technology in biotechnological research.
2. Train students in strategizing research methodologies employing cloning, construction of DNA libraries.
3. Illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences
4. Able to understand the gene expression and genetic information
5. Learn the concepts of genome analysis

UNIT I MOLECULAR GENETICS 9

Bacterial conjugation, transduction and transformation, prokaryotic and eukaryotic genome organization; Introduction to nucleic acids, Nucleic acids as genetic material, Structure and function of DNA and RNA, DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

UNIT II TRANSCRIPTION AND TRANSLATION 9

Structure and function of mRNA, rRNA and tRNA-RNA synthesis: Initiation, elongation and termination of RNA synthesis, Translation: Introduction to Genetic code: Elucidation of geneticcode, Codon degeneracy, Wobble hypothesis and its importance, Steps in translation: Initiation, Elongation and termination of protein synthesis-Inhibitors of protein synthesis. Post-translational modifications and its importance-Organization of genes in prokaryotic and eukaryotic chromosomes

UNIT III RECOMBINANT DNA TECHNOLOGY 9

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

UNIT IV SEQUENCING AND AMPLIFICATION OF DNA 9

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

UNITV GENOME ANALYSIS AND GENOMICS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the basic structure of nucleic acids

CO2 : Identify the principles of DNA replication, transcription and translation of proteins
CO3: Produce the commercially important recombinant proteins
CO4: Apprehend the concept of genome analysis and genomics
CO5: Analyse the concept of sequencing techniques
CO6: Understand about the gene expression

TEXT BOOKS:

1. David Fried feld "Molecular Biology." Narosa Publications, 1999.
2. Primrose SB and R. Twyman "Principles of Gene Manipulation & Genomic Blackwell Science publication, 2006

REFERENCE BOOKS:

1. Tropp, Burton. "Molecular Biology: Genes to Proteins". 3rd Edition. Jones andBartlett,2008.
2. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology" Greene Publishing Associates, NY, 1998
3. Genomes 3 by T.A.Brown, Third Edition (Garland Science Publishing), 2007
4, Principles of Genome Analysis and Genomics by S.B. Primrose and R.M. Twyman, Third Edition (Blackwell Publishing), 2003

U23PTT44	PHARMACOLOGY AND CHEMOTHERAPHY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To provide the general pharmacological principles.
2. To make understand the pharmacology of different types of drugs acting on various physiological systems.
3. Learn about pharmacology of cardiovascular system
4. Able to understand the concepts of pharmacology in gastrointestinal system
5. Understand the functions of chemotherapy in various diseases.

UNIT I GENERAL PHARMACOLOGY 9

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

UNIT II PERIPHERAL AND CENTRAL NERVOUS SYSTEM 9

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

UNIT III CARDIOVASCULAR PHARMACOLOGY 9

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

UNIT IV GASTROINTESTINAL PHARMACOLOGY 9

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

UNITV CHEMOTHERAPY AND ANTIMICROBIAL AGENTS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the previous principles of general pharmacology

CO2 : Understand the pharmacology of various categories of drugs acting on nervous

CO3: Able to know the role of pharmacology in cardiovascular system

CO4: Able to understand the activity of pharmacology in gastrointestinal systems

CO5: Understand the principles of chemotherapy of antimicrobial agents

CO6: Understand the Concepts on pharmacology of Antimicrobial Agents

TEXT BOOKS:

1. Tripathi, K.D., “Essentials of Medical Pharmacology”, 7th Edition, Jaypee Brothers Medical Publishers (P) Ltd, 2015.

2. Satoskar, R.S., Bhandarkar, S.D. and Rege, N., “Pharmacology and Pharmacotherapeutics”, 24th edition, Popular Prakashan (P) Ltd., 2015.

REFERENCE BOOKS:

1. Laurence L. Brunton, Bjorn C. Knollmann, RandaHilal-Dandan, " Goodman and Gilman S“The Pharmacological Basis of Therapeutics", 13thedition, McGraw-Hill Education /Medical, 2017.
2. Humphrey P. Rang, Maureen M .Dale ,James M .Ritter , Rod J. Flower, Graeme Henderson,"Rang &Dale's Pharmacology", 8th edition, Churchill Livingstone, 2015.
3. Katzung, B.G., Trevor AJ. Basic and Clinical Pharmacology, McGraw-Hill Education
4. H. L. Sharma, K. K. Sharma, Principles of Pharmacology, Paras Medical Publishers, 3rdEdition, 2017

U23PTT45	PHARMACEUTICAL ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To facilitate students to acquire knowledge about the principles and applications of pharmaceutical analysis.
2. Understand the chemical properties of pharmaceutical compound
3. Learn the control the errors in the analysis of drug sample
4. Understand the methods used for quality control of drug samples.
5. Learn the skills on range of physical analytical methods

UNIT I INTRODUCTION 9

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

UNIT II ULTRAVIOLET SPECTROSCOPY AND FLUORIMETRY 9

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

UNIT III IR AND NMR SPECTROSCOPY 9

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

UNIT IV ATOMIC ABSORPTION AND MASS SPECTROSCOPY 9

Atomic absorption spectroscopy- Principle, instrumentation and applications. Advantages and limitations of Atomic absorption spectroscopy. Mass Spectroscopy - Principles, instrumentation, Ionization techniques – chemical ionization (CI), electron impact ionization (EI), fast atom bombardment (FAB), matrix assisted laser desorption ionization (MALDI), Types of peaks, Applications, LC-MS/MS, GC-MS/MS

UNITV CHROMATOGRAPHIC METHODS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Highlight the sources of impurities and methods to determine the impurities in inorganic drugsand pharmaceuticals.

CO2 : Demonstrate the skills on various types of extraction techniques

CO3: Develop skills on range of physical analytical methods
CO4: Determine the chemical properties of pharmaceutical compound
CO5: Control the errors in the analysis of drug sample
CO6: illustrate the methods used for quality control of drug samples.

TEXT BOOKS:

1. A. H. Beckett & J. B. Stenlake, "Practical Pharmaceutical Chemistry", Part II, 4th Edition, Bloomsbury Academic, 2001.
2. Gurdeep R. Chatwal, Instrumental methods of chemical analysis" Himalaya publishing house, 5th edition, 2018.
3. Siddiqui, Anees A. "Pharmaceutical Analysis". Vol.I&II, CBS,2006.
4. Parimoo, P. "Pharmaceutical Analysis". CBS, 2018
5. Hobert H.Willard, "Instrumental Methods of Analysis", 7th Edition,CBS Publishers & Distributors, 2004.
6. B.K. Sharma, "Instrumental Method of Chemical Analysis", Krishna's Education Publishers, 2014.
7. Dr. S. Ravi Sankar "Text of pharmaceutical analysis" 4th edition, Rx Publications.2010

REFERENCE BOOKS:

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

U23GET41	ENVIRONMENTAL SCIENCES AND ENGINEERING	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

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

1. To the study of nature and the facts about environment.
2. To finding and implementing scientific, technological, economic and political solutions to environmental problems.
3. To study the interrelationship between living organism and environment.
4. To appreciate the importance of environment by assessing its impact on the human world envisions the surrounding environment, its functions and its value.
5. To study the integrated themes and biodiversity, natural resources, pollution control and waste Management.

UNIT I Ecosystem and Biodiversity **6**

Definition, Scope and importance of environment – Need for public awareness. Ecosystem Types and Energy flow– Ecologicalsuccession.Typesofbiodiversity:genetic,speciesandecosystemdiversity –valuesofbiodiversity,Indiaasamega-diversitynation–hot-spotsofbiodiversity–threatsto biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts endangered and endemic species of India– conservation of biodiversity: In-situ and ex-situ.

UNIT II Environmental Pollution 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and SafetyManagementsystem(OHASMS).Environmentalprotection,Environmentalprotectionacts.

UNIT III Renewable Sources of Energy **6**

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

UNIT IV Environmental Issues **6**

Social Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust - Population growth, variation among nations population explosion – family welfare programme – human rights – value education – HIV / AIDS – women and child welfare.

UNITV Sustainability Practices **6**

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation.

CO2 : Discover knowledge in ecological perspective and value of environment

CO3: Categorize different types of pollutions and their control measures.

CO4: Understand the significance of various natural resources and its management.
CO5: Analyse global environmental problems and come out with best possible solutions.
CO6: Understand environmental laws and sustainable development.

TEXT BOOKS:

1. BennyJoseph,'EnvironmentalScienceandEngineering',TataMcGraw-Hill,NewDelhi,2016.
2. GilbertM.Masters,'IntroductiontoEnvironmentalEngineeringandScience',2ndedition,Pearson Education,2004.
3. Allen,D.T.andShonnard,D.R.,SustainabilityEngineering:Concepts,DesignandCaseStudies, PrenticeHall.
4. J. Manivel and A. Arunkumar, "Environmental Science & Engineering"R.K.Publishers, 1st Edition 2023

REFERENCE BOOKS:

1. R.K.Trivedi,'HandbookofEnvironmentalLaws,Rules,Guidelines,CompliancesandStandards', Vol.IandII,EnviroMedia.38.
2. Cunningham,W.P.Cooper,T.H.Gorhani,'EnvironmentalEncyclopedia',JaicoPubl.,House,Mumbai,2001.
3. Rajagopalan,R,'EnvironmentalStudies-FromCrisistoCure',OxfordUniversityPress,2005.
4. ErachBharuch"TextbookofEnvironmentalStudiesforUndergraduateCourses"OrientBlackswanPvt.Ltd.2013.

U23PTP41	PHARMACEUTICAL CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. To provide students with the practical laboratory skills of pharmaceutical chemistry
2. To demonstrate the effect of the different synthetic methodology.
3. To clarify theoretical concepts of chemical synthesis of drug molecules.

LIST OF EXPERIMENTS

1. To determine the strength of a given unknown solution of HCl by titrating it against with the help of a known solution of NaOH using phenolphthalein indicator.
2. To determine the strength of a given unknown solution of NaOH by titrating it against with the help of a known solution of HCl using methyl orange indicator.
3. To prepare and standardize 200 ml of 0.1 M silver nitrate solution.
4. Determination of physical constants: melting point, boiling point, viscosity and pKa.
5. Determination of partition coefficient of any medicinal compound by shake flask method.
6. Preparation and identification tests of the following official (IP) compounds: Magnesium sulphate, Calcium Carbonate, Ferrous sulphate, Boric acid
7. Determination of impurities by limit test
8. Synthesis of compounds by hydrolysis reaction: Salicylic acid from Alkyl Benzoate.
9. Synthesis of compounds by oxidation reaction: Benzoic acid from Benzyl chloride.
10. Synthesis of compounds involving Electrophilic substitution reaction: Benzoylation: Benzanilide, Phenyl benzoate, 2-Naphthyl benzoate

    Acetylation: Aspirin

    Nitration: Picric acid, p-nitro aniline, m - dinitro benzene

    Halogenaion: p-bromo acetanilide

    Haloform: Iodoform
11. Synthesis of compounds by naming reaction: 7- hydroxy -4- methyl coumarin (Pechmann reaction), 1- phenyl azo-2-napthol (Diazotization and Coupling reaction)
12. Synthesis of major industrial compounds: Paracetamol from p-aminophenol, Benzocaine from p-nitro benzoic acid

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Digital weighing balance	5
2.	Nessler's cylinder,Burette,Conical flask,Beakers and standard volumetric flasks	30

COURSE OUTCOMES:

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

CO1 : Apply safe laboratory practices in the preparation of reagents, handling and

storage of chemicals.

CO2 : Identify/confirm the unknown organic compounds by melting point determination, pKa, boiling point, Viscosity etc.

CO3: Carry out quality control tests for fine chemicals and bulk drugs.

CO4: Implement the knowledge of chemistry in designing the synthetic scheme of organic compounds.

CO5: Demonstrate feasible synthesis of some important class of drugs using chemical reactions.

CO6: Develop the reaction mechanism and orientation of chemical bonds in the synthesis of major industrial compounds.

U23PTP42	PHYSIOLOGY AND PHARMACOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. To learn the gross histology, structure and functions of various organs of the human body
2. To perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body.
3. Communicate clearly and in a way that reflects knowledge and understanding of the human body and demonstrates the ability to adapt information to different audiences and applications.

LIST OF EXPERIMENTS

PHYSIOLOGY EXPERIMENTS

1. Microscopical examination of tissue samples and endocrine glands.
2. Measurements of enzyme activity (Glucose, amino acids, cholesterol, etc in biological specimens)
3. Determination of bleeding time and clotting time
4. Estimation of Haemoglobin.
5. RBC estimation, WBC total count and differential count
6. Erythrocyte sedimentation rate determination.
7. Determination of pulse, heart rate, BP and recording of ECG.
8. Determination of vital capacity.
9. Study of nervous system through reflex arcs and jerks.

PHARMACOLOGY EXPERIMENTS

1. Practical &/ Online demonstration of laboratory animals handling and various routes of drug administration.
2. Virtual study of use of anaesthetics in various laboratory animals.
3. Virtual demonstration of determination of toxicity, LD 50 .
4. To demonstrate the bioassay of Ach using isolated ileum /rectus abdomen is muscle preparation using online videos.
5. Bioassay of 5-HT using rat fundus strip or Bioassay of oxytocin using rat uterus using simulation software's / online gadgets.
6. Computer assisted demonstration of estimation of pA 2 value on isolated tissues.
7. Study of alternative methods for drug evaluation

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Microscopes	5
2.	Haemocytometer with Micropipettes	5
3.	Hutchinson's spirometer	1
4.	Spygmomanometer	5
5.	Stethoscope	5

6.	Haemoglobinometer	5
7.	Sherrington's Kymograph Machine / Polyrite	5
8.	Sherrington Drum	5
9.	Computer with LCD	1
10.	Software packages for experiment	1
11.	Convulsiometer	1
12.	Plethysmograph	1
13.	Permanent Slides for various tissues-one pair for each tissues	1

COURSE OUTCOMES:

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

CO1 : Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.

CO2 : Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system.

CO3: Interpret graphs of anatomical and physiological data.

CO4: Understand how to estimate the quantitative analysis of RBC.

CO5: Understand the basic procedures of laboratory handlings.

CO6: Understand the various methods used for drug evaluation.

U23PTT51	PHARMACEUTICAL DOSAGE FORMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. provide the concepts of various parameters involved in the formulation and development of various solid dosage forms.
2. Understand the concepts of solid dosage forms.
3. Able to understand the concepts of pharmaceutical aerosols and blood products
4. Understand the different types of packaging and packaging of pharmaceutical products.
5. Understand the properties and formulation of sterile pharmaceutical products in detail.

UNIT I LIQUID AND SEMISOLID DOSAGE FORMS 9

Introduction, types of additives used in formulation, manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia-Semisolid Dosage Forms: Definition, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection-General formulation of semisolids, clear gels, manufacturing procedure, evaluation and packaging

UNIT II SOLID DOSAGE FORMS IN TABLETS, CAPSULES AND COATING 9

Tablets and Coating: Types of tablets, Formulation, Manufacturing of tablets, Tableting problems, Evaluation of Tablets, Tablets coating, Film coating, Sugar Coating, Enteric coating, Evaluation of coated tablets, Applications, Large scale Manufacture. Capsules - Classification, Composition and Manufacturing and Formulation.

UNIT III PHARMACEUTICAL AEROSOLS, BLOOD PRODUCTS AND PLASMA SUBSTITUTES 9

Definition, propellants, general formulation, manufacturing, packaging methods, pharmaceutical applications and evaluation-Blood Products and Plasma Substitutes: Collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin foam, plasma substitutes, ideal requirements of PVP, dextran.

UNIT IV PACKAGING OF PHARMACEUTICAL PRODUCTS 9

Types and tests assuring quality of glass-Types of plastics used, permeation, leaching, sorption, chemical reactions, biological tests, modification of plastics by drugs, different types of closures liners, film wrapper, blister packs, bubble packs, shrink handling, foil/plastic pouches, bottle seals, tape seals, breakable seals and sealed tubes-quality control of packaging material and filling equipment.

UNITV STERILE PHARMACEUTICAL PRODUCTS 9

Formulation – requirements, factors & related aspects, evaluation of injectable solutions, suspensions and sterile powders, container and closure-Total parenteral nutrition(TPN)&IV additives-Production facilities and process control-layout, air control, design of aseptic area, LAF and maintenance-Ophthalmic preparation: Requirements, formulation, methods of preparation, containers and evaluation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1 :** comprehend the factors influencing the development of various solid dosage forms.
- **CO2 :** recognize the formulation concepts and evaluate different dosage forms to meet out the compendial requirements.
- **CO3:** execute and involve in the manufacturing process for the tablet and capsule dosage forms.
- **CO4:** design microencapsulation techniques in the multiparticulate dosage forms
- **CO5:** apprehend the advances in solid dosage forms
- **CO6:** apply the technology of solid dosage forms in pharmaceutical industries

TEXT BOOKS:

1. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 8th Edition, CBS Publishers, New Delhi, 2008.
2. Aulton, M.E., "Pharmaceutics – The Science of Dosage form Design", 2nd Edition, ELBS Publications, 2002.

REFERENCE BOOKS:

1. Gennaro, A.R., "Remington: The Science and Practice of Pharmacy", Vol. I and II, 21st Edition, Lippincott Williams and Willkins, 2005.
2. Banker, G.S. and Rhodes, C.T., "Modern Pharmaceutics", 4th Edition, Informa Health Care, 2002.
3. Liberman, H.A., Lachman, L. and Schwartz, J.B., "Pharmaceutical Dosage Form: Tablets", 2ndEdition, Volume II, Mercel Dekker, 1999.
4. Cooper and Gunn's "Dispensing for Pharmaceutical Students", Edited by S J Carter, CBS Publishers, New Delhi, 2008.

U23PTT52	UNIT OPERATIONS IN PHARMACEUTICAL INDUSTRIES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. To provide the basic fundamentals and various unit operations such as filtration, centrifugation, crystallization and evaporation.
2. Learn the fundamental concepts of Size reduction, separation in Pharmaceutical industry.
3. Able to understand the fundamental concepts of crystallization and evaporation
4. Learn the concepts of filtration and centrifugation process in pharmaceutical industries.
5. Able to understand the mixing of materials and do sampling for analyze the characteristics

UNIT I MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION 9

Overview of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel and glass- Industrial Hazards and Safety Precautions – Mechanical, Chemical, Electrical, Fire and Dust hazards, etc.

UNIT II SIZE REDUCTION & SEPARATION 9

Properties and characterization of particulate solids — Introduction to storage and conveying of solids - Analysis and technical methods for size determination of powders - Size reduction equipment – Screening equipment

UNIT III CRYSTALLIZATION 9

Characters of crystals like purity, size, shape, geometry, habit, forms, size and its factors- Solubility curves- Super saturation theory and its limitations- nucleation mechanism and crystal growth- crystallisers- Swenson Walker crystalliser - Caking of crystals and its prevention and numerical problems on yields

UNIT IV FILTRATION AND CENTRIFUGATION 9

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

UNITV MIXING 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Recognize the various categories of materials used in pharmaceutical industry.

CO2 : Apprehend the fundamental concepts of Size reduction, separation in Pharmaceutical industry.

CO3: Comprehend the fundamental concepts of crystallization and evaporation

CO4: Explain the concepts of filtration and centrifugation process in pharmaceutical industries.

CO5: Perform mixing of materials and do sampling for analyze the characteristics

CO6: Understand the concepts of unit operations used in pharmaceutical industries.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Coulson, J.M. and et al. "Coulson & Richardson's Chemical Engineering", 4th Edition, Vol.6, Elsevier Butterworth – Heinemann, MA, 2005
2. Badger, W.L and Banchero, J.T "Introduction to Chemical Engineering" Tata McGraw Hill, 2002
3. K. Sambamurthy, Pharmaceutical Engineering New Age International (P) Ltd., Publishers, New Delhi, 2003

U23PTT53	TECHNOLOGY OF SEMISOLID DOSAGE FORMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To impart the knowledge of the various semisolid dosage forms and its implications in pharmaceutical technology.
2. Learn the composition, preparations and applications of ointments.
3. Learn the composition, preparations and applications of paste and gels
4. Learn the composition, preparations and applications of suppositories and pessaries.
5. Understand the dosage forms in cosmetic products

UNIT I INTRODUCTION 9

Ideal properties of semisolid dosage forms - various types - advantages and disadvantages; Semi solid dosage forms-Preparations; Semi solid bases and their selection – preservatives - drug penetration through skin –mechanism - penetration enhancers.

UNIT II OINTMENTS 9

Ointments, classification of ointments: based on therapeutic and penetration, Bases used for the ointment, Preparation - various classes of materials for preparation - manufacturing method. Compendial Requirements for ointments - characterization, applications

UNIT III PASTES AND GELS 9

Pastes: Introduction to Pastes, bases used - additives – manufacturing methods - containers and closures – characterisation. Gels: types of gels, bases used and preparations – materials - manufacturing – characterisation - applications.

UNIT IV SUPPOSITORIES AND PESSARIES 9

Suppositories, pessaries, Ideal requirements - bases used - manufacturing procedure - displacement value - packaging and evaluation – storage – packaging - stability studies, applications

UNITV COSMETOLOGY ANDCOSMETIC PREPARATIONS 9

Raw materials used in Cosmetics: humectants, emulsifier, antioxidants, buffers - Skin Cream – Types – materials - preparation – characterization - applications. Lipstick – materials – preparation – characterization - applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understands the principles of various semisolid dosage forms
CO2 : Know about the classes of material preparation in semisolid dosage forms
CO3: Understands basic process used in different preparation of semisolid formulation
CO4: Comprehend raw materials used in cosmetic preparations.
CO5: Able to know formulation, labeling, and packing of different types semisolid product
CO6: Able to know the applications of semi solid dosage forms.

TEXT BOOKS:

1. Loyd V. Allen, Howard C. Ansel, Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th Edition, Wolters Kluwer Health,2013.

2. SP Vyas, AK Goyal and G Rath, Handbook of Pharmaceutical Dosage Forms, First Edition, Vallabh Prakashan, New Delhi, 2011.

REFERENCE BOOKS:

1. Gabriella Baki, Kenneth S. Alexander, "Introduction to Cosmetic Formulation and Technology" First Edition John Wiley, First edition, 2015.
2. Ram I. Mahato, Ajit S. Narang "Pharmaceutical Dosage Forms and Drug Delivery, Second Edition" 2nd Edition, CRC Press,2012.
3. James Swarbrick "Encyclopedia of Pharmaceutical Science and Technology",4th Edition, CRC Press,2012
4. Roop K. Khar, SP. Vyas "Lachman/Liebermans: The Theory and Practice of Industrial Pharmacy", 4th Edition CBS Publishers and Distributors,2013.

U23PTP51	DOSAGE FORMS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. To study, the basic principles in formulating liquid, semisolid, solid and their evaluations
2. To study, the basic principles in formulating parentral dosage forms and their evaluations

LIST OF EXPERIMENTS

1. Preparation of solutions
2. Preparation of creams
3. Evaluation of creams
4. Preparation of ointments
5. Evaluation of ointments
6. Preformulation studies on prepared granules
7. Manufacture and evaluation of granules - wet granulation and dry granulation methods
8. Preparation of tablets

a. Tablets prepared from wet and dry granules

b. Tablets prepared by direct compression

9. Formulation and filling of hard gelatin capsules
10. Preparation and evaluation of parenterals

c. Ascorbic acid injection

d. Calcium gluconate injection

e. Sodium chloride injection

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Mechanical stirrers	10
2.	Homogenizer	5
3.	Tray dryer	1
4.	Propeller type mechanical agitator	10
5.	Capsule filling machine	2
6.	Ampoule washing machine	1
7.	Ampoule filling and sealing machine	1
8.	Tablet punching machine	1
9.	Tablet disintegration test apparatus	1
10.	Tablet dissolution test apparatus	1
11.	Monsanto’s hardness tester	3
12.	Friability test apparatus	1
13.	Clarity test apparatus	1
14.	Ointment filling machine	1
15.	Collapsible tube crimping machine	1
16.	Bulk Density Apparatus	2
17.	Liquid Filling Machine	1

COURSE OUTCOMES:

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

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

CO2 : Acquire knowledge to prepare and evaluate solid dosage forms and parenteral dosage Forms

CO3: Apply the knowledge to formulate new dosage forms

CO4: Develop Knowledge on formulating semi solid dosages.

CO5: Develop knowledge on tablet formulation.

CO6: Understand the concept on manufacturing various dosage forms

U23PTP52	NANO PHARMACEUTICAL TECHNOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. Acquire knowledge on the synthesis and characterization of nanoparticles
2. Understand the concept of nano technological approaches ion pharmaceutical industries

LIST OF EXPERIMENTS

1. Preparation of nanoparticles sol-gel method
2. Green synthesis of nanomaterial
3. Preparation of metal-oxide nanoparticles by wet chemical precipitation method
4. Extraction of biopolymer from natural source
5. Preparation of hybrid composites for drug delivery
6. Preparation of nanoparticles – drug conjugates
7. Preparation of polymeric films
8. Preparation of hydrogels
9. Functionalization of nanoparticles
10. Preparation of magnetic nanoparticles
11. Characterization of prepared nanomaterials(DEMO)

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Magnetic stirrer with thermostat	1
2.	Beaker	1
3.	Magnetic bead	1
4.	UV/ Vis spectroscopy	1

COURSE OUTCOMES:

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

CO1 : Develop knowledge on synthesis of nanoparticles.

CO2 : Understand the different methods for the preparation of nanoparticle.

CO3: Able to understand the characterization methods of nanoparticles.

CO4: Implement the concept of nano technological approaches ion pharmaceutical industries.

CO5: Create novel nano drug carriers.

CO6: Develop control and targeted durg delivery sysatems.

U23BTT42	HEAT MASS TRANSFER OPERATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Introduce the principles of Mass Transfer Operations
2. Impart knowledge about various mass transfer operations equipments and its design Concepts
3. Learn the engineering process in bulk industrial equipments
4. Understand the use of accurate engineering correlations of diffusion
5. understand how mass transfer coefficient is applied in model a separation process

UNIT I CONDUCTION HEAT TRANSFER 9

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

UNIT II CONVECTION HEAT TRANSFER 9

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

UNIT III RADIATION HEAT TRANSFER AND HEAT TRANSFER EQUIPMENTS 9

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

UNIT IV DIFFUSION AND MASS TRANSFER 9

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

UNITV EXTRACTION OPERATIONS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the basic concepts on conduction and convection

CO2 : Explain radiation involved in Heat exchanger equipment and furnace wall

CO3: Demonstrate the engineering process in bulk industrial equipments
CO4: Classify the use of accurate engineering correlations of diffusion
CO5: Able to understand how mass transfer coefficient is applied in model a separation process
CO6: Able to understand extraction operations in detail

TEXT BOOKS:

1. Kern, D.Q., 'Process Heat Transfer', McGraw-Hill, 1999.
2. P. K. Nag "Heat & Mass Transfer", Tata McGraw Hill, III edition, 2011.
3. Treybal R.E. "Mass Transfer Operations" III edition. Mcgraw Hill, 2017.

REFERENCE BOOKS:

1. Frank Kreith, Raj M. Manglik, and Mark S. Bohn "Principles of Heat Transfer" VII edition, Cengage Learning Inc., 2018.
2. J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker "Coulson and Richardson's Chemical Engineering. Vol I", VI edition Butterworth-Heinemann, 1999.
3. J. M. Coulson and J. F. Richardson with J. R. Backhurst and J. H. Harker "Coulson and Richardson's
Chemical Engineering. Vol II", V edition Butterworth-Heinemann, 2013.
4. Roop K Khar, SP Vyas, Farhan J Ahmad, Gaurav K Jain "Lachman/Lieberman's The theory and Practise of Industrial Pharmacy", 4th Edition, CBS publishers & distributors, 2014.

U23PTT62	INSTRUMENTAL TECHNIQUES IN DRUG ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To facilitate students to acquire knowledge about the principles and operations of various modern analytical instruments.
2. Learn the principle and instrumentation and applications of IR and NMR spectroscopy
3. Understand the basic principle, instrumentation and ionization methods of Mass spectroscopy
4. Able to understand the principle, instrumentation, solvents and packing materials of CC, TLC and HPLC
5. Develop the theoretical knowledge of instruments, new analytical methods

UNIT I UV-VISIBLE 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, PMT, PDA detectors; Applications in pharmaceuticals

UNIT II ATOMIC ABSORPTION SPECTROSCOPY 9

Principles, Instrumentation, Operation – single and double beam spectroscopy; sampling technique – Detection limit, Difference between Atomic absorption spectroscopy and Flame spectroscopy; Applications in pharmaceuticals.

UNIT III INFRARED and NMR SPECTROSCOPY 9

Principles of vibrational spectroscopy – Instrumentation and sampling techniques – Applications in pharmaceutical sciences – NMR principles – Instrumentation – Applications in pharmaceuticals

UNIT IV MASS SPECTROMETRY 9

Basic principles, instrumentation and ionization methods, atmospheric pressure ionization (API), chemical ionization (CI), electron impact ionization (EI), fast atom bombardment (FAB), matrix assisted laser desorption ionization (MALDI), time of flight (TOF); Applications in pharmaceuticals

UNITV CHROMATOGRAPHIC METHODS 9

History, origin and classification of chromatography: Column Chromatography: principle, theory, column operations, instrumentation, derivatisation methods and applications-High Performance Liquid Chromatography: Principle, instrumentation, solvents system, packing materials and applications-Thin Layer Chromatography: Principle, instrumentation, solvents, packing materials and applications in pharmaceuticals

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Discuss the principle, theory and instrumentation of UV/Visible spectroscopy; Applications in pharmaceuticals.

CO2 : Describe the principle, instrumentation and operation of AAS; Difference between AAS and FES; Applications in pharmaceuticals.

CO3: Illustrate the principle and instrumentation of IR and NMR spectroscopy; Applications in pharmaceuticals.

CO4: Discuss the basic principle, instrumentation and ionization methods of Mass spectroscopy; Applications in pharmaceuticals.

CO5: Describe the principle, instrumentation, solvents and packing materials of CC, TLC and HPLC; Applications in pharmaceuticals.

CO6 Apply the theoretical knowledge of instruments, new analytical methods may be developed and validated for the screening of various pharmaceutical agents

TEXT BOOKS:

1. A. H. Beckett & J. B. Stenlake, "Practical Pharmaceutical Chemistry", Part II, 4th Edition,Bloomsbury Academic, 2001.
2. Hobert H. Willard, "Instrumental Methods of Analysis", 7th Edition,CBS Publishers & Distributors, 2004.
3. B.K. Sharma, "Instrumental Method of Chemical Analysis", Krishna's Education Publishers, 2014.
4. P. D. Sethi, "HPTLC: High Performance Thin Layer Chromatography: Quantitative Analysis of Pharmaceutical Formulations", 1st edition, CBS, 2013.

REFERENCE BOOKS:

1. Robert M. Silverstein, Francis X .Webster, David J. Kiemle,David L . Bryce, "Spectroscopic Identification of Organic Compounds", 8th Edition, Wiley, 2014.
2. Mendham J, "Vogel's Text Book of Quantitative Chemical Analysis", 6th Edition, Pearson Education 2009.
3. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, "Principles of Instrumental Analysis", 7th Edition, Brooks Cole, 2017.
4. William Kemp, "Organic Spectroscopy" W.H. Freeman, New York, 3rd Edition, 2011.

U23GET61	HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

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

1. Teach definition and classification of values.
2. Explain Purusartha.
3. Describe Sarvodaya idea.
4. Summarize sustenance of life.
5. Conclude views of hierarchy of values.

UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic Social-Aesthetic-Moral and Religious values.

UNIT II CONCEPTS RELATED TO VALUES 9

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good.

UNIT III IDEOLOGY OF SARVODAYA 9

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam.

UNIT IV SUSTENANCE OF LIFE 9

The Problem of Sustenance of value in the process of Social, Political and Technological Changes.

UNITV VIEWS ON HIERARCHY OF VALUES 9

The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand definition and classification of values.
CO2 : Understand purusartha.
CO3: Understand sarvodaya idea.
CO4: Understand sustenance of life.
CO5: Understand the hierarchy of values.
CO6: Compare hierarchial views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

TEXT BOOKS:

1. AwadeshPradhan : MahamanakeVichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)

REFERENCE BOOKS

1. William, K Frankena : Ethics (Prentice Hall of India, 1988)

U23PTP61	HEAT MASS TRANSFER OPERATIONS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. To provide basic understanding of chemical engineering principles and operations
2. To train the students to work on different types of Heat transfer equipment.
3. To train the students to develop sound working knowledge on different types of mass

LIST OF EXPERIMENTS

1. To determine the Thermal Conductivity of metal rod.
2. To determine individual heat transfer film coefficient in forced convection.
3. Heat transfer studies in Stefan - Boltzmann apparatus.
4. To determine overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
5. To determine overall heat transfer coefficient of double pipe heat exchanger by counter flow.
6. To determine overall heat transfer coefficient of shell and tube heat exchanger.
7. Determination of diffusivity of acetone in air
8. Determination of mass transfer coefficient for steady state surface evaporation of water at different temperature.
9. Conduction of liquid - liquid extraction studies
10. Conduction of Adsorption studies
11. Separation of binary mixture using Simple distillation
12. Separation of binary mixture using Steam distillation

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Distillation column	1
2.	Heat exchanger	2
3.	Boltzmann apparatus	1
4.	Double pipe heat exchanger	1

COURSE OUTCOMES:

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

CO1 : Determine heat transfer coefficient.
CO2 : Apprehend the conduction parameters.
CO3: Determine heat transfer film coefficient.
CO4: Demonstrate the separation of Binary mixtures
CO5: Determine diffusivity and Drying characteristics
CO6: Demonstrate distillation, extraction, diffusivity and drying principles which are having wide applications in various industries.

U23PTP62	INSTRUMENTAL TECHNIQUES IN DRUG ANALYSIS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. To carry out analytical experiments related to spectroscopic and chromatographic techniques.
2. To carry out the experiments on calibration of glasswares

LIST OF EXPERIMENTS

1. Calibration of volumetric glasswares.
2. Establishing standard operating procedure (SOP) and Calibration records for analytical balance, pH meter and UV/Vis spectroscopy.
3. Determination of λmax.
4. Quantitative analysis by titrimetric methods.
5. Effect of change in physio-chemical parameters on absorbance spectrum of a drug molecule.
6. Quantitative and qualitative analysis of drug molecule using standard comparison method by UV/Vis spectroscopy.
7. Quantitative analysis of drug molecule using calibration graph method by UV/Vis Spectroscopy.
8. Quantitative analysis of drug molecule using E1%1cm method by UV/Vis spectroscopy.
9. Simultaneous analysis of drug molecules using UV/Vis Spectroscopy.
10. Separation and identification of mixtures of drugs by TLC.
11. Separation and identification of amino acids by paper chromatography.
12. Identification of functional group of a drug molecule by IR spectroscopy
13. Quantitative and qualitative analysis of drug molecule using standard comparison method by HPLC.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	UV Spectroscopy	1
2.	HPLC	1
3.	TLC Plate	1
4.	IR Spectroscopy	1
5.	Whatman Filter Paper	1

COURSE OUTCOMES:

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

CO1 : Discuss the principle, theory and instrumentation of UV/Visible spectroscopy; Applications in pharmaceuticals.

CO2 : Describe the principle, instrumentation and operation of AAS; Difference between AAS and FES; Applications in pharmaceuticals.

CO3: Illustrate the principle and instrumentation of IR and NMR spectroscopy; Applications in pharmaceuticals.

CO4: Discuss the basic principle, instrumentation and ionization methods of Mass spectroscopy; Applications in pharmaceuticals.

CO5: Describe the principle, instrumentation, solvents and packing materials of CC, TLC and HPLC; Applications in pharmaceuticals.

CO6: Apply the theoretical knowledge of instruments, new analytical methods may be developed and validated for the screening of various pharmaceutical agents.

U23PTT71	CHEMISTRY OF NATURAL PRODUCTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To facilitate students to acquire knowledge about the principles and operations of various modern analytical instruments.
2. Learn the principle and instrumentation and applications of IR and NMR spectroscopy
3. Understand the basic principle, instrumentation and ionization methods of Mass spectroscopy
4. Able to understand the principle, instrumentation, solvents and packing materials of CC, TLC and HPLC
5. Develop the theoretical knowledge of instruments, new analytical methods

UNIT I STRUCTURAL CHARACTERISATION 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.

UNIT II GLYCOSIDES 9

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

UNIT III ALKALOIDS 9

Classification, chemistry, general methods of extraction, isolation, chemical tests, and structural elucidation of pyridine alkaloids, tropane alkaloids, quinoline and iso-quinoline alkaloids, phenanthrene alkaloids, indole alkaloids, imidazole alkaloids, alkaloid amines, glycoalkaloids and xanthene alkaloids.

UNIT IV TERPENES AND FLAVONOIDS 9

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

UNITV PHARMACEUTICALLY IMPORTANT NATURAL PRODUCTS 9

Structure, stereochemistry, synthesis, biogenesis and biological activity of azadirachtin, forskolin, taxanes, camptothecin, artemisinin, podophyllotoxin, estrone and mifepristone.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : To understand and apply the concept of extraction, isolation and characterization of the natural products.

CO2 : To explain the classification plan metabolites.

CO3: To explain metabolic pathways, metabolites and structural elucidation of plant secondary metabolites.

CO4: To acquire knowledge on structure, synthesis, biogenesis

CO5: To describe biological activity of some of the pharmaceutically important natural products.

CO6 To develop formulations for pharmaceutically active products.

TEXT BOOKS:

1. O.P. Agarwal, Chemistry of Natural Products (Vol.-1 & 2),41st edition, Goel publishing House, 2014.
2. Gurdeep Chatwal, Organic Chemistry of Natural Products (Vol. 1 & 2), Himalaya Publishing House, 2015.
3. I.L.Finar, "Organic chemistry" Volume 2, 5th edition, Published by Pearson India, 2012.

REFERENCE BOOKS:

1. Varro E. Tyler, Lynn R. Brady, James E. Robbers, Pharmacognosy, 9th edition, Published by Lea &Febiger, 2011.
2. Trease, G. E. and Evans, W.C. Pharmacognosy, 16th edition, Published by Elsevier, 2009.
3. Wallis, T.E. Textbook of Pharmacognosy, 5th Edition, CBS Publishers, 2005.

U23PTT72	NOVEL DRUG DELIVERY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To facilitate students to acquire knowledge about the principles and operations of various modern analytical instruments.
2. Learn the principle and instrumentation and applications of IR and NMR spectroscopy
3. Understand the basic principle, instrumentation and ionization methods of Mass spectroscopy
4. Able to understand the principle, instrumentation, solvents and packing materials of CC, TLC and HPLC
5. Develop the theoretical knowledge of instruments, new analytical methods

UNIT I POLYMERS 9

Polymers used in controlled drug delivery modules – Classification – Advantages and disadvantages of polymers – Polymerization mechanisms – Degradation mechanism – Polymer characterization.

UNIT II SUSTAINED RELEASE DRUG DELIVERY SYSTEMS 9

Physicochemical and biological properties of drugs – Oral dosage forms – Diffusion systems – Systems utilizing dissolution – Osmotic systems – Ion exchange resins.

UNIT III TARGETED DRUG DELIVERY SYSTEM 9

Nanoparticles – Liposomes – Resealed erythrocytes – Immunologically based system – Antibodies for drug delivery – Magnetic microspheres.

UNIT IV MODULE FOR GASTRO INTESTINAL TRACTS 9

Approaches to increase gastric retention – Factors affecting gastric retention – Formulation development of floating drug delivery system – Expanding systems – Systems for colon specific delivery – Targeting approaches to colon.

UNITV MUCOADHESIVE DRUG DELIVERY SYSTEMS 9

Buccal drug delivery – Concepts – Advantages – Disadvantages – Permeability enhancers – In vitro and in-vivo evaluation – Nasal drug delivery system – Pulmonary drug delivery system – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the properties and importance of polymer in novel drug delivery systems.

CO2 : Understand the application of polymer in sustained release, topical and targeted drug delivery systems.

CO3: Apprehend the drug module for GI tracts.

CO4: Apply the concepts of newer method of drug delivery systems involved in the pharmaceutical sciences and relevance of their drug delivery strategies.

CO5: Comprehend various classes of excipients involved in formulation of novel drug delivery systems.

CO6 To develop novel drug delivery module for specific region

TEXT BOOKS:

1. Robinson, J.R. and Lee, V.H.L., "Controlled Drug Delivery Systems", 2nd Edition, Marcel Dekker, 1992.
2. Vyas, S.P. and Khar, R.K., "Controlled Drug Delivery Concepts and Advantages", 1st Edition, 2002.

REFERENCE BOOKS:

1. Varro E. Tyler, Lynn R. Brady, James E. Robbers, Pharmacognosy, 9th edition, Published by Lea &Febiger, 2011.
2. Trease, G. E. and Evans, W.C. Pharmacognosy, 16th edition, Published by Elsevier, 2009.
3. Wallis, T.E. Textbook of Pharmacognosy, 5th Edition, CBS Publishers, 2005.

U23PTP71	CHEMISTRY OF NATURAL PRODUCTS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. learn, understand and perform various standardisation techniques of natural products as per WHO guidelines
2. Learn how to extract and isolate the secondary metabolites

LIST OF EXPERIMENTS

1. Morphology, microscopy and quantitative microscopy of medicinal plants: Macroscopic and microscopic identification of 4-5 commonly used medicinal plants
2. Physical constants like: specific gravity, swelling factor, ash values, extractive values, refractive index, optical rotation of selected plant materials
3. Phytochemical methods, identification tests for various classes of phytoconstituents
4. Extraction and isolation of active principles such as alkaloids, glycosides from natural drugs
5 Extraction and isolation of flavonoids from natural drugs
6 Extraction and isolation of carbohydrates from natural drugs
7 Extraction and isolation of essential oils from natural drugs
8 Extraction and isolation of terpenes from natural drugs
9. Quantification of phytochemicals in plant extracts by chromatography and spectroscopy
10. Extraction and isolation of tannins from natural drugs

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Microscope	1
2.	Polarimeter	1
3.	Soxhlet Apparatus	1
4.	Water Bath	1
5.	Hot Air Oven	1
6.	Rotary Vacuum Evaporator	1
7.	Camera Lucida	1
8.	Phytochemical Reagents	1
9.	Chromatographic Plates	3
10.	UV Spectrophotometer	1
11.	HPLC	1
12.	HPTLC	1

COURSE OUTCOMES:

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

CO1 : Perform standardization of medicinal plant products.

CO2 : Identify different types of medicinal plants and its products by morphology, physical and chemical characteristics.

CO3: Carry out chromatographic and spectroscopic analysis of medicinal plant products.

CO4: Develop knowledge on the extraction of secondary metabolites.

CO5: Understand the techniques involved in the identification of plant morphology.

CO6: Understand the various methods used for the identification of phytoconstituents in the plant.

U23PTP72	NOVEL DRUG DELIVERY SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

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

1. Understand and analyse the factors influencing the formulation of novel drug delivery Systems
2. Choose the right choice of excipients for the right delivery systems, characterize and Interpret the results of marketed products**.**

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Weighing balance	1
2.	pH meter	2
3.	Rotary evaporator	2
4.	Hot plate	2
5.	Phase contrast microscope	2

COURSE OUTCOMES:

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

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

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

CO3: Perform various quality control tests for the marketed products.

CO4: Understand the factors influencing the formulation of novel drug delivery Systems.

CO5: able to know the concept of drug delivery methods.

CO6: Knowledge on developing novel natural products.

U23PTP81	PROJECT WORK / INTERNSHIP	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES

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

1. In identifying problem and developing the structured methodology
2. To solve the identified problem in the industry or research problem at research Institution or college.
3. Conducting experiments, analyze and discuss the test results, and make conclusions.
4. Preparing project reports and presentation

PROJECT WORK PLAN

a) The students shall individually / or as group work on a specific topic approved by the Department.
b) The student can select any topic which is relevant to his/her specialization of the programme.
c) The student should continue the work on the selected topic as per the formulated methodology.
d) At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department.
e) The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

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

CO1 : Formulate and analyze problem / create a new product/ process.

CO2 : Design and conduct experiments to find solution

CO3: Analyze the results and provide solution for the identified problem, prepare project report and make presentation

PROFESSIONAL ELECTIVE COURSES
VERTICAL I : DRUG DESIGN AND DEVELOPMENT

		L	T	P	C
U23PTV11	**MEDICINAL CHEMISTRY**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

1. To impart comprehensive understanding of the physicochemical basis of drug action including steric and stereoisomerism.
2. To provide knowledge on the classification, chemical nomenclature, generic names and synthesis of various categories of medicinal drugs.
3. To enable the students to learn and understand the structure activity relationship
4. Understand biochemical/molecular basis of mechanism of action and uses of different classifications of drugs
5. Understand the principles of medicinal chemistry.

UNIT I PRINCIPLES OF MEDICINAL CHEMISTRY 9

Physicochemical properties in relation to biological action: Ionization, Drug distribution and pKa values and their relation to drug transport, hydrogen bonding, redox potential, surface activity and chelation. Conformational isomerism, optical and geometrical isomerism; Bioisosterism in drug design

UNIT II DRUGS ACTING ON AUTONOMIC NERVOUS SYSTEM 9

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 Cholinergics, Anticholinergics and Adrenergics

UNIT III DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM 9

Classification, molecular basis of mechanism of action, structure activity relationship and synthesis of Sedatives, Hypnotics and anxiolytics; Opioid analgesics; Anticonvulsants and antidepressants

UNIT IV DRUGS ACTING ON CARDIOVASCULAR SYSTEM 9

Structural basis of mechanism of action, structure activity relationship including physiochemical properties and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers and cardiac glycosides.

UNITV EICOSANOIDS, ANTIHISTAMINE AND ANTIINFLAMMATORY DRUGS 9

Synthetic procedures, uses, structure activity relationship including physicochemical properties of the following classes of drugs Antihistamines, Eicosanoids, Non-steroidal anti-inflammatory drugs (NSAIDs).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Correlate the relationship between the physicochemical properties, steric properties andstructural features of the drugs with its biological action.

CO2 : Explain the biochemical/molecular mechanism of action, Structure Activity Relationship, therapeutic use and depict the synthesis of drugs acting on autonomic

nervous system.

CO3: Describe the molecular basis of mechanism of action, therapeutic use, Structure Activity Relationship and synthesis of drugs acting on central nervous system.

CO4: Illustrate the mechanism of action, therapeutic use and synthesis of drugs acting on cardiovascular system.

CO5: Outline the chemical structure, mechanism of action, Structure Activity Relationship and therapeutic uses of eicosanoids and eicosanoid blocking agents.

CO6: Apply the working knowledge of chemical structures, Structure Activity Relationship and molecular mechanism of drug action to suggest drug design ideas and to develop suitable techniques to synthesis different drug molecules

TEXT BOOKS:

1. Ashutosh Kar, Medicinal Chemistry, 6th Edition, New Age International (P) Ltd. Publishers, New Delhi 2015.
2. Graham L. Patrick, An introduction to Medicinal Chemistry, 6th Edition, Oxford University Press, 2017.

REFERENCE BOOKS:

1. Donald J. Abraham, Burger's Medicinal Chemistry and Drug Discovery, Vol 1-8, 8th Edition, Donald J. Abraham, Michael Myers, Wiley, 2021.
2. Wilson and Gisvold's Textbook of Organic, Medicinal and Pharmaceutical Chemistry, Editors - John M Beale and John Block, 12th Edition, Lippincott Williams & Wilkins, 2010.
3. William O Foye, Thomas L Lemke, David A Williams Foye's Principles of Medicinal Chemistry, 7th Edition, Wolters Kluwer Health Adis (ESP) Publisher, 2012.
4. Ilango, K. and Valentina, P., "Text book of Medicinal Chemistry", Vol.1 & 2, 1st & 2 nd edition, Keerthi Publishers, 2017.

U23PTV12	BIOINFORMATICS AND CHEMINFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Provide an introduction to cheminformatics - an interdisciplinary area on the interface of chemistry, informatics and biology.
2. Able to learn and understand the fundamentals of cheminformatics and its applications
3. Learn the importance of proper use of various parameters in cheminformatics
4. Understand practical use of various computational tools available for computer aided drug design
5. Analyse cheminformatics problems that are suitable for applying machine learning techniques

UNIT I BIOINFORMATICS AND BIOLOGICAL DATABASES 9

Introduction and scope of Bioinformatics, DNA and protein sequences, genome and transcriptome, extracting, collecting and storing sequences-various file formats for bio-molecular sequences: GenBank, FASTA, GCG, MSF, NBRF-PIR; Introduction to Biological Databases; nucleic acid sequence databases: GenBank, EMBL, DDBJ-protein sequence databases: Uniprot-KB, SWISSPROT

UNIT II SEQUENCE ALIGNMENT 9

Pairwise and Multiple sequence alignments: basic concepts of sequence alignment, Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results. Algorithms used in sequence alignments- Needleman– Wunsch algorithm & Smith–Waterman algorithm. Sequence-based Database Searches: BLAST and FASTA, various versions of basic BLAST and Clustal OMEGA

UNIT III PHYLOGENETIC METHODS 9

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics

UNIT IV CHEMINFORMATICS 9

Introduction, history and applications of cheminformatics; Data and Databases, Accessing PubChem through a Web interface, Programming Access to the PubChem Database- Structural Data files, Chemical Resolvers, Molecular Editors and Visualization-Database Resources, Database Management, Public chemical Databases, Data Organization in PubChem as Data Aggregator, Database Query-Searching Databases for Chemical Information, PubChem Web Interfaces for Text, Text Search in PubChem, Additional Data Retreival in PubChem,

UNIT V ADVANCED CHEMINFORMATICS 9

Quantitative Structure-Property Relationships, Similar-Structure, Similar-Property Principle, Molecular Descriptors, Molecular Similarity, Similarity Coefficients. Computer-Aided Drug Discovery Design (CADDD), Virtual Screening and Molecular Docking. Physicochemical parameters, Chemical reaction prediction and synthesis design, Self study: Open source tools, techniques, data in cheminformatics, simulation and predictive tools, applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1 :** Have the knowledge of the basic ligand/structure based drug design approaches.
- **CO2 :** Understand the basic algorithms used in the established software to carry out the mostcommon CADD project.
- **CO3:** Understand the importance of proper use of various parameters in cheminformatics application programs
- **CO4:** Practical use of various computational tools available for computer aided drug design including 2D/3D structural database.
- **CO5:** Identify cheminformatics problems that are suitable for applying machine learning techniques
- **CO6:** Know the kinds of descriptors available for chemical structures

TEXT BOOKS:

1. Introduction to Bioinformatics by Lesk, Arthur M., 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 Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press. Media.
5. Thomas Engel , Johann Gasteiger, Chemoinformatics: Basic Concepts and Methods, ISBN: 978-3-527-33109-3.
6. Andrew R Leach and Valerie J. Gillet. (2007). Introduction to Chemoinformatics. Springer Publications.

REFERENCE BOOKS:

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition (2005) Andreas D. Baxevanis Francis Ouellette ISBN: 978-0-471-47878-2
2. Bioinformatics For Dummies, 2nd Edition (2006) Jean-Michel Claverie Cedric Notredame ISBN: 978-0-470-08985-9
3. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.
4. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O‟Reilley
5. Navneet Sharma, Himanshu Ojha, Pawan Raghav and Ramesh Goyal, “Chemoinformatics and Bioinformatics in the Pharmaceutical Sciences, 1st Edition, Academic Press 2021, Paperback ISBN: 9780128217481, eBook ISBN: 9780128217474
6. https://chem.libretexts.org/Courses/Intercollegiate_Courses/Cheminformatics_OLCC_(2019)

U23PTV13	PROTEIN STRUCTURE, FUNCTION AND PROTEOMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To identify the importance of protein biomolecules to access, use and evaluate the information available in protein databases to find about a protein of interest.
2. To realize and explain key concepts in protein function such as affinity and specificity, allosteric regulation.
3. Understand the concepts of reading and critically discussing original literature in this field
4. Learn the elective pressure at the level of protein structure and dynamics in the evolution of new functions
5. Develop the molecular principles behind the structure of proteins

UNIT I PROTEIN STRUCTURE 9

Amino Acids Structure and Properties - Peptide Bond Formation and Primary Protein Structure, Secondary Protein Structure - Supersecondary Structure and Protein Motifs - Tertiary and Quaternary Protein Structure - Protein Folding, Denaturation and Hydrolysis

UNIT II INVESTIGATING PROTEINS 9

Protein Purification - Protein Identification and Visualization - Protein Synthesis and Sequencing - Protein Structure Elucidation - Proteome Analysis

UNIT III PROTEIN REGULATION AND DEGRADATION 9

Isozymes - Post-Translational Modifications - Allosteric Regulation - Zymogen Activation Intracellular Protein Degradation

UNIT IV TECHNIQUES IN DETERMINING PROTEIN STRUCTURE AND FUNCTION 9

Structure-function relations - Protein Fluorescence Spectroscopy - Protein Circular Dichroism Spectroscopy - Protein EPR spectroscopy - Protein NMR Spectroscopy - Protein X-ray crystallography.

UNITV PROTEOMICS 9

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : have a foundational level of understanding of the principles of protein structure-dynamicsfunction relations

CO2 : explain the molecular principles behind the structure of proteins

CO3: describe entropy - enthalpy compensation in macromolecular systems and how it controls stability and structural properties

CO4: have a foundational level of understanding of multiple techniques that are collectively used to determine structures of dynamic protein complexes (NMR, cryo-electron microscopy, small angle X-ray scattering)

CO5: understand selective pressure at the level of protein structure and dynamics in the

evolution of new functions

CO6: gain experience reading and critically discussing original literature in this field

TEXT BOOKS:

1. Branden C. and Tooze J., "Introduction to Protein Structures" 2nd Edition, Garland Publishing, 1999'.
2. Creighton T.E. "Proteins" 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, "Proteomics: Protein Sequence to Function". VivaBooks, 2002.
4. Peptides and Proteins, RSC - ROYAL SOCIETY OF CHEMISTRY, SHAWN DOONAN.
5. Proteins Biochemistry and Biotechnology Second Edition Gary Walsh Wiley Blackwell.
6. Recent review articles from peer reviewed journals.

REFERENCE BOOKS:

1. Liebler, "Introduction to Proteomics" Humana Press, 2002.
2. David Whitford, "Proteins: Structure and Function" John Wiley & Sons ltd, 2005.
3. Introduction to Proteins Structure, Function, and Motion, Second Edition By Amit Kessel, Nir Ben-Tal Copyright Year 2018 ISBN 9781498747172 Published May 17, 2018 by Chapman and Hall/CRC.
4. Flatt, P.M. (2019) Biochemistry – Defining Life at the Molecular Level. Published by Western Oregon University, Monmouth. (e-book)

U23PTV14	COMPUTER AIDED DRUG DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. find a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.
2. to know the informatics approaches to the prediction of chemical properties of new drugs.
3. to present the appropriate tools for such a modelling, ranging from electronic structure.
4. methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR.
5. Molecular docking and Molecular dynamics.

UNIT I ELECTRONIC STRUCTURE METHODS 8

Quantum chemical methods semi-empirical and ab initio methods. Conformational analysis, energy minimization, predicting the mechanism of organic reactions using electronic structure methods

UNIT II MOLECULAR MODELING 9

Bioactive vs. global minimum conformations. Automated methods of conformational search. Advantages and limitations of available software. Molecular graphics. Computer methodologies behind molecular modeling including artificial intelligence methods

UNIT III STRUCTURE ACTIVITY RELATIONSHIPS IN DRUG DESIGN 9

Qualitative versus quantitative approaches advantages and disadvantages. Random screening, Non-random screening, rational approaches to lead discovery. Homologation, chain branching, ring-chain transformations. Insights into molecular recognition phenomenon. Structure based drug design, ligand based drug design.

UNIT IV QSAR: ELECTRONIC EFFECTS 9

Hammett equation, lipophilicity effects. Hansch equation, steric effects. Taft equation. Experimental and theoretical approaches for the determination of physicochemical parameters, parameter interdependence: Regression analysis, Descriptor calculation. The importance of biological data in the correct form; 2D QSAR; 3D-QSAR examples of CoMFA and CoMSIA.

UNITV MOLECULAR DOCKING 10

Rigid docking, flexible docking, manual docking. Advantages and disadvantages of Flex-X, Flex-S,Autodock and Dock softwares, with successful examples. Dynamics of drugs, biomolecules, drug receptor complexes, Monte Carlo simulations and Molecular dynamics in performing conformational search and docking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Gain knowledge about fundamental concepts, challenges, and rich opportunities in developing and applying algorithms for structural bioinformatics and healthcare.

CO2 : Interpret and practice the fundamental concepts of Molecular Modeling and Computer aided Drug Design.

CO3: Develop practical skills in computational approaches to analyse, predict, and engineer biomolecules and biomolecular systems.

CO4: Find a chemical compound that can fit to a specific cavity on a protein target both

geometrically and chemically.

CO5: Present the appropriate tools for such a modelling, ranging from electronic Structure methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR, Molecular docking and Molecular dynamics

CO6: Apply the fundamental tools in techniques like docking, modelling, electronic structure methods which leads to new drug target design.

TEXT BOOKS:

1. Andrew R. Leach, Molecular Modelling Principle and Application, 2nd Edition, Prentice Hall, England,2001.
2. Richard B. Silverman, Mark W. Holladay, Organic Chemistry of Drug Design and Drug
3. Action, 3rd Edition, Academic Press, USA, 2014.
4. Paul S. Charifson, Practical Applications of computer aided drug design, 1st Edition, Marcel Dekker, New York, 1997.
5. J. M. Goodman, Chemical Applications of Molecular Modelling, The Royal Society of Chemistry, Cambridge, 1998.

REFERENCE BOOKS:

1. Donald J. Abraham, Burger's Medicinal Chemistry and Drug Discovery, Vol V, 6th Edition, John Wiley and Sons, Inc., 2003.
2. John B. Taylor and David J. Triggle, Comprehensive Medicinal Chemistry II, Vol IV, Elsevier Science, 2006.
3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th Edition, Oxford University Press, UK, 2013.
4. David. C. Young, Computational Drug Design – A Guide for Computational and Medicinal Chemists, John Wiley and Sons Ltd, Hoboken, United States, 2009.
5. Alan Hinchliffe, Molecular Modelling for Beginners, 2nd Edition, Wiley, United University of California, 2008.

U23PTV15	BIOLOGICAL SPECTROSCOPIC TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Deliver the knowledge of spectroscopic techniques and its functions
2. Provide technical information of spectroscopy for biological applications
3. Learn and demonstrate the key steps in analytical method development and validation.
4. Learn techniques in material science for research, quality control and analysis.
5. Learn theoretical knowledge of modern analytical tools, new screening methods for the estimation of micro and macro molecules

UNIT I EXTRACTION OF DRUGS FROM THE BIOLOGICAL MATRIX 9

Introduction – types of samples - sampling – physicochemical properties of drug – sample pretreatment in different biological matrices - sample preparation - – methods of extraction – liquid liquid extraction – solid phase extraction – Protein precipitation method- solid phase microextraction.

UNIT II GAS CHROMATOGRAPHY 9

Principle of separation – criteria for compounds - carrier gas – flow regulatory – injection devices – column – temperature control device – detectors – recorders and integrators –parameters used in GC – Application of GC.

UNIT III X-RAY DIFFRACTION 9

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 IV BIOANAYTICAL METHOD DEVELOPMENT AND VALIDATION 9

Key steps for analytical method development - General principles – ligand binding assays –incurred sample reanalysis – practical and cross validation – additional consideration.

UNITV MICROSCOPIC TECHNIQUES AND HIGH THROUGHPUT SCREENING 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand and demonstrate the separation of drugs from the biological matrix.

CO2 : Understand the basic principle and instrumentation methods of gas chromatography and its applications in pharmaceuticals.

CO3: Describe the theory and operation of X-ray diffraction; Determination of crystal structure of drug molecule.

CO4: Understand and demonstrate the key steps in analytical method development and validation.

CO5: Apply the techniques in material science for research, quality control and analysis.

CO6: Apply the theoretical knowledge of modern analytical tools, new screening methods for the estimation of micro and macro molecules

TEXT BOOKS:

1. Banwell, Colin N. and E.M. McCash. "Fundamentals of Molecular Spectroscopy" IVth Edition, Tata McGraw-Hill, 2017.
2. Aruldas, G. "Molecular Structure and Spectroscopy". IInd Edition, Prentice Hall of India,2007.
3. G.R. Naik. Applied biological engineering principles and practice. InTech, Croatia, 2012
4. Williams, Dudley H. and Ian Fleming. "Spectroscopic Methods in Organic Chemistry". VIth Edition, Tata McGraw-Hill, 2007.

REFERENCE BOOKS:

1. ICH Harmonized Guideline BIOANALYTICAL METHOD VALIDATION M10.
2. Hammes, Gordon G. "Spectroscopy for the Biological Sciences". John Wiley, 2005. 80
3. Hobert H. Willard, "Instrumental Methods of Analysis", 7th Edition,CBS Publishers & Distributors, 2004.
4. Atkins P.W., "Physical Chemistry ",10th Edition, Oxford University Press India, 2014.

U23PTV16	PHARMACEUTICAL NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To gain nsight into the fundamentals of nanotechnology in biomedical and Pharmaceutical research.
2. To understand how nanomaterials can be used for a diversity of analytical and medicinal rationales
3. To gain knowledge on usage of nanomaterials in cancer therapy
4. To understand the technological approach in preparing cosmetics
5. To create awareness on the toxicological effects of nanomaterials

UNIT I NANO STRUCTURES 9

Preparation, properties and characterization - Self-assembling nanostructure - vesicular and micellar polymerization-nanofilms - Metal Nanoparticles- lipid nanoparticles- nanoemulsion – Molecular nanomaterials: dendrimers

UNIT II NANOTECHNOLOGY IN BIOMEDICAL INDUSTRY 9

Reconstructive Intervention and Surgery- Nanomaterials in bone substitutes and dentistry – Implants and Prosthesis -in vivo imaging- genetic defects and other disease states — Nanorobotics in Surgery –Nanocarriers: sustained, controlled, targeted drug delivery systems

UNIT III NANOTECHNOLOGY IN CANCER THERAPY 9

Cancer Cell Targeting and Detection- Polymeric Nanoparticles for cancer treatment - mechanism of drug delivery to tumors -advantages and limitations - Multifunctional Agents - Cancer Imaging – Magnetic Resonance Imaging- Cancer Immunotherapy.

UNIT IV NANOTECHNOLOGY IN COSMETICS 9

Polymers in cosmetics: Film Formers – Thickeners – Hair Colouring – Conditioning Polymers: conditioning, Cleansing – Silicons – Emulsions – Stimuli Responsive Polymeric Systems – Formulation of Nano Gels, Shampoos, Hair-conditioners -Micellar self-assembly Sun-screen dispersions for UV protection – Color cosmetics

UNITV NANOTOXICITY 9

NanoToxicology- introduction, dose relationship- Hazard Classification-Risk assessment and management - factors affecting nano toxicity- Dermal Effects of Nanomaterials, Pulmonary, Neuro and Cardiovascular effects of Nanoparticles - Gene–Cellular and molecular Interactions of Nanomaterials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Comprehend the structural and functional principles of Pharmaceutical nanotechnology

CO2 : Recognize nanomaterials for analysis and sensing techniques

CO3: Apprehend the biomedical applications of nanotechnology

CO4: Explain the use of nanotechnology in cancer therapy and cosmetics.

CO5: Analyse the toxicity of nanoparticles

CO6: analyze and use various nanotechnological approaches in pharmaceutical products

TEXT BOOKS:

1. Springer Handbook of Nanotechnology- Ed. by B. Bhushan, Springer-Verlag 2004
2. Nanobiotechnology: Concepts, Applications and Perspectives,. CM.Niemeyer C A. Mirkin, (Eds) , Wiley, 2004
3. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, Second Edition, CRC Press, 2013
4. Sarah E. Morgan, Kathleen O. Havelka, Robert Y. Lochhead "Cosmetic Nanotechnology: Polymers and Colloids in Cosmetics", American Chemical Society, 2006.

REFERENCE BOOKS:

1. Nanotechnology in Biology and Medicine: Methods, Devices and Applications, Tuan VoDinh, CRC Press, 2007
2. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A. Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag 2004
3. Nanotechnology: Environmental Health and safety, Risks, Regulation and Management, Matthew Hull and Diana Bowman, Elsevier, 2010

VERTICAL II: FORMULATION AND MANUFACTURING TECHNOLOGY

		L	T	P	C
U23PTV21	**TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

1. Understand the basic concept of bulk drug and their intermediates involved in the manufacture.
2. Understand the diverse aspects in bulk drug industry like unit processes, equipments used and process optimization.
3. Acquire the knowledge on plant design, process development and chemical hazards in fine chemical and bulk drug industry.
4. Learn the different process involved in bulk drug manufacturing chemical and manufacturing processes
5. Understand the kinetics, thermodynamics and the concept of process economics

UNIT I INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS 9

Concept of fine and Bulk drugs and their salient features – Evolution of process – Process chemistry – Research and development strategies in pharmaceutical industries, Chemical process life cycle, Legislative requirements for safe process development and scale up.

UNIT II PRODUCTION, PLANNING AND CONTROL 9

Flow sheets – Types of flow sheets – Flow symbols – Line symbols – Concept of all purpose and multipurpose plants – Plant design – Layout — Process economics – Materials of construction – Effluent minimization and control and solvent recovery for fine chemicals and bulk drugs.

UNIT III PROCESS DEVELOPMENT AND HAZARDS 9

Developing the best synthetic route; Selection of the best route for scale-up, Choice of raw materials and reagents, Development techniques for safe process design, Effect of process variables on yield and quality of products, Unit operations posing particular hazards during development, Strategies for chemical hazards assessment, Hazards of gas and vapor generation, Identification of highly-energetic materials

UNIT IV BASE CHEMICALS, DRUG INTERMEDIATES AND FINE CHEMICAL PRODUCTION 9

Manufacture of following chemicals and their applications – Sulphuric acid – Caustic soda – Ammonia – Phenol – Industrial alcohol - Urea – Acrylonitrile –Ethyl acetate – Butadiene – Aniline – Titanium dioxide –Vanillin.

UNITV BULK DRUGS PRODUCTION 9

Raw Materials – Production Techniques – Reaction Flow Sheet – Equipments Utilities for the production of drugs below – Paracetamol – Aspirin – Ibuprofen – Diazepam, Vitamin C –Salbutamol – Ranitidine – Sulphamethoxazole – Cephalosporins – Erythromycin, Chloramphenicol, Sulfathiazole

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply legislative requirements and obtain official approval of the regulatory authorities for safe process development and scale up of fine chemicals and bulk drugs industries.

CO2 : Demonstrate the importance of flow sheets, flow symbols, plant design, layout and plant construction materials for the production of bulk drugs and fine chemicals and to implementthe concept of effluent treatment and solvent recovery in pharmaceutical industries

CO3: Develop and optimize the best synthetic scheme and pilot plant procedure to manufacture compounds and to insist development techniques for safe process considering the hazard assessment

CO4: Apply the knowledge of process chemistry in the production techniques of fine chemicals.

CO5: Analyze the different process involved in bulk drug manufacturing chemical and manufacturing processes associated with the production of small molecule drugs.

CO6: Understand and apply the kinetics, thermodynamics and the concept of process economics in multipurpose plants

TEXT BOOKS:

1. Gopal Rao, M. and Sittig, M., "Dryden's Outlines of Chemical Technology", 3rd Edition, Affiliated East West Press Pvt. Ltd., 2001.
2. Austin, G.T., "Shreve's Chemical Process Industries", 5th Edition, McGraw Hill BookCompany, 2012.
3. Pandey, G.N., "A Text Book of Chemical Technology", Vol. II, Vikas Publishing House (P) Ltd., 2000.

REFERENCE BOOKS:

1. A. Cybulski, " Fine Chemicals Manufacture- Technology and Engineering Elsevier Publication, 2000
2. Stanley Nusim, "Active Pharmaceutical Ingredients" Informa Healthcare, 2009

U23PTV22	PREFORMULATION TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. recognize the principles of preformulation
2. understand the role of preformulation in drug and formulation development
3. Learn the solubilisation role in preformulation
4. Learn the optimization techniques
5. Gain knowledge on overview of preformulation in drug development and formulation

UNIT I **INTRODUCTION** **8**

Preformulation studies of drug substances, proteins and peptides- Fundamental and derived properties in preformulation profiling -Preformulation worksheet.

UNIT II **ROLE OF PREFORMULATION IN FORMULATION DEVELOPMENT** **8**

Preformulation as a support for formulation development- identification of 'developmental challenges' during pharmaceutical development - dosage form specific studies.

UNIT III **SALT SELECTION** **9**

Role of salt selection in drug discovery and development - theoretical concepts for selection of counter ions for salt formation- 'pKa rule' for salt formation- decision tree for salt selectionappropriate case studies.

UNIT IV **SOLUBILIZATION** **9**

Solubility and solubilization of non-electrolyte- drug solubilization in surfactant systems -use of cosolvents for development of liquid formulations-solid state manipulations including use of metastable solid forms like amorphous state.

UNITV **OPTIMIZATION TECHNIQUES IN PHARMACEUTICAL FORMULATION AND PROCESSING** **12**

Introduction- optimization parameters- statistical design-response surface method, contour diagrams, factorial design, partial factorial design, simplex methods, mixture designs, and Box Benken method- applications in pharmaceutical formulation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apprehend the principles of preformulation
CO2 : Demonstrate the role of preformulation in Formulation
CO3: Comprehend the strategy of salt selection of drugs
CO4: Understand the solubilisation role in preformulation
CO5: Know the optimization techniques
CO6: Give an overview of preformulation in drug development and formulation

TEXT BOOKS:

1. Mark Gibson, Pharmaceutical Preformulation and Formulation, A Practical Guide from Candidate Drug Selection to Commercial Dosage Form,2nd Edition, CRC Press, 2009
2. James I. Wells. Ellis Horwood, Pharmaceutical preformulation: The physicochemical

properties of drug substances.

REFERENCE BOOKS:

1. Ram I. Mahato, Ajit S. Narang, Pharmaceutical Dosage Forms and Drug Delivery, CRC Press, 2007
2. Simon Gaisford, Mark Saunders, Essentials of Pharmaceutical Preformulation, John Wiley & Sons, 2012
3. Aulton's Pharmaceutics, The Design and manufacture of Medicines, Churchill Livingstone Elsevier, 2013

U23PTV23	MANUFACTURING TECHNOLOGY OF DOSAGE FORMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Impart the knowledge of the various types and stages of process of liquid and sterile pharmaceutical products.
2. Understand the principles of formulating Parenterals and ophthalmics.
3. Gain knowledge of sterilisation process for the sterile products
4. Understand the technology used in the formulations of ophthalmic products
5. Learn the concepts of pharmaceutical liquid and sterile products manufacturing

UNIT I INTRODUCTION TO LIQUIDS 9

Liquid dosage forms: Types, Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

UNIT II MONOPHASIC LIQUIDS 9

Definition, preparation and evaluation of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions

UNIT III PARENTERALS 9

Introduction, historical perspective - parenteral routes of administration - formulation additives. Small volume parenterals - large volume parenterals - packaging - labelling - storage of injections

UNIT IV STERILIZATION 9

Sterilization methods – Steam - Dry heat – Filtration – Gas - Ionizing radiation with their advantages and disadvantages, Validation of sterility, Particulate contamination.

UNITV OPHTHALMICS 9

Absorption of drugs in the eye - raw materials - ocular penetration enhancers - general safety consideration. Formulation of various ophthalmic products with their characterization

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Acquire the concepts of liquid dosage form
CO2 : Attain the knowledge of liquid dosage form preparation
CO3: Acquire the concepts in the formulation of parenterals
CO4: Get the knowledge of sterilisation process for the sterile products
CO5: Know the technology used in the formulations of ophthalmic products
CO6: Acquire the knowledge of pharmaceutical liquid and sterile products manufacturing

TEXT BOOKS:

1. Loyd V. Allen, Howard C. Ansel, Pharmaceutical Dosage Forms and Drug Delivery Systems, 10thEdition, Wolters Kluwer Health 2013.
2. Roop K. Khar, SP. Vyas “Lachman/Liebermans: The Theory and Practice of IndustrialPharmacy”, 4th Edition, CBS Publishers and Distributors 2013

REFERENCE BOOKS:

1. James Swarbrick “Encyclopedia of Pharmaceutical Science and echnology”,4thEdition, CRC Press, 2012.
2. Sandeep Nema, Nema Sandeep, John D “Pharmaceutical Dosage Forms: Parenteral Medications”, 3rd Edition, Informa Healthcare 2010.
3. David B. Troy, Paul Beringer, Remington: The science and practice of pharmacy, 21st Edition, Lippincott Williams and Wilkins, 2006

U23PTV24	INDUSTRIAL PROCESS AND SCALE UP TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To develop the concepts of pilot plant and scale-up techniques in industrial processes
2. To know the principle, design, methods, and equipment involved in scale – up processes
3. Understand the knowledge of design methods for distillation columns.
4. Gain knowledge on filters and mechanical operations equipments
5. Understand the concepts of industrial process and scale –up techniques

UNIT I PILOT PLANT AND SCALE-UP TECHNIQUES 9

Pharmaceutical Pilot plant – Pilot plant design – Case studies for tablets – Capsules – Aerosols – Liquid orals – Parenterals – Sustained release preparation – Semi-solid preparation – Basic requirements – Design of product – Facility – Equipment selection and personnel

UNIT II PRINCIPLE 9

Principle of similarity – Dimensional analysis – Scale up equations – Extrapolations – Analog models.

UNIT III DESIGN 9

Pilot plant design for flow ducts – Mixing equipments – Heat transfer equipments

UNIT IV METHODS 9

Design methods for packed towers – Batch and continuous distillation columns

UNITV EQUIPMENTS 9

Pilot plants for reactors – Furnaces – Filters and mechanical operations equipments

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Acquire the knowledge of pilot plant scale-up techniques for pharmaceutical products

CO2 : Describe the principle behind the industrial scale –up process

CO3: Explains pilot plant design for flow, mixing and heat transfer equipments

CO4: Attain the knowledge of design methods for distillation columns.

CO5: Acquire the knowledge of filters and mechanical operations equipments

CO6: Apply the knowledge of industrial process and scale –up techniques

TEXT BOOKS:

1. Bisio, A. and Kabel, R.L., “Scale Up of Chemical Processes”, John Wiley Publishers, 1990.
2. Johnstone, R.E. and Thring, M.W., “Pilot Plants Models and Scale Up Methods in Chemical Engineering”, McGraw Hill Book Co., 1987

REFERENCE BOOKS:

1. Ernest, J. and Staffin, K.H., “Stage-wise Process Design”, John Wiley Publications, 1989.
2. Levin, M., “Pharmaceutical Process Scale-Up”, Informa Healthcare, 2002.
3. Hynes, M.D., “Preparing for FDA Pre-approval Inspections”, Informa Healthcare, 1998.

U23PTV25	VACCINE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand the basic knowledge on basics of biotechnology
2. Provide the knowledge on conventional to recent technology of vaccine production.
3. learn the types of vaccines, its immunological effects and regulatory guidelines
4. Learn the concepts of various computational methods in vaccine production.
5. Understand the knowledge in developing various animal testing methods.

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, immunodeficiency, mechanism of adjuvant action, Scope of future vaccine strategies.

UNIT II CLASSIFICATION OF VACCINES AND ITS PREPARATIONS 9

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; Cell based vaccines.

UNIT III VACCINE RESEARCH AND DESIGN 9

Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens, Fundamentals of Immune recognition, implications for manipulating the T-Cell repertoire, Targeting Dendritic cells; a ational 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 9

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.

UNITV 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

COURSE OUTCOMES:

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

CO1 : Aware of the strategies available for developing an innovative vaccine technology with different mode of vaccine delivery.

CO2 : Able to explain the significance of critical antigens in vaccine development

CO3: Understand the use of immunogens and adjuvants in developing effective vaccines.

CO4: Aware of the regulatory issues, guidelines for the management of production of vaccine.

CO5: Comprehend on drug animal testing and quality control.

CO6: Apply the knowledge in developing animal testing

TEXT BOOKS:

1. Ronald W. Ellis, "New Vaccine Technologies", Landes Bioscience, 2001.
2. Cheryl Barton, "Advances in Vaccine Technology and Delivery", Espicom Business Intelligence, 2009.
3. Male, David et al., "Immunology", 7thEdition, Mosby Publication, 2007.

REFERENCE BOOKS:

1. Coico, R. etal., "Immunology: A Short Course", 5th Edition, Wiley – Liss, 2003.
2. Parham, Peter "The Immune System", 2nd Edition, Garland Science, 2005.
3. Abbas, A.K. etal., "The Cellular and Molecular Immunology", 6thEdition, Sanders / Elsevier,2007
4. Weir, D.M. and Stewart, John "Immunology", 8th Edition, Churchill Pvt. Ltd., 2000

U23PTV26	PHARMACEUTICAL PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To instill the cognizant of packaging technology and its requirements in pharmaceutical products.
2. Understand proper packaging materials for different pharmaceutical dosage forms.
3. Evaluate the appropriate packaging materials for the different dosage forms.
4. Estimate the factors influencing the packaging of liquid and sterile products.
5. Learn the regulations of the packaging materials.

UNIT I PHARMACEUTICAL PACKAGING AND LABELLING 9

Introduction of packaging - classification of packaging - packaging essential requirements functions of packaging - importance / significance of pharma packaging - main packaging materials – ideal package material properties – Label functions – types – label substrate materials – legal requirements of labels

UNIT II PRIMARY PACKAGING MATERIAL 9

Glass containers- introduction - selection of glass as packaging materials for the pharmaceutical products - properties of glass - production of glass - types of glass - test for glass containers advantages and disadvantages of glass containers. Metals containers- aluminium - aluminium foil collapsible tubes and stainless steel. Polymers -and plastics- introduction to plastics – raw materials of plastics - types of plastics - resin identification code - plastics and packaging and testing of plastic containers.

UNIT III SOLID DOSAGE FORM PACKAGING 9

Blister package- introduction to blister package - types of blisters - advantages and disadvantages of blister packaging - types of problems/ defects-Strip package- strip Packaging Process -packaging materials - child-resistant and multi-dose strip packaging – tamper evident packaging intelligent packaging

UNIT IV LIQUID FORMULATION AND STERILE PRODUCT PACKAGING 9

Liquid Formulation - Factors influencing selection of liquid filling machinery - balanced and unbalanced constant level filling – volumetric – gravimetric - level sensing - time fill - peristaltic andoverflow liquid filling machinery. Sterile product packaging- various types of containers used forsterile products like ampoules – vials - bottles for I.V. fluid, etc. Types of closures used for the sterile products. Sterile product filling and sealing machinery i.e. ampoule filling and sealing machine.

UNITV QUALITYCONTROL AND REGULATIONS OF PACKAGING MATERIALS 9

Specifications–quality control tests–methods and evaluation of packaging of materials– stability of packaging materials–law and regulations governing packaging

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the various categories of packaging materials used in pharmaceutical industry.

CO2 : Differentiate proper packaging materials for different pharmaceutical dosage forms.
CO3: Select and evaluate the appropriate packaging materials for the different dosage forms.
CO4: Recognize the factors influencing the packaging of liquid and sterile products.
CO5: Understand the regulations of the packaging materials.
CO6: Excel in the technology of pharmaceutical packaging process.

TEXT BOOKS:

1. Textbook of Pharmaceutical Packaging Technology. Kaushik A.Chaurasia B. Dakar V. First Edition. CBS Publishers New Delhi. 2019
2. D.A. Dean, E.R. Evans, I.H. Hall, "Pharmaceutical Packaging Technology", Taylor and Francis,2000.
3. Edward J. Bauer, Pharmaceutical Packaging Handbook. CRC Press, 2009.

REFERENCE BOOKS:

1. Anonymous,"Quality Assurance of Pharmaceuticals:A Compendium of Guidelines and Related Materials",2nd Edition, World Health Organization,2004.
2. U.K. Jain, D.C. Goupale, S. Nayak, "Pharmaceutical Packaging Technology", 2nd ed., Pharma Med Press, Hyderabad, 2008.
3. Remington: The Science and Practice of Pharmacy. 21st ed., 2005.
4. James Swarbrick, "Encyclopedia of Pharmaceutical Science and Technology", 4th ed., CRC Press, 2013.

VERTICAL III: QUALITY CONTROL AND QUALITY ASSURANCE

U23PTV31	REGULATORY TOXICOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Provide up-to-date information of the international, and national regulatory processes concerning chemical risk assessment in humans, biomaterials and medical devices.
2. Develop awareness of how toxicology is applied in real world regulatory situations and
3. Know the methods used to evaluate risk and produce safety guidelines, including laboratory testing, epidemiological studies and evaluation of the literature and online resources available to gather this information
4. Develop knowledge of the complexities and competing interests that are part of the regulatory decision making
5. Develop an understanding of Toxicogenomics

UNIT I INTRODUCTION 9

Regulatory aspects and strategy in medical device and biomaterials safety evaluation. Regulations affecting cosmetic and over-the- counter drug products

UNIT II REGULATIONS GOVERNING TOXICOLOGY 9

Aim and mission, working areas, regulatory process in toxicology, quality assurance in regulatory toxicology, toxicological risk assessment

UNIT III TOXICOLOGY AND DRUG PRODUCT REGULATIONS 8

Introduction, aspects of the IND / NDA process, toxicology and other issues, paediatric drug products, drug combinations, excipients and reformulations, conclusions.

UNIT IV TOXICOGENEOMICS, GENETIC TOXICOLOGY AND REGULATORY POLICY 10

Microarrays in toxicology, proteomics and metabolomics, case examples, toxicogenomics in regulatory environment. Initiation of genetic toxicology testing, ICPEMC, NTP, Genetic toxicology technologies and concepts. Influence of genetic toxicology research on regulatory policy, future role in safety testing strategies

UNITV ALTERNATIVES IN TOXICOLOGY 9

Introduction, Societal need for information about toxic chemicals, evolution of alternatives in toxicology, humane science and animal welfare, assessing alternatives, challenges and future

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the general principles in toxicological risk assessment

CO2 : Apprehend both ecotoxicology, human toxicology, and Quality Assurance

CO3: Understand the basic principles of and have current, cutting-edge knowledge in IND/NDA regulatory process.

CO4: Demonstrate an understanding of Toxicogenomics

CO5: Describe the Genetic Toxicology and ethical considerations relating to toxicology within the broader societal context

CO6: Comprehend alternative options in toxicology

TEXT BOOKS:

1. Regulatory Toxicology. Eds. Franz XaverReichl and Michael Schwenk. Springer, 2014.
2. Shayne C. Gad, Regulatory Toxicology, Second Edition,, CRC Press, 2001.

REFERENCE BOOKS:

1. Regulatory Toxicology in the European Union, Ian Dewhurst, Royal Society of Chemistry, 2017
2. Regulatory Toxicology: Essentially Practical Aspects, Renuka Sengupta, Narosa Publishing House, 2015
3. Toxicology and Regulatory Process. Sidney Green, CRC Press, 2006.

U23PTV32	QUALITY ASSURANCE IN PHARMACEUTICAL INDUSTRIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the importance of cGMP aspects in a pharmaceutical industry.
2. To understand the responsibilities of QA and QC departments
3. Learn the different assessments involved in the finished products.
4. Learn the principle and process involved in the process analytical technology
5. Learn the various regulations, modern methods and assessment techniques in maintaining the quality of the product in pharmaceutical industries

UNIT I GOOD LABORATORY PRACTICE 9

Concept and evolution and scopes of Quality Control and Quality Assurance. Good Laboratory Practices: Scope of GLP, The principles of good laboratory practice, Test facility management, Quality assurance programme, protocol for conduct of non-clinical testing, CPCSEA guidelines.

UNIT II ANALYSIS OF RAW MATERIAL 9

Developing specification for new drug substances, new drug products and impurities as per ICH Q6 and Q3.

UNIT III IN-PROCESS QUALITY CONTROL 9

Laboratory control, testing and release for distribution, in-process control, water for pharmaceutical use, aseptic process control, deviation procedure, stability testing.

UNIT IV QUALITY ASSURANCE 9

Quality assurance of finished products - tablets, capsules, ointments, parenteral, creams according to Indian Pharmacopoeias.

UNITV GUIDANCE FOR INDUSTRY PAT 9

Guidance development process and scope, process understanding-principles and tools – PAT tools-Risk based approach-Integrated systems approach-Real time release – strategy for implementation-PAT regulatory approach.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply GLP regulation in pharmaceutical manufacturing.

CO2 : Perform an experiment using modern equipment's in identifying the drug substance, drug products and impurities.

CO3: Design and develop process to ensure the critical systems in pharmaceutical industries and products.

CO4: Demonstrate the different assessments involved in the finished products.

CO5: Understand the principle and process involved in the process analytical technology

CO6: Understand the various regulations, modern methods and assessment techniques in maintaining the quality of the product in pharmaceutical industries

TEXT BOOKS:

1. The Quality Management Sourcebook: An International Guide to Materials and Resources By Christine Avery; Diane Zabel, Routledge, 1997.
2. The Quality Toolbox, Second Edition, Nancy R. Tague, ASQ Publications.
3. Juran's Quality Handbook, Sixth Edition, Joseph M. Juran and Joseph A. De Feo, ASQ Publications.

REFERENCE BOOKS:

1. Root Cause Analysis, The Core of Problem Solving and Corrective Action, Duke Okes, 2009, ASQ Publications.
2. Good laboratory Practice Regulations – Allen F. Hirsch, Volume 38, Marcel Dekker Series,1989.
3. The drugs and cosmetics act 1940 – Deshpande, Nilesh Gandhi, 4 th edition, Susmit Publishers, 2006.
4. Sarker DK. Quality Systems and Controls for Pharmaceuticals. John Wiley & Sons; 2008.

U23PTV33	AUDITS AND REGULATORY COMPLIANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the importance and methodology of auditing.
2. To prepare check list for audit process, audit report and regulatory compliance
3. Learn the process in checking the microbial laboratory facility.
4. Learn the critical engineering systems in pharmaceutical manufacturing area.
5. Understand the different auditing process and prepare the compliance report for approval pharmaceutical products.

UNIT I INTRODUCTION – AUDIT 9

Objectives, Management of audit, Responsibilities, Audit checklist for drug industries, factory acceptance test (FAT), site acceptance test

UNIT II VENDOR AUDIT & PRE-APPROVAL INSPECTIONS/INVESTIGATIONS 9

Vendor certification- Objectives, vendor appraisal, Vendor rating, Assessment of new vendor, vendor preferences, rewards system. Pre-Approval Inspections- Facility cGMP compliance and the capability to produce the product, Data accuracy and completeness, Laboratory methodology, manufacturing changes to approved drugs

UNIT III AUDITING OF MICROBIOLOGICAL LABORATORY 9

Auditing the process, Product and process information, General areas of interest in the building raw materials, Water, Packaging materials

UNIT IV AUDITING OF QUALITY ASSURANCE AND ENGINEERING DEPARTMENT 9

Quality Assurance Maintenance, Critical systems: HVAC – Purpose, life cycle, control during routine operation, Required Quality for Water for Pharmaceutical Purposes, Selection of Water for Pharmaceutical Purposes, Equipment and Components for Water System - Purposes of an Air Handling System, verification of air quality Cleanliness

UNITV QUALITY AUDIT AND REGULATORY COMPLIANCE 9

Scope, objective, quality audit, periodic evaluation, self-inspection, quality audit – internal audit, external audit, regulatory audit, role of GMP audits in QC and QA, benefits of GMP audits, elements of a systemic audit

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Perform the auditing in pharmaceutical industries.

CO2 : Design and develop the check list for vendor auditing and inspection of the pharmaceutical industries.

CO3: Design and develop process in checking the microbial laboratory facility.

CO4: Perform and verify the critical engineering systems in pharmaceutical manufacturing area.

CO5: Demonstrate the different auditing process and prepare the compliance report for approval pharmaceutical products.

CO6: Understand the various auditing and inspection process to ensure the quality of the pharmaceutical product.

TEXT BOOKS:

1. Compliance Auditing for Pharmaceutical Manufacturers: A Practical Guide to In-Depth Systems Auditing by Karen Ginsbury, Gil Bismuth, CRC Press BSP Books, 2018.
2. Pharmaceutical Manufacturing Handbook, Regulations and Quality by Shayne Cox Gad. Wiley-Interscience, A John Wiley and sons, Inc., Publications. 2008.

REFERENCE BOOKS:

1. Laboratory auditing for quality and regulatory compliance. Donald C. Singer, Raluca-loana Stefan, Jacobus F. Van Staden. CRC Press (2008).
2. Pharmaceutical Process validation by Robert A. Nash, Alfred H. Wachter, Marcel Dekker Inc, 2003.
3. Pharmaceutical Vendors Approval Manual A Comprehensive Quality Manual for API and Packaging Material Approval by Erfan Syed Asif, CRC Press, 2021.
4. Handbook of microbiological Quality control. Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyar. CRC Press. 2000.

U23PTV34	VALIDATION IN PHARMACEUTICAL INDUSTRIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To provide the basic fundamental knowledge about the flow properties of different types of fluids and its momentum balance.
2. To provide the knowledge about the various transporting and flow measurement and fluid machineries.
3. Learn the experiment process using modern equipment tools in identifying the drug substances and products.
4. Learn the different process and activities involved in the new product development.
5. Learn the various process and procedure to ensure the quality of the pharmaceutical product.

UNIT I CONCEPTS OF VALIDATION 9

Introduction – Regulatory basis for process validation – Total approach to pharmaceutical process validation – Pilot- scale up and process validation – Process validation order of priority – Process characterization and optimization techniques – Process validation as a quality assurance tool

UNIT II EQUIPMENT VALIDATION 9

Introduction – Project Scope- Prequalification – Installation Qualification –Operation Qualification –Process qualification – Equipment Approval – change Control

UNIT III CLEANING VALIDATION 9

Regulatory requirements– Multiplevs dedicated equipment– Uniquenatureof API–Multiple level approach to cleaning–Natureofcontaminants–Selectionofa worstcase–Cleaning techniques – Sampling – Analytical methods – Limits and acceptance criteria, documentation

UNIT IV ANALYTICAL METHOD VALIDATION 9

Introduction –Premarketing activities in assay validation methods development- Validation on analytical procedures(Q2A) - Validation for a NDA, ANDA – Validation in the quality control laboratory and transfer of methods from one laboratory to another

UNITV PROCESS VALIDATION 9

Process validation as a quality assurance tool-General QA tools, purpose of process validation, Qualification activities, Process validation activities. Prospective process validation-Organization, documentation, product development, development of manufacturing capability, full scale production development, defining experimental programs, experimental design and analysis

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand about the validation approach in pharmaceutical industries.

CO2 : Perform the different equipment validation process for successful installation of equipment.

CO3: Design and develop process in cleaning the equipment based on cleaning validation in pharmaceutical industries.

CO4: Design, develop an experiment process using modern equipment tools in identifying the drug

substances and products.

CO5: Demonstrate the different process and activities involved in the new product development.

CO6: Understand the various process and procedure to ensure the quality of the pharmaceutical product.

TEXT BOOKS:

1. R.A. Nash, A.H. Wachter, "Pharmaceutical Process Validation", 3rd ed., CRC Press, Taylor & Francis Group, 2003.
2. Y. Anjaneyulu, R.Maraya, "Quality Assurance and Quality Management in Pharmaceutical Industry", Pharma Book Syndicate, 2005

REFERENCE BOOKS:

1. Michael Levin, Pharmaceutical Process Scale-Up‖, Drugs and Pharm. Sci. Series, Vol. 157,2nd Ed., Marcel Dekker Inc., N.Y.
2. Pharmaceutical Equipment Validation: The Ultimate Qualification Handbook, Phillip A. Cloud, Interpharm Press
3. Analytical Method validation and Instrument Performance Verification by Churg Chan, Heiman Lam, Y.C. Lee, Yue. Zhang, Wiley Inter Science
4. J. P. Agalloco, F.J. Carleton, "Validation of Pharmaceutical Processes", 3rd ed., Informa Healthcare, NY, USA, 2007.

U23PTV35	QUALITY MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To provide the basic fundamental knowledge and importance of quality in pharmaceutical products.
2. Analysis the issues in quality and provides tools for quality improvement
3. Understand the quality risk process and manage to ensure the products quality in the manufacturing.
4. Able to learn the quality culture by adopting new strategies for improving the process and quality of the product.
5. Learn the various standards, systems, process to ensure the quality of the product in pharmaceutical industries

UNIT I QUALITY MANAGEMENT 9

Basics of Quality Management, Total Quality Management (TQM), Principles of Six sigma, ISO 9001 and ISO 14000, Pharmaceutical Quality Management – ICH Q10.

UNIT II QUALITY SYSTEMS 9

Personal hygiene, sanitation, training, calibration, cleaning and monitoring of equipment, packaging and labeling, product coding, documentation, inventory control, ware housing.

UNIT III QUALITY SYSTEM INSPECTION 9

Out of Specifications (OOS), Out of Trend (OOT), Complaints and evaluation of complaints, handling of returned goods and its disposal, product recalls, rejects and scrap disposal, annual product reviews, batch review and batch release, area clearance, line clearance.

UNIT IV QUALITY RISK ASSESSMENT 9

Quality risk management - Introduction, risk assessment, risk control, risk review, risk management tools, HACCP, risk ranking and filtering according to ICH Q9 guideline.

UNITV QUALITY CULTURE DEVELOPMENT 9

Quality by design – Definition, overview, elements of QbD program tools according to ICH Q8 (R2) guideline, measuring process control and quality improvement

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand and develop different standards for the quality management.

CO2 : Understand, design, develop and implement the systems in pharmaceutical industries.

CO3: Demonstrate and verify the process to ensure the product quality and quality systems.

CO4: Verify and assess the quality risk process and manage to ensure the products quality in the manufacturing.

CO5: Develop the quality culture by adopting new strategies for improving the process and quality of the product.

CO6: Understand the various standards, systems, process to ensure the quality of the product in pharmaceutical industries

TEXT BOOKS:

1. Good manufacturing procedure for Pharmaceuticals by Joseph D. Nally. Informa Health Care, NY, USA, 2007.
2. Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Controlby Sidney H. Wiliig, James R. Stoker, Dekker Series, 1997.

REFERENCE BOOKS:

1. cGMP Current Good Manufacturing Practices for Pharmaceuticals by Manohar A. Potdar and Ramkumar Dubey, Pharmamed Press / BSP Books, 2018.
2. ISO 9001, ISO 14001, and New Management Standards, by Inaki Heras-Saizarbitoria, Springer, 2018.
3. Good Manufacturing Practices for Pharmaceuticals by Graham P. Bunn, CRC Press, 2018.
4. Understanding, Managing and Implementing Quality Frameworks, Techniques and Cases, By Jiju Antony; David Preece, Routledge, 2002.

U23PTV36	PRODUCT DEVELOPMENT AND TECHNOLOGY TRANSFER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the new drug substance development process
2. To understand the information to pilot plant scale up and technology transfer from R& D to manufacturing premises
3. Learn an experiment using modern equipment to evaluate the packing materials.
4. Understand the different process and activities involved in the pilot plant scale up of the products.
5. Learn the process for successful transfer of the developed product.

UNIT I PRINCIPLES OF DRUG DISCOVERY AND DEVELOPMENT 9

Development and informational content for Investigational New Drugs Application (IND), New DrugApplication (NDA), Abbreviated New Drug Application (ANDA), Supplemental New Drug Application (SNDA), Scale Up Post Approval Changes (SUPAC), Post marketing surveillance, Product registration

UNIT II PRE-FORMULATION STUDIES 9

Introduction/concept, organoleptic properties, purity, impurity profiles, particle size, shape and surface area. Solubility, Methods to improve solubility of Drugs: Surfactants & its importance, cosolvency-Techniques for the study of Crystal properties and polymorphism

UNIT III PHARMACEUTICAL PACKAGING 9

Pharmaceutical packaging: Pharmaceutical dosage form and their packaging requirements, Pharmaceutical packaging materials, enteral Packaging, aseptic packaging systems, container closure systems, selection and evaluation of Pharmaceutical packaging materials

UNIT IV PILOT PLANT SCALE TECHNIQUES 9

Concept, significance, pilot plant scale up activities – general consideration for solids, semisolids, liquid, its relevant documentation and contract manufacturing

UNITV TECHNOLOGY TRANSFER 9

Scope, organization and management, production, quality control, premises and equipment, documentation, qualification and validation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the process in developing new drug substances.

CO2 : Perform an experiment using modern equipment to investigate the physicochemical properties of the drug substances.

CO3: Design, develop and perform an experiment using modern equipment to evaluate the packing materials.

CO4: Demonstrate the different process and activities involved in the pilot plant scale up of the products.

CO5: Design and develop the process for successful transfer of the developed product.

CO6: Understand the systems and process for the development and transfer of the product into the pharmaceutical industries.

TEXT BOOKS:

1. Computer Applications in Drug Discovery and Development by A. Puratchikody, S. Lakshmana Prabu, A. Umamaheswari, IGI Global Medical Information Science Reference, USA, 2018.
2. The process of new drug discovery and development. I and II Edition (2006) by Charles G. Smith, James T and O. Donnell. CRC Press, Group of Taylor and Francis.

REFERENCE BOOKS:

1. Remingtons Pharmaceutical Sciences, by Alfonso & Gennaro, 19th Edn.(1995)OO2C Lippincott; Williams and Wilkins A Wolters Kluwer Company, Philadelphia.
2. The Pharmaceutical Sciences; the Pharma Path way 'Pure and applied Pharmacy' by D. A Sawant, Pragathi Books Pvt.Juran's Quality Handbook, Sixth Edition, Joseph M. Juran and Joseph A. De Feo, ASQ Publications.
3. Pharmaceutical Packaging technology by D.A. Dean. E.R. Evans, I.H. Hall. 1 st Edition (Reprint 2006). Taylor and Francis. London and New York.
4. Pharmaceutical product development. Vandana V. Patrevale. John I. Disouza. MaharukhT.Rustomji. CRC Press, Group of Taylor and Francis.

VERTICAL IV: PHARMACEUTICAL INDUSTRIAL MANAGEMENT

U23PTV41	PHARMACEUTICAL PRODUCTION MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To make understand the process involved in the pharmaceutical industries and its management
2. Understand the different categories of Pharmaceutical Plant maintenance
3. Learn various process of pharmaceutical product manufacturing and manage the materials and human resources.
4. Learn the performance in inventory management
5. Learn the concepts in the management of human resources

UNIT I PILOT PLANT AND SCALE-UP TECHNIQUES 9

Pharmaceutical Pilot plant – Pilot plant Design – Theories of similarities – General considerations of pilot plant scaleup – Case studies for tablets – Capsules – Liquid orals – Parenterals – Sustained release preparation – Semi-solid preparation

UNIT II FORMULATION PRODUCTION MANAGEMENT 9

Plant site selection and layout – Plant Material handling for various pharmaceutical products – Functions – Selection – Maintenance – Types – Different categories of Pharmaceutical Plant maintenance – Replacement analysis – Group and individual replacement.

UNIT III PRODUCTION, PLANNING, SCHEDULING AND FORECASTING 9

Production systems – Production department Personnel – Production process, routing, loading and Scheduling – Despatching of records – Production control

UNIT IV MATERIAL MANAGEMENT 9

Materials – Quality and quantity – Value analysis – Purchasing – Centralized and decentralized – Vendor development – Buying techniques – Purchasing cycle and procedures – Stores management – Salvaging and disposal of scrap surplus – Selective inventory control – RQM and EOQ – Modern inventory management systems – Cost and savings in inventory – Evaluation of inventory performance

UNITV HUMAN RESOURCE MANAGEMENT 9

Human resource planning – Job analysis and design – Recruitment – Personnel selection – Orientation and placement – Training and development – Supervision – Performance appraisal – Remuneration and salaries – Compensation – Industrial relations – Motivation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Illustrate the general considerations of pilot plant scaleup

CO2 : Identify the various factors influencing for choosing a suitable location for pharmaceuticalplant and its construction

CO3: Analyse the different categories of Pharmaceutical Plant maintenance

CO4: Handle and execute various process of pharmaceutical product manufacturing and manage the materials and human resources.

CO5: Measure performance in inventory management
CO6: Apply the learned knowledge in the management of human resources

TEXT BOOKS:

1. Vidyasagar, G., "Pharmaceutical Industrial Management", 3rd Edition, Varghese Publications, 2001.
2. Subramaniam, C.V.S., "Textbook of Pharmaceutical Production Management", Vallabh Prakashan, 2000

REFERENCE BOOKS:

1. Lachman, L. and Liberman, H.A., "The Theory and Practice of Industrial Pharmacy", 3rd Edition, Varghese Publications, 1986.
2. Evans, J., Sweeny, A. and Wiliams, H "Applied Production and Operations Management", 3rd Edition, West Publishing Company Ltd., 1992.
3. Drucker, P.F., "Management (Task, Responsibility and Practices)", Allied Publication, 1993.

U23PTV42	PHARMACEUTICAL SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Develop an understanding of basic concepts and role of Logistics and supply chain management in business.
2. Understand how supply chain drivers play an important role in redefining value chain excellence of Firms.
3. Develop analytical and critical understanding & skills for planning, designing and operations of supply chain.
4. Understand, appraise and integrate various supply chain strategies
5. Understand warehousing management system and transportation practiced in various industries

UNIT I DEVELOPMENT OF SCM CONCEPTS 9

Concept of supply chain management, scope of SCM in Pharma Sector -Key decision areas – strategic. Supply Chain Management and Key components, External Drivers of Change. Dimensions of Logistics – The Macro perspective and the macro dimension – Logistic system analysis

UNIT II SOURCING STRATEGY 9

Manufacturing management – make or buy decision – capacity management – Materials Management – choice of sources – procurement planning. Key Drivers and enablers in Supply Chain Management, Supply chain components, SC Strategy, Measures of Supply Chain Performance

UNIT III DISTRIBUTION STRATEGY 9

Choice of Market – network design – warehouse designed operation and distribution planning – transportation – packaging

UNIT IV INVENTORY STRATEGY AND CHANNELS OF DISTRIBUTION 9

Demand forecasting – inventory planning – planning of stocking facilities – warehouse location allocation. Warehouse design and operations – inventory norms. Customer Service Strategy: Identification of Service needs, cost of services – revenue Management

UNITV LOGISTICS IN SUPPLY CHAIN 9

Reverse Logistics, Networks in Reverse Logistics, Decision options in Reverse Logistics, Entities in Reverse Logistics, Small Intermediate logistics, Clinical trial Logistics

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : understand the fundamentals of elements and functions of supply chain, role of drivers and demand forecasting.

CO2 : apply various techniques of inventory management and their practical situations.

CO3: analyze how supply chain decisions related to facility location can be applied to various industries and designing the supply chain.

CO4: describe warehousing management system and transportation practiced in various

industries

CO5: analyse logistics and supply chain strategies to create value generation and utilise IT applications

CO6: measure supply chain performance using various models

TEXT BOOKS:

1. Supply Chain Management in the Drug Industry Delivering Patient Value for Pharmaceuticals and Biologics by Hedley Rees · 2011.
2. The Supply Chain Management Casebook: Comprehensive Coverage by Chuck Munson 2013.

REFERENCE BOOKS:

1. Supply Chain Management: A Global Perspective by Nada R. Sanders · 2011
2. Supply Chain Science books by Wallace J. Hopp · 2011

U23PTV43	SAFETY AND DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To provide comprehensive knowledge about the safety management, safety procedures And handling techniques of the chemicals in Industry
2. To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
3. To enhance awareness of institutional processes in the country and
4. To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity
5. Understand the safety procedure and handling of chemicals used in the various process.

UNIT I INDUSTRIAL SAFETY 9

Concepts of safety – Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards – Hazards from utilities like air, water, steam

UNIT II HAZARD IDENTIFICATION AND CONTROL 9

HAZOP, job safety analysis – Fault tree analysis – Event tree analysis – Failure modes and effect analysis and relative ranking techniques – Safety audit – Plant inspection – Past accident analysis

UNIT III RISK MANAGEMENT 9

Overall risk analysis – Chapains model, E and FI model– Methods for determining consequences effects: Effect of fire, Effect of explosion and toxic effect – Disaster management plan – Emergency planning – Onsite and offsite emergency planning – Risk management – Gas processing complex, refinery – First aids

UNIT IV TYPES OF 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

UNITV DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, ManMade disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : illustrate the various aspects of industrial safety, hazard identification and control

CO2 : highlight the various risk management systems in chemical industry.

CO3: describe safety procedure and handling of chemicals used in the various process.

CO4: differentiate the types of disasters, causes and their impact on environment and society

CO5: assess vulnerability and various methods of risk reduction measures as well as mitigation.

CO6: draw the hazard and vulnerability profile of India, scenarios in the Indian context, Disaster damage assessment and management process

TEXT BOOKS:

1. J Maiti, Pradip Kumar Ray (Editor)., "Industrial Safety Management: 21st Century Perspectives of Asia, Kindle edition, Springer, 2019.
2. Lees, F.P., "Loss Prevention in Process Industries", 4th Edition, Butterworth Heinemann, 2012.
3. Harsh K.GuptaDisaster Management, University Press, 2020.

REFERENCE BOOKS:

1. Geoff Wells, Hazard Identification and Risk Assessment, Butterworth-Heinemann, 1996.
2. L. M. Deshmukh, Industrial Safety Management: Hazard Identification and Risk Control, 1st Edition, McGraw Hill Education (India) Private Limited, 2005.
3. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.
4. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011.
5. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

U23PTV44	MANAGEMENT INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To describe the role of information technology and decision support systems in business and record the current issues with those of the firm to solve business problems.
2. To introduce the fundamental principles of computer-based information systems analysis and design and develop an understanding of the principles and techniques used.
3. To enable students understand the various knowledge representation methods and different expert system structures as strategic weapons to counter the threats to business and make business more competitive.
4. understand how various information systems like DBMS work together to accomplish the information objectives of an organization.
5. Learn the theoretical models used in database management systems to answer business question.

UNIT I INTRODUCTION TO INFORMATION TECHNOLOGY 9

Impact of IT on Individuals, Organisations and Society - Information Technology Developments and Trends– Role of IT in an Organisation – Information System Concept and Types – IT Infrastructure and Architecture- Emerging Computing Environments (SaaS, SOA, etc.).

UNIT II 9

File Management- Database Management Systems- Creating Databases- Data Warehousing- Marketing Databases - Webbased Data Management Systems- Big Data- Basic overview of Oracle/SQL – Network Computing

UNIT III ENTERPRISE INFORMATION SYSTEM 9

Enterprise Systems and Supply Chains – Need for ERP – ERP Integration Challenges – Business Process Management - Customer Relationship Management- Virtual Corporations- Cloud Computing - Application: basic SAP Tutorial.

UNIT IV MANAGERIAL AND DECISION SUPPORT SYSTEMS 9

Knowledge Management Systems Implementation - Real-time Business Intelligence and Competitive Intelligence –Business Analytics – Online Analytical Processing – Business Performance Management, Scorecards and Dashboards- Types of Decision Support Systems- Intelligent Support Systems - Automated Decision Support (ADS) - Expert Systems

UNITV ESTABLISHING AND MANAGING IT SECURITY 9

Securing the enterprise; IS Vulnerabilities and Threats- Fraud and Computer Crimes- IT Security Management Practices-Network Security- Internal Control and Compliance Management- Business Continuity and Disaster Recovery Planning- Implementing Security: Auditing and Risk Management- Computer Forensics

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Relate the basic concepts and technologies used in the field of management informationsystems.

CO2 : Compare the processes of developing and implementing information systems.

CO3: Outline the role of the ethical, social, and security issues of information systems.

CO4: Translate the role of information systems in organizations, the strategic management processes, with the implications for the management.

CO5: Apply the understanding of how various information systems like DBMS work together to accomplish the information objectives of an organization.

CO6: Describe the theoretical models used in database management systems to answer business question.

TEXT BOOKS:

1. Efraim Turban, et al., (2013), Information Technology Management, Wiley, New Delhi.
2. Jawadekar, W.S., "Management Information Systems", Tata McGraw Hill Private Limited, New Delhi, 2009.

REFERENCE BOOKS:

1. Alex Leon and Mathew Leon: "Data Base Management Systems", Vikas Publishing House, New Delhi.
2. Goyal, D.P.: "Management Information System", MACMILLAN India Limited, New Delhi, 2008.
3. James A. O'Brien et al.,(2013), Management Information System, McGraw Hill Education India.
4. Kenneth C. Laudon and Jane P. Laudon: "Management Information Systems" 9/e, Pearson Education, New Delhi.

U23PTV45	INDUSTRIAL PSYCHOLOGY AND HUMAN RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Learn and Understand the human resource management skills
2. able to function effectively in their professional careers.
3. develop their soft skills for organizational culture
4. Learn the entrepreneurship skills
5. Learn the personality and behaviour development

UNIT I INTRODUCTION AND OVERVIEW OF HUMAN RESOURCE MANAGEMENT 9

Introduction and Overview, Management Theories- Taylor, Fayol, Weber, Hawthorne; Basic types of structures; Span of Control, Delegation, Authority, Responsibility, Recruitment- Philosophies, Different methods of attracting candidates, Selection- Application blanks, Interviews, Induction

UNIT II PERFORMANCE MANAGEMENT, TRAINING AND DEVELOPMENT 9

Performance management -Goal setting process, Performance appraisal methods, Appraisal interviews, Rating errors, Training & Development- Identifying training needs, Training methods (on the job and off the job techniques), Evaluation of training, Change Management- Types of change, Theories of change management, Hurdles to change, Olmosk change strategies

UNIT III KNOWLEDGE MANAGEMENT AND MOTIVATION 9

Knowledge management -Innovation, Importance and benefits of Knowledge Management, Framework, Motivation Theories-Classification of motives, Various theories (Maslow, Herzberg, ERG, Vroom, Equity and Nohria's 4 drive model)

UNIT IV LEADERSHIP AND ORGANIZATIONAL CULTURE 9

Leadership Theories- Blake Mouton model, Hersey Blanchard Model, Michigan Model, Organizational Culture-Types of cultures, Understanding and influencing cultures, Conflict Management- Stages of conflict, Types of conflict and sources of conflicts, Conflict resolution

UNITV POWER, POLITICS, PERSONALITY AND PERCEPTION 9

Power &Politics- Bases of power, Politicking strategies, Personality- Theories of personality, Behaviour and personality styles, Perception- Perception versus sensation, Perceptual process, Perceptual errors

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the fundamental concepts of industrial psychology and human resource management

CO2 : Analyze practical solutions

CO3: Provide applicable solutions

CO4: Provide leadership qualities

CO5: Enhance their Entrepreneurship skills

CO6: Personality and behaviour development

TEXT BOOKS:

1. C.B Gupta, Management Theory & Practice, Sultan Chand & Sons, 19th Edition, 2017.
2. L.M Prasad, Principles and Practices in Management, Sultan Chand & Sons, 2015.

REFERENCE BOOKS:

1. Innovation and Entrepreneurship, Peter Drucker, ASIN: 0060851139, Publisher: Harper Business; Reprint edition (9 May 2006), ISBN-13:978-0060851132.
2. Essentials of organizational Behaviour, Stephen P. Robbins, Publisher: Pearson; 14th edition (30 March 2017), ISBN-13: 978-0134523859.
3. Harold Koontz, Cyril O' Donnell & Heinz Weihrich, Essentials of Management, McGraw Hill,Inc, 5th Edition, 2017.

U23PTV46	PROJECT MANAGEMENT FOR PHARMACEUTICAL TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Learn the characteristics of project and formulate phases of project life cycle
2. Understand and estimate cost of project and means of financing
3. Able to learn the tools and techniques for project management.
4. Identify the risk involved in a project and analyse the sensitivity, scenario of market using Information technology tools.
5. evaluate cost of project and means of financing, sales and production.

UNIT I CONCEPTS OF PROJECT MANAGEMENT 9

Concepts of projects, characteristics of project, Phases of project life cycle, Tools and techniques for project management, Computer based project management. Project planning and estimating: Feasibility report, Preparation of cost estimation, Evaluation of the project profitability

UNIT II TECHNICAL ANALYSIS 9

Study of material inputs and utilities, manufacturing process and technology, product mix, plant capacity, location and site, project charts and layouts, work schedule financial analysis: Estimation of cost of project and means of financing, estimates of sales and production, cost of production, working capital requirement and its financing. Estimates of working results, breakeven point. Project cash hours. Time value of money. Cost of capital appraisal criteria: Net present value. Benefit cost ratio. Internal rate of return, payback period. Accounting rate of return, Investment appraisal in practice

UNIT III TOOLS AND TECHNIQUES OF PROJECT MANAGEMENT 9

Bar (GANTT) chart, Networks – PERT and CPM, Applications, Basic steps in PERT/CPM, Rules for drawing network diagram, Labelling, Time estimates, Critical Path Method, Project Evaluation and Review Technique (PERT).

UNIT IV PERFORMANCE MEASURES IN PROJECT MANAGEMENT 9

Performance indicators, Performance Improvement, Project management and environment. Risk Analysis: Sources, measures and perspectives on risk, sensitivity analysis, scenario analysis, breakeven analysis, Hiller model, simulation analysis, decision tree analysis, managing risk, project selection under risk

UNITV FINANCING OF PROJECTS 9

Capital structure, menu of financing, equity capital, internal accruals, term loans, debentures, working capital advance, miscellaneous sources, raising of venture capital, raising capital in international markets

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Identify characteristics of project and formulate Phases of project life cycle
CO2 : estimate cost of project and means of financing
CO3: select, and apply the tools and techniques for project management,
CO4: measure the risk involved in a project and analyse the sensitivity, scenario of market using Information technology tools.

CO5: estimate of cost of project and means of financing, sales and production, cost of production, working capital requirement and its financing.

CO6: Plan human aspects of project management and pre-requisites for successful project implementation

TEXT BOOKS:

1. Project Management: Choudhry S., Tata McGraw-Hill,2010
2. Projects: Planning, Analysis, Financing, Implementation, and Review- Prasanna Chandra, 5th edition, Tata McGraw-Hill publishing company limited,2005.
3. Operations Research- N V R Naidu, G. Rajendra, T Krishna kumar, I K international Publishing house, Pvt. Ltd. 2011.
4. Operations Research and Engineering Management, S. D. Sharma, Kedar Nath Ram Nath & Co., 2010.
5. Bhavesh M. Patel, Project Management: Strategic Financial Planning, Evaluation and Control Patel Sangam Books Ltd, 2000

REFERENCE BOOKS:

1. A Guide to the Project Management Body of knowledge PMBOK Guide 6th Edition, Project Management Institute 2017.
2. Project management a system approach to planning scheduling and controlling- Harold Kerzner, CBS Publisher and distributors, 2002.
3. A management guide to PERT and CPM- WEIST and LEVY Eastern Economy of PH 2002.
4. T R Banga, N K Agarwal and S C Sharma -Industrial engineering and Management Sciences, -KhannaPublishers.
5. United Nations: Industrial Development Organization's guide to Practical Project Appraisal Social Benefit Cost Analysis in Development Countries, publisher United Nations Industrial Development Organisation, 1986.

OPEN ELECTIVES

U23PTO01	CLINICAL RESEARCH AND PHARMACOVIGILANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. provide a value addition and current requirement for the students in clinical research and pharmacovigilance
2. teach the students on conceptualizing, designing, conducting, managing and reporting of clinical trials
3. focuses on global scenario of pharmacovigilance in different methods that can be used to generate safety data
4. teach the students in developing drug safety data in pre-clinical, clinical phases of drug development and post market surveillance
5. Learn the adverse drug reaction reporting systems and communication in pharmacovigilance

UNIT I REGULATORY PERSPECTIVES OF CLINICAL TRIALS 9

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

UNIT II CLINICAL TRIALS 9

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

UNIT III CLINICAL TRIAL DOCUMENTATION 9

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

UNIT IV BASIC ASPECTS, TERMINOLOGIES AND ESTABLISHMENT OF PHARMACOVIGILANCE 9

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

UNITV METHODS, ADR REPORTING AND TOOLS USED IN PHARMACOVIGILANCE 9

International classification of R22 M.Pharm Pharmacology JNTUH 10 diseases, International Nonproprietary names for drugs, Passive and Active surveillance, Comparative observational studies, targeted clinical investigations and Vaccine safety surveillance. Spontaneous reporting system and

Reporting to regulatory authorities, Guidelines for ADRs reporting. Argus, Aris G Pharmacovigilance, Vigi Flow, Statistical methods for evaluating medication safety data.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the regulatory requirements for conducting clinical trial
CO2 : Demonstrate the types of clinical trial designs
CO3: Explain the responsibilities of key players involved in clinical trials
CO4: Execute safety monitoring, reporting and close-out activities
CO5: Explain the principles of Pharmacovigilance
CO6: Detect new adverse drug reactions and their assessment
CO7: Perform the adverse drug reaction reporting systems and communication in pharmacovigilance

TEXT BOOKS:

1. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons.
2. A Textbook of Clinical Research and Pharmacovigilance by KPR Chowdary, Pharmamed Press.
3. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.
4. Textbook of Pharmacovigilance: Concept and Practice. G. P. Mohanta and P. K. Manna. 2016, Pharma Med Press.
5. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications.

REFERENCE BOOKS:

1. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.
2. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice. E6; May 1996.230
3. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.
4. Handbook of clinical Research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone.
5. A textbook of Clinical Pharmacy Practice: Essential Concepts and Skills. Second Edition, 2012, University Press.

U23PTO02	MOLECULAR PHARMACEUTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Impart knowledge on the area of advances in novel drug delivery systems.
2. Able To understand the various approaches for development of novel drug delivery systems
3. Learn the criteria for selection of drugs and polymers for the development of NTDS
4. Learn the concepts of targeting methods
5. Learn the properties and functions of microcapsules or microspheres

UNIT I TARGETED DRUG DELIVERY SYSTEMS 9

Concepts, Events and biological process involved in drug targeting-Tumor targeting and Brain specific delivery

UNIT II TARGETING METHODS 9

Introduction, preparation and evaluation of Nano Particles & Liposomes-Applications, advantages and disadvantages

UNIT III MICRO CAPSULES / MICRO SPHERES 9

Types, preparation and evaluation, Monoclonal Antibodies; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes.

UNIT IV PULMONARY DRUG DELIVERY SYSTEMS 9

Aerosols, propellents, Containers:Types, preparation and evaluation-Intra Nasal Route Delivery systems; Types, preparation and evaluation

UNITV NUCLEIC ACID BASED THERAPEUTIC DELIVERY SYSTEM 9

Gene therapy, introduction (ex-vivo & in-vivo gene therapy)-Potential target diseases for gene therapy (inherited disorder and cancer)- Gene expression systems (viral and nonviral gene transfer)-Liposomal gene delivery systems-Biodistribution and Pharmacokinetics- Knowledge of therapeutic antisense molecules and aptamers as drugs of future.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : To understand the various approaches for development of novel drug delivery systems

CO2 : To understand the criteria for selection of drugs and polymers for the development of NTDS

CO3: Learn the formulation and evaluation of novel drug delivery systems.

CO4: Understand the concepts of targeting methods

CO5: Understand the properties and functions of microcapsules or microspheres

CO6: Summarize the process of drug delivery systems

TEXT BOOKS:

1. 1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

REFERENCE BOOKS:

1. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, NewDelhi, First edition 1997

U23PTO03	ADVANCED PHARMACOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Strengthen the basic knowledge in the field of pharmacology
2. Understand the concepts of drug action and mechanisms involved.
3. Explain the mechanism of drug actions at cellular and molecular level
4. Understand the adverse effects, contraindications and clinical uses of drugs
5. Impart recent advances in the drugs used for the treatment of various diseases.

UNIT I GENERAL PHARMACOLOGY 9

Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. b. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors quantitation of drug receptors interaction and elicited effects.

UNIT II NEUROTRANSMISSION 9

General aspects and steps involved in neurotransmission-Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetylcholine)-Neuro humoral transmission in central nervous system (Detailed study about neurotransmitters histamine, serotonin, dopamine, GABA, glutamate and glycine]-Non-adrenergic non-cholinergic transmission (NANC)-Cotransmission Systemic Pharmacology , pathophysiology of diseases, mechanism of action, pharmacology and toxicology, Autonomic Pharmacology, Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscular junction

UNIT III CENTRAL NERVOUS SYSTEM PHARMACOLOGY 9

General and local anesthetics Sedatives and hypnotics, drugs used to treat anxiety. Depression, psychosis, mania, epilepsy, neurodegenerative diseases. Narcotic and non-narcotic analgesics.

UNIT IV CARDIOVASCULAR PHARMACOLOGY 9

Diuretics, anti-hypertensives, anti-ischemics, anti- arrhythmics, drugs for heart failure and hyperlipidemia-Hematinics, coagulants, anticoagulants, fibrinolytics and antiplatelet drugs.

UNIT V AUTACOID PHARMACOLOGY 9

Physiological and Pathological role of Histamine, Serotonin, Kinins, Prostaglandins, Opioid autacoids-Pharmacology of antihistamines, 5HT antagonists.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Discuss the pathophysiology and pharmacotherapy of certain diseases
CO2 : Explain the mechanism of drug actions at cellular and molecular level
CO3: Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases
CO4: Understand the concepts of drugs used in central nervous system
CO5: Develop knowledge in drugs used for cardiovascular

CO6: Develop knowledge in autacoid pharmacology

TEXT BOOKS:

1. The Pharmacological Basis of Therapeutics, Goodman and Gillman‘s.
2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapyby David E Golan, Armen H, Tashjian Jr, EhrinJ, Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.
3. Basic and Clinical Pharmacology by B. G Katzung .
4. Dipiro Pharmacology, Pathophysiological approach.

REFERENCE BOOKS:

1. Hand book of Clinical Pharmacokinetics by Gibaldi andPrescott.
2. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B. C. Yu.
3. Graham Smith. Oxford textbook of Clinical Pharmacology.
4. Advnced Pharmacology by Bikash Medhi. R22 M.Pharm Pharmacology.

U23PTO04	CLINICAL IMMUNOLOGY AND VACCINOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. gain knowledge about immunological against infections
2. Gain knowledge on humoral and cell mediated immunity
3. Learn about the autoimmunity mechanisms and damage
4. Learn the immunodiagnostic tests and assays
5. Learn the concepts of vaccines, its preparations and use

UNIT I MOLECULAR BASIS 9

Microbial pathogens – Bacterial, Viral and Fungal Pathogens and Parasitic diseases. Immune response vs infection. Immunity against bacterial infections – Innate and Acquired Immune responses – cellular involvement – Macrophages, Neutrophils, NK cells, Defensins, Humoral and Cell mediated Immune responses, Intracellular infections.

UNIT II INFECTION AND IMMUNITY 9

Immunity against bacterial and viral infections – Innate and Acquired immune responses – Effector mechanisms of HI and CMI – cytokine involvement. Immunodeficiency. Immunity to fungal and parasitic infections – overview of Humoral and Cell mediated immune responses against the pathogens. Immunomodulation in infections.

UNIT III CLINICAL IMMUNOLOGY 9

Clinical Immunology - Disease caused by immune response – hypersensitivity, immune tolerance and autoimmunity, mechanism of autoimmunity, therapy for immunological diseases - Immune complex disease, immunosuppression and immunomodulation.

UNIT IV IMMUNODIAGNOSIS 9

Diagnostic Immunology - Methods based on precipitation; ODD, CIE, IEP, immuno fixation and immunoblotting, RIA, RE, Immunonephlometry. Methods based on Agglutination - agglutination of whole cells, agglutination of inert particles coated with Ag/Ab. Haemagglutination – Direct, indirect, passive; CFT, labeled assays – ELISA, RIA, FISH, IFT-in vivo reactions- skin tests, immune complex demonstration. Diagnostic evaluation of lymphocytic haemagglutination inhibition, lymphocytic function and CMI, phagocytosis.

UNITV VACCINES 9

Introduction to Vaccines and Adjuvants - Types of vaccines – Whole cell - Killed and Live Attenuated vaccines. Sub–unit vaccines – polysaccharides, proteins, Toxoids. Recombinant vector vaccines, DNA vaccines, Development of vaccines and antibodies in plants. Vaccines against AIDS and Tropical Infectious Diseases – Leprosy, malaria and TB. Vaccines for control of fertility , Anti – HCG Vaccines and Anti – sperm antigen vaccine. Immunization – Active and Passive. Therapy for immunological diseases. Immuno therapy for cancer. Strategies of vaccine production. Gene silencing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Learn the molecular basis of microbial pathogens.

CO2 : Understand the Innate and Acquired immune responses against microbial pathogens

CO3: Learn various disease caused by immune response.

CO4: Learn immune diagnostic tests and assays against pathogens.

CO5: Understand the vaccines preparations and its clinical uses.

CO6: Understand the process involved in immune system.

TEXT BOOKS:

1. Mark Peakman, Basic and Clinical Immunology; Churchill Livingstone. 2 nd Ed., 2009. 19
2. Talwar GP, Rao KVS and Chauhan VS, Recombinant and Synthetic Vaccines; Narosa, New Delhi. 1994.

REFERENCE BOOKS:

1. Benjamini E, Coico R and Sunskise G,;Immunology – A short course, Wiley – Liss Publication, NY. Ed.4; 2000.
2. Kuby J, Immunology, WH Freeman and Co. NY. Ed.4; 1997.
3. Clark WR, The Experimental Foundations of Modern Immunology; John Wiley and Sons Inc. New York. 1991
4. Leslie Hudson and Frank C. Hay., Practical Immunology. Wiley. Ed.3; 1989. 6. Noel R. Rose, Herman Friedman, John L. Fahey., Manual of Clinical Laboratory Immunology. ASM. Ed.3; 1986.

U23PTO05	ADVANCED MOLECULAR TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Learn the concept of biomolecules and approaches for its characterization
2. Able to learn the chromatographic techniques.
3. Learn about concepts of centrifugation
4. Understand the concept of electrophoresis and its applications.
5. Learn about cell sorting techniques.

UNIT I CHARACTERIZATION OF BIOMOLECULES 9

Introduction and various approaches for characterization of biomolecules. Concentration of biomolecules: Salting out with ammonium sulfate, flash evaporation, lyophilization, dialysis, hollow fibre membranes, membrane filtration and their applications

UNIT II CHROMATOGRAPHY 9

Principle/simple theory and applications of partition, adsorption, ion exchange, gel permeation and affinity chromatography based techniques – paper, thin layer and column chromatography, Principle and applications of: HPTLC, GLC, HPLC, FPLC, GC/LC-MS, MALDI-TOF

UNIT III CENTRIFUGATION 9

Simple theory of preparative and analytical centrifuges and rotors; sedimentation analysis; differential, rate zonal and equilibrium density gradient centrifugations and applications, isolation of cells, sub-cellular organelles, viruses and macromolecules.

UNIT IV ELECTROPHORESIS (SIMPLE THEORY AND APPLICATIONS) 9

Types of electrophoresis paper, gel (starch, acrylamide and agarose) disc, vertical, horizontal submarine, gradient, 2D-PAGE, pulse-field and capillary; isoelectrofocussing; isolation and analysis of molecules from gel and recovery of molecules from paper/gels; southern, northern and western blotting.

UNITV CELL SORTING AND FLOW CYTOMETRY 9

Principles and Applications-Micro array based techniques-Introduction to Histological techniques - Detection of molecules in living cells, in situ localization by techniques such as FISH and GISH

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the concept of biomolecules and also approaches for its characterization

CO2 : Understand how the molecules are separated and purified using chromatographic techniques

CO3: Illustrate about concepts of centrifugation process

CO4: Understand how the maromolecules are separated

CO5: Understand the novel techniques involved in cell sorting

CO6: Understand the process and functons of flow cytometry

TEXT BOOKS:

1. Practical Biochemistry: Principles and Techniques 1995, 4th ed. by K. Wilson and J. Walker,

Cambridge University Press.
2. Modern Experimental Biochemistry. 1993. 2nd ed. by R.F. Boyer. The Benjamin Cummings Publ. Company.

REFERENCE BOOKS:

1. Introduction to Practical Biochemistry. 2000. by S.K. Sawhney and Randhir Singh (eds.) Narosa Publ. House
2. Biochemical Methods for Agricultural Sciences. 1992 by S. Sadasivam and A. Manikam. Wiley Eastern Ltd.
3. Essentials of Nuclear Chemistry by Prof. Hari Jeevan Arnikar, University of Pune. ISBN: 978-81-224-3203-9.
4. Fluorescence In Situ Hybridization (FISH) – Application Guide (Kindle Edition 2010). Editor Thomas Liehr. Springer Publication. ISBN-10: 1607617889, ISBN-13: 978-1607617884.

U23PTO06 **PRINCIPLES OF DRUG DISCOVERY** **L T P C**

3 0 0 3

COURSE OBJECTIVES

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

1. Understand the various targets for drug discovery
2. Learn and understand the drug discovery process
3. learn the importance of the role of genomics, proteomics and bioinformatics in drug discovery
4. Understand the various lead seeking method and lead optimization
5. learn the importance of the role of computer aided drug design in drug discovery

UNIT I AN OVERVIEW OF MODERN DRUG DISCOVERY PROCESS 9

Target identification, target validation, lead identification and lead Optimization. Economics of drug discovery. Target Discovery and validation-Role of Genomics, Proteomics and Bioinformatics. Role of Nucleic acid microarrays, Protein microarrays, Antisense technologies, siRNAs, antisense oligonucleotides, Zinc finger proteins. Role of transgenic animals in target validation.

UNIT II COMPUTATIONAL METHODS FOR PROTEINS 9

Lead Identification combinatorial chemistry & high throughput screening, in silico lead discovery techniques, Assay development for hit identification. Protein structure Levels of protein structure, Domains, motifs, and folds in protein structure. Computational prediction of protein structure: Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction.

UNIT III DRUG DESIGNING 9

Rational Drug Design Traditional vs rational drug design, Methods followed in traditional drug design, High throughput screening, Concepts of Rational Drug Design, Rational Drug Design Methods: Structure and Pharmacophore based approaches Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,

UNIT IV MOLECULAR DOCKING 9

Rigid docking, flexible docking, manual docking; Docking based screening. De novo drug design. Quantitative analysis of Structure Activity Relationship History and development of QSAR, SAR versus QSAR, Physicochemical parameters, Hansch analysis, Fee Wilson analysis and relationship between them.

UNIT V NOVEL TECHNIQUES 9

QSAR Statistical methods – regression analysis, partial least square analysis (PLS) and other multivariate statistical methods. 3D-QSAR approaches like COMFA and COMSIA Prodrug design-Basic concept, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze the various targets for drug discovery
CO2 : Understand the drug discovery process
CO3: Summarize the importance of the role of genomics, proteomics and bioinformatics in drug discovery
CO4: analyze the various lead seeking method and lead optimization
CO5: Understand the importance of the role of computer aided drug design in drug discovery
CO6: Understand the concept of modern drug discovery process.

TEXT BOOKS:

1. MouldySioud. Target Discovery and Validation Reviews and Protocols: Volume 2 Emerging Molecular Targetsand Treatment Options. 2007 Humana Press Inc.
2. Darryl León. Scott MarkelIn. Silico Technologies in Drug Target Identification and Validation. 2006 by Taylor and Francis Group, LLC.
3. Johanna K. DiStefano. Disease Gene Identification. Methods and Protocols. Springer New York Dordrecht Heidelberg London.

REFERENCE BOOKS:

1. J. Rick Turner. New drug development design, methodology and, analysis. John Wiley & Sons, Inc., New Jersey.
2. Abby L . Parrill. M . Rami Reddy. Rational Drug Design. Novel Methodology and Practical Applications. ACS Symposium Series; American Chemical Society: Washington, DC, 1999.
3. Klaus Gubernator, Hans-Joachim Böhm. Structure-Based Ligand Design. Methods and Principles in Medicinal Chemistry. Publisher Wiley-VCH
4. Hugo Kubiny. QSAR: Hansch Analysis and Related Approaches. Methods and Principles in Medicinal Chemistry. Publisher Wiley-VCH

U23PTO07	HERBAL TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To acquire the basic knowledge of Indian system of medicines.
2. To enable the students to know about the plant tissue culture techniques
3. Learn about the instruments used in the extraction, isolation, purification and identification of herbal drugs.
4. Learn various activities of traditional plants.
5. Learn the government policies to conserve traditional plants.

UNIT I INDIAN SYSTEMS OF MEDICINE 9

Introduction, basic principles and treatment modalities of Ayurveda – Unani – Homeopathy – Siddha –naturopathy- Introduction and streams of Yoga. Classification of herbs - Harvesting – Post harvesting –Conditions of storage.-seasonal and geographical variation.

UNIT II PHYTO PHARMACEUTICALS **9**

Requirements – Setting up a tissue culture lab – Basic laboratory procedure – Processing of plant tissue culture – Growth profile – Growth measurement – Plant tissue culture methods – Callus culture – Types of tissue culture – Tissue culture of medicinal plants – Applications of plant tissue culture.

UNIT III PHYTO PHARMACEUTICALS 9

Traditional and modern extraction techniques: Successive solvent extraction- Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox –General extraction process: Carbohydrates – Proteins – Alkaloids –Glycosides. Isolation and purification of phytochemicals (Eg. Quinine from cinchona, vincristine from Vinca, sennoside from senna, Euginol from clove oil.)

UNIT IV SCREENING METHODS FOR HERBAL DRUGS 9

Screening methods for anti-fertility agents – Antidiabetic drugs – Anti anginal drugs – Diuretic – Analgesic activity – Antipyretic activity – Anti cancer activity –Evaluation of hepatoprotective agents – anticonvulsive- Anti ulcer drugs.

UNIT V STANDARDIZATION AND CONSERVATION OF HERBAL DRUGS 9

Importance of standardization - Standardization of single drugs and compound formulations – WHO guidelines for the quality assessment herbal drugs - Conservation strategies of medicinal plants – Government policies for protecting the traditional knowledge.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the basic principle, design, control and processing techniques of medicinal plants and their derivatives.

CO2 : Learn plant tissue culture methods

CO3: Understand the techniques used for extraction process.

CO4: Learn various plant phytochemical activities

CO5: Find a solution to problems, including social, scientific and ethical issues connected with the use of medicinal plants in the different field of applications.

CO6: Describe the biological effects of medicinal plants with legislation and governmental policies for conserving medicinal plants.

TEXT BOOKS:

1. Agarwal, S.S. & Paridhavi, M., "Herbal Drug Technology" Universities Press,Pvt Limited, 2007.
2. Wallis, T.E., "Textbook of Pharmacognosy" 5th Edition, CBS Publishers and Distributors, 2005.
3. Indian System of Medicine and Homeopathy, Planning and Evaluation Cell, Govt.of India, New Delhi,
   2001.
4. Yoga- The Science of Holistic Living by V.K.Yoga, VKY Prakashna Publishing, Bangalore, 2005.
5. Quality Control Methods for medicinal plant material, WHO Geneva, 1998.

REFERENCE BOOKS:

1. Evans, W.C., "Trease and Evans Pharmacognosy" 15th Edition, Elsevier HealthSciences, 2001.
2. Pulok K. Mukherjee., "Quality control of Herbal Drugs"Reprintedn, Business Horizons, New Delhi, 2012.
3. Daniel, M., "Herbal Technology: Concepts and Advances" Satish Serial PublishingHouse, 2008.

U23PTO08	INTRODUCTION TO DRUG SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand the fundamental concepts of drug science, including drug classification and mechanisms of action
2. Learn about the drug development process, including discovery, formulation, and regulatory considerations.
3. Explore pharmacokinetics and pharmacodynamics, understanding how drugs interact with biological systems.
4. Identify the role of medicinal chemistry in drug design and synthesis.
5. Identify the role of medicinal chemistry in drug design and synthesis.
6. Examine the ethical, legal, and social implications of drug use and pharmaceutical regulations.

UNIT I INTRODUCTION TO DRUG SCIENCE 9

Definition and scope of drug science - History and evolution of drug discovery - Drug classification based on source, nature, and action - Drug nomenclature (chemical, generic, and brand names) - Introduction to pharmacokinetics and pharmacodynamics

UNIT II DRUG DISCOVERY AND DEVELOPMENT 9

Drug discovery approaches: Natural products, synthetic drugs, and biotechnology - Preclinical studies: In vitro and in vivo testing - Clinical trials: Phases I, II, III, and IV - Regulatory agencies (FDA, EMA, CDSCO) and drug approval process - Good Manufacturing Practices (GMP) and quality control

UNIT III PHARMACOKINETICS AND PHARMACODYNAMICS 9

Absorption, distribution, metabolism, and excretion (ADME) - Bioavailability and bioequivalence - Receptor theory and drug-receptor interactions - Dose-response relationship and therapeutic index - Factors affecting drug action (age, genetics, disease conditions)

UNIT IV MEDICINAL CHEMISTRY AND DRUG DESIGN 9

Basics of medicinal chemistry - Structure-activity relationship (SAR)- Prodrugs and drug metabolism - Target-based drug design and molecular docking - Role of biotechnology in modern drug design

UNIT V DRUG CLASSES AND ETHICAL CONSIDERATIONS 9

Major drug classes (antibiotics, analgesics, cardiovascular drugs, etc.) - Mechanisms of action and clinical applications - Adverse drug reactions and drug interactions - Ethical issues in drug use- Global policies on drug regulation and control

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the basic principles of drug action and classification.

CO2 : Describe the drug discovery and development process from research to market approval.

CO3: Analyze the pharmacokinetic and pharmacodynamic properties of drugs.

CO4: Demonstrate an understanding of medicinal chemistry concepts related to drug design.

CO5: Identify key drug classes, their therapeutic uses, and adverse effects.

CO6: Evaluate the ethical and legal aspects of pharmaceuticals and their impact on society.

TEXT BOOKS:

1. Rang & Dale's Pharmacology – Humphrey P. Rang, James M. Ritter, Rod J. Flower, Graeme Henderson (Elsevier)
2. Foye's Principles of Medicinal Chemistry – Thomas L. Lemke, David A. Williams (Lippincott Williams & Wilkins)
3. Goodman & Gilman's: The Pharmacological Basis of Therapeutics – Laurence L. Brunton, Randa Hilal-Dandan, Bjorn Knollmann (McGraw Hill)

REFERENCE BOOKS:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry – John H. Block, John M. Beale (Lippincott Williams & Wilkins)
2. Pharmaceutical Drug Analysis – Ashutosh Kar (New Age International)
3. The Science and Business of Drug Discovery – Edward D. Zanders (Springer)
4. Essentials of Pharmacokinetics and Pharmacodynamics – Thomas N. Tozer, Malcolm Rowland (Lippincott Williams & Wilkins)
5. Drug Discovery and Development: Technology in Transition – Raymond G. Hill, Duncan Richards (Elsevier)

U23PTO09	DIETARY SUPPLEMENTS AND NUTRACEUTICALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand the need and requirements of dietary supplements among different groups in the population.
2. Understand the need of supplements by the different group of people to maintain healthy life.
3. Understand the outcome of deficiencies in dietary supplements.
4. Appreciate the components in dietary supplements and the application.
5. Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

UNIT I INTRODUCTION 9

Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS 9

Occurrence and characteristics of Carotenoids, Polyphenolics, Flavonoids Anthocyanidins, Flavones, Phyto estrogens, Tocopherols, Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

UNIT III INTRODUCTION TO FREE RADICALS 9

Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids. Dietary fibres and complex carbohydrates as functional food ingredients

UNIT IV DISEASES 9

Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing. Antioxidants: Endogenous antioxidants– enzymatic and nonenzymatic antioxidant defence. Functional foods for chronic disease prevention

UNIT V REGULATING BODIES 9

Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the importance of nutraceuticals.
CO2 : Learn the phytochemical activities of nutraceuticals.
CO3: Learn the functioning of free radicals.

CO4: Understand various activities of free radicals.

CO5: Understand regulatory and commercial aspects of dietary supplements including health claims.

CO6: Understand the aspects of food authorities and certifications for dietary supplements.

TEXT BOOKS:

1. Advanced Nutritional Therapies by Cooper. K.A., (1996).
2. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
3. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn., Avery Publishing Group, NY (1997).

REFERENCE BOOKS:

1. Labuza, T.P. 2000 Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf Life Testing in Essentials of Functional Foods M.K. Sachmidl and T.P. Labuza eds. Aspen Press.
2. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
3. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn., Avery Publishing Group, NY (1997).

U23PTO10	BASIC LABORATORY ANIMAL SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. present basic facts and principles that are essential for the humane use and care of laboratory animals and for the quality of research.
2. present basic and appropriate biology, care, health and management of animals, recognition of pain, suffering and distress in these animals.
3. meets the standards for the species-specific education and training requirements.
4. persons designing projects and procedures for these specific animals.
5. minimally invasive procedures without anaesthesia to be applied on these animals.

UNIT I FUNDAMENTALS OF LABORATORY ANIMAL SCIENCE 9

Contribution of Laboratory animals to Medical Progress: Past, Present and Future. Overview of ethics of animal research.

UNIT II LABORATORY ANIMAL CARE 9

Animal accommodation, animal care routines, animal health and hygiene, diets, feeding and drinking, reproduction, breeding and heredity.

UNIT III GLOBAL REGULATIONS 9

An overview of global and Indian legislation, regulation and policies about experimentation on laboratory animals.

UNIT IV PRE-CLINICAL RESEARCH 9

Animal models, concepts, classification of animal models and disease models, extrapolation from animals to humans, model body size and scaling.

UNIT V ALTERNATIVES TO ANIMAL TESTING 9

Alternatives to animal models, refinement, reduction, and replacement of animal uses in the life sciences.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Describe the requirements of various legislation concerning scientific use of animals.

CO2: Identify ethical issues in human-animal interaction, including replacement, reduction and refinement.

CO3: Describe normal behaviour of rodents and lagomorphs, handling, husbandry needs, and enrichment.

CO4: Know the animal models used in research.

CO5: Understand the alternatives opf animal models.

CO6: describe the need for hygiene in animal housing and experimental work**.**

TEXT BOOKS:

1. Introduction to Laboratory Animal Science and Technology J. K. INGLIS. Pergamon Press, Elsevier; 2013.
2. Hau, Jann, and Steven J. Schapiro, eds. Handbook of laboratory animal science: essential principles and practices. Vol. 1. CRC press, 2002
3. Fundamentals of Laboratory Animal Science, Anqi Li, Jianglin Fan, CRC press,2017.

REFERENCE BOOKS:

1. Handbook of Laboratory Animal Science 2nd Edition, Edited by Jann Hau and Gerald L.Van Hoosier Jr. Vol, I, II, III. 2004.

2. Management of laboratory animal care and use programs. Edited by Mark A. Suckow, Fred A Douglas, Robert H Weichbrod, 2001.

3. Conn, P.M., Animal models for the study of human disease. Academic Press, 2017.

U23PTO11 **REMEDIAL BIOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. Understand the basic components of anatomy & physiology of plant.
2. Know the classification and salient features of five kingdoms of life.
3. Know understand the basic components of anatomy & physiology animal with special reference to human.
4. Able to understand the various metabolic reactions of plants.
5. Know the growth and development of plants.

UNIT I **INTRODUCTION** **9**

Definition and characters of living organisms, Diversity in the living world,Binomial nomenclature, Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus, Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones.

UNIT II **HUMAN RESPIRATORY SYSTEM** **9**

Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones. Human alimentary canal and digestive glands-Role of digestive enzymes, Digestion, absorption and assimilation of digested food, Human respiratory system-Mechanism of breathing and its regulation, Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes

UNIT III **EXCRETION AND NERVOUS SYSTEM** **9**

Excretory products and their elimination- Modes of excretion, Human excretory system- structure and function, Urine formation, Rennin angiotensin system, Neural control and coordination-Definition and classification of nervous system, Structure of a neuron, Generation and conduction of nerve impulse, Structure of brain and spinal cord, Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata, Chemical coordination and regulation- Endocrine glands and their secretions, Functions of hormones secreted by endocrine glands, Human reproduction- Parts of female reproductive system, Parts of male reproductive system, Spermatogenesis and Oogenesis, Menstrual cycle

UNIT IV **INTRODUCTION TO PLANT BIOLOGY** **9**

Plants and mineral nutrition- Essential mineral, macro and micronutrients, Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation, Photosynthesis-Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.

UNIT V **GROWTH AND DEVELOPMENT** **9**

Plant respiration-Respiration, glycolysis, fermentation (anaerobic). Plant growth and development-Phases and rate of plant growth, Condition of growth,Introduction to plant growth Regulators Cell - The unit of life Structure and functions of cell and cell organelles.Cell division Tissues-Definition, types of tissues, location and functions

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the five kingdoms and general anatomy of root, stem.

CO2 : Know the functional units of body.

CO3: Know the excretory and nervous system of the body.

CO4: Understand the cycles of plants.

CO5: Know the development and growth of plants.
CO6: Understand the cell cycle and cell organelles.

TEXT BOOKS:

1. A Text book of Biology by Naidu and Murthy
2. Botany for Degree students By A.C.Dutta.

REFERENCE BOOKS:

1. A Text book of Biology by B.V. Sreenivasa Naidu
2. Outlines of Zoology byM. Ekambaranatha ayyer and T. N. Ananthakrishnan.
3. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

U23PTO12 **PHARMACEUTICAL MICROBIOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES

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

1. Understand methods of identification, cultivation and preservation of various microorganisms.
2. To understand the importance and implementation of sterlization in pharmaceutical processing and industry.
3. Learn sterility testing of pharmaceutical products.
4. Carried out microbiological standardization of Pharmaceuticals.
5. Understand the cell culture technology and its applications in pharmaceutical industries.

UNIT I **INTRODUCTION** **9**

Introduction, History of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes. Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth. Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.

UNIT II **MICROBIOLOGY TECHNIQUES** **9**

Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Sterility indicators.

UNIT III **FUNGI AND VIRUSES** **9**

Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation, bacteriostatic and bactericidal actions.

UNIT IV **STERILIZATION** **9**

Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.

UNIT V **PERSERVATION TECHNIQUES** **9**

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the basics of microbiology.
CO2 : Know the staining and sterilization methods
CO3: Study the morphology of virus and fungi.
CO4: Know the various microbiological assay and sterilization techniques.
CO5: Understand the various preservation techniques
CO6: Know the cell culture techniques and their applications in pharmaceutical industries.

TEXT BOOKS:

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific Publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.

REFERENCE BOOKS:

1. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan.
2. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi.

ELECTIVE – MANAGEMENT COURSES

U23GET71	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

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

UNIT II PLANNING 9

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

UNIT III ORGANISING 9

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

UNIT IV DIRECTING 9

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

UNITV CONTROLLING 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.

CO2 : Have same basic knowledge on international aspect of management.

CO3: Ability to understand management concept of organizing.

CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling
CO6: Understand the application of the principles in an organization.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23GET72	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I INTRODUCTION 9

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

UNIT II TQM PRINCIPLES 9

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

UNIT III TQM TOOLS & TECHNIQUES I 9

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

UNIT IV TQM TOOLS & TECHNIQUES II 9

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

UNITV 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

COURSE OUTCOMES:

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

CO1 : Ability to apply TQM concepts in a selected enterprise.

CO2 : Ability to apply TQM principles in a selected enterprise.

CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5: Ability to apply QMS and EMS in any organization.

CO6: Understand the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCE BOOKS:

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

U23GET73	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understanding the concept of Engineering Economics.
2. Implement various micro economics concept in real life.
3. Gaining knowledge in the field of macro economics to enable the students to have better
4. Understanding of various components of macro economics.
5. Understanding the different procedures of pricing.

UNIT I DEMAND & SUPPLY ANALYSIS 9

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis.Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.

UNIT II PRODUCTION AND COST ANALYSIS 9

Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT III PRICING 9

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) 9

Balance sheet and related concepts - Profit & Loss Statement and related concepts – Financial Ratio Analysis - Cash flow analysis - Funds flow analysis – Comparative financial statements - Analysis & Interpretation of financial statements.

UNITV CAPITAL BUDGETING (ELEMENTARY TREATMENT) 9

Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 :	Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions
CO2 :	Evaluate the economic theories, cost concepts and pricing policies
CO3:	Understand the market structures and integration concepts
CO4:	Understand the measures of national income, the functions of banks and concepts of globalization
CO5:	Apply the concepts of financial management for project appraisal
CO6:	Understand the various cost related concepts in micro economics.

TEXT BOOKS:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.

2. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.

REFERENCE BOOKS:

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

U23GET74	HUMAN RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To provide knowledge about management issues related to staffing,
2. To provide knowledge about management issues related to training
3. To provide knowledge about management issues related to performance
4. To provide knowledge about management issues related to compensation
5. To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9

The importance of human resources – Objective of Human Resource Management - Human resource policies - Role of human resource manager.

UNIT II HUMAN RESOURCE PLANNING 9

Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.

UNIT III TRAINING AND EXECUTIVE DEVELOPMENT 9

Types of training and Executive development methods – purpose – benefits

UNIT IV EMPLOYEE COMPENSATION 9

Compensation plan – Reward – Motivation – Career Development - Mentor – Protege relationships.

UNITV PERFORMANCE EVALUATION AND CONTROL 9

Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Gain knowledge on the various aspects of HRM
CO2 : gain knowledge needed for success as a human resources professional
CO3: develop the skills needed for a successful HR manager
CO4: prepare to implement the concepts learned in the workplace
CO5: aware of the emerging concepts in the field of HRM
CO6: Gain knowledge on management issues related to human factors consideration and compliance with human resource requirements.

TEXT BOOKS:

1. 1. Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2. John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013, New Delhi.

REFERENCE BOOKS:

1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources",

7th Edition, PHI, 2012.
2. Dessler, "Human Resource Management", Pearson Education Limited, 2007.

\

U23GET75	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Learn the Evolution of Knowledge management.
2. Be familiar with tools.
3. Be exposed to Applications.
4. Gain knowledge on the concepts of some case studies.
5. Gain knowledge on management Applications.

UNIT I INTRODUCTION 9

Introduction: An Introduction to Knowledge Management -The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING 9

Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS 9

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

UNIT IV KNOWLEDGE MANAGEMENT APPLICATION 9

Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT V FUTURE TRENDS AND CASE STUDIES 9

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan – A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the process of acquiry knowledge from experts.
CO2 : Understand the learning organization.
CO3: Use the knowledge management tools.
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.
CO6: Understand the Evolution of Knowledge management.

TEXT BOOKS:

1. Srikantaiah, T.K., Koenig,M., “Knowledge Management for the Information Professional” Information Today, Inc., 2000.

REFERENCE BOOKS:

1. 1. Nonaka, I., Takeuchi, H., “The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation”, Oxford University Press, 1995.

U23GET76	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT II FUNCTIONS OF MANAGEMENT - I 9

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT III FUNCTIONS OF MANAGEMENT - II 9

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics;
Nature; Process; Classifications.

UNIT IV ORGANIZATION THEORY 9

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivationhygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT V PRODUCTIVITY AND MODERN TOPICS 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1 :** Explain basic concepts of management; approaches to management; contributors to management studies;
- **CO2 :** Discuss the planning; organizing and staffing functions of management in professional organization.
- **CO3:** Apply the leading; controlling and decision making functions of management in professional organization.
- **CO4:** Discuss the organizational theory in professional organization.
- **CO5:** Apply principles of productivity and modern concepts in management in professional organization.
- **CO6:** Develop various forms of business organization and trade unions function in professional organizations.

TEXT BOOKS:

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCE BOOKS:

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.