SEMESTER V

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PC	PT19501	IPR in Pharmaceutical Industry	3	0	0	3
2	PC	PT19502	Chemical Engineering Thermodynamics	3	0	0	3
3	PC	PT19503	Medicinal Chemistry	3	0	0	3
4	HS	PT19504	Cell & Molecular Biology	3	0	0	3
5	ES	PT19505	Technology of Solid and Semi Solid Dosage Forms	3	0	0	3
6	PE	PT1915*	Professional Elective I	3	0	0	3
PRACTICALS							
7	PC	PT19506	Medicinal Chemistry Laboratory	0	0	4	2
8	PC	PT19507	Cell & Molecular Biology Laboratory	0	0	4	2
9	EE	EE19501	Career Development Laboratory I	0	0	2	1
			TOTAL	**18**	**0**	**10**	**23**

SEMESTER VI

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	PC	PT19601	Bioprocess Engineering	3	0	0	3
2	PC	PT19602	Genetic Engineering & Genomics	3	0	0	3
3	PC	PT19603	Protein Engineering & Proteomics	3	0	0	3
4	PC	PT19604	Immunology & Immunotechnology	3	0	0	3
5	PE	PT1925*	Professional Elective II	3	0	0	3
6	OE	PT1990*	Open Elective I	3	0	0	3
PRACTICALS							
7	PC	PT19605	Bioprocess Engineering Laboratory	0	0	4	2
8	PC	PT19606	Immunogenetics Laboratory	0	0	4	2
9	EE	EN19601	Career Development Laboratory II	0	0	2	1
			TOTAL	**18**	**0**	**10**	**23**

PROFESSIONAL ELECTIVE I

S. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	PT19151	Basic Laboratory Animal Science	3	0	0	3
2.	PT19152	Technology of Fine Chemical & Bulk Drugs	3	0	0	3
3.	PT19153	Chemistry of Natural Products	3	0	0	3
4.	PT19154	Enzyme Technology	3	0	0	3

PROFESSIONAL ELECTIVE II

S. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	PT19251	Chemical Reaction Engineering	3	0	0	3
2.	PT19252	Engineering of Biomaterial Science	3	0	0	3
3.	PT19253	Cosmetic Technology	3	0	0	3
4.	PT19254	Pharmaceutical Biotechnology	3	0	0	3

OPEN ELECTIVE I

S. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	PT19901	Safety and Health Evaluation	3	0	0	3
2.	PT19902	Medicinal Natural Products	3	0	0	3

PT19501 IPR IN PHARMACEUTICAL INDUSTRY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- enable the students to understand the medical ethics.
- analyze medical standards.
- study the medicine and drug acts.
- learn about drugs and cosmetics standards.
- learn about various medical laws.

UNIT I MEDICINE AND MEDICAL ETHICS 9

Infectious diseases - Diseases of CVS, Respiratory system, Kidney and Urinary tract, Liver and Biliary tract disease, Endocrinology, and Metabolism; Medical ethics, Code of conduct, Basic principles of medical ethics, Autonomy and Informed consent, Organ transplantation, Medico legal aspects of medical.

UNIT II MEDICAL STANDARDS 9

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA – Electronics Patient Records – Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine – Bioethics

UNIT III INTELLECTUAL PROPERTY RIGHTS 9

Introduction and the Need for Intellectual Property Right (IPR) - Kinds of Intellectual Property Rights - Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge, Ethics of Resource Management.

UNIT IV DRUGS AND COSMETICS STANDARDS 9

Medicinal and Toilet preparations (Excise duties) Act and rules - Drugs Price control order, Shops and Establishments Act, Sales promotion employees (conditions of service) Act.

UNIT V TRADE SECRET 9

IPR in India - Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights - Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967, the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994 India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt; Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- get educated on the students to understand the medical ethics.
- understand and implement the basics of medical standards in pharma industry

- implementing the concepts of medicine and drug related act in the regulatory environment
- understand and implement the drugs and cosmetics standards.
- implement the various medical laws in pharma regulated industries.

TEXT BOOKS

1. R.D.Lele, "Computers in Medicine Progress in Medical Informatics", Tata McGraw Hill Publishing computers Ltd, 2005, New Delhi.
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing computers Ltd, 2003 New Delhi.

REFERENCES

1. G. Vidyasagar and T. V. Narayana,"Forensic Pharmacy", Kalyani Publishers, New Delhi.
2. Vijay Malik,"Drugs and Cosmetics Act, 1940", Eastern Book Company, Lucknow.
3. N. K. Jain,"Forensic Pharmacy", 6th Edition CBS Publishers. Delhi
4. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

CO/PO MAPPING :

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	3	2	2	-	-	-	-	2	-	1
CO2	3	-	2	1	3	2	2		-	-	-	3	-	1
CO3	3	-	2	-	3	3	3	2	-	-	-	2	2	1
CO4	2	-	2	2	2	3	3	3	-	-	-	3	2	2
CO5	3	-	2	-	3	3	3	3	-	-	-	3	3	1

PT19502 CHEMICAL ENGINEERING THERMODYNAMICS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- apply the concepts of heat, work and energy conversion to calculate heat and work quantities for industrial processes.
- apply the basic concepts of first and second laws of thermodynamics for the design and analyze of the open and closed system in chemical process plants.
- predict the changes in the properties of real fluids undergoing changes in process plant equipment
- use empirical correlations and experimental date to evaluate thermodynamic quantities that relate to the vapour - liquid or liquid-liquid equilibria of ideal and non-ideal chemical mixtures
- determine equilibrium constants, standard enthalpy, gibbs free energy and equilibrium compositions for single and multiple reaction systems

UNIT I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9

Terminologies of Thermodynamics - Categorization of Systems and Processes, Laws of Thermodynamics. Reversible and Irreversible process; PVT behaviour gases; Equation of state; Entropy changes in Reversible and Irreversible process, Internal Energy and Entropy as a function of Temperature and Pressure

UNIT II THERMODYNAMIC PROPERTIES 9

Thermodynamics relations - Maxwell relations; Fugacity and Fugacity coefficients; Estimation of Thermodynamic properties; Types of Thermodynamic diagrams.

UNIT III PHASE EQUILIBRIA AND VAPOUR LIQUID EQUILIBRIA 9

Phase equilibria - Activity and Activity coefficients; Gibbs-Duhem equations; Van laar, Margules equation; Consistency test; Prediction of VLE

UNIT IV CHEMICAL REACTION EQUILIBRIA 9

Criteria of equilibrium - Standard free energy change and Equilibrium constants; Effect of Temperature; Evaluation of Equilibrium Constants

UNIT V APPLICATION OF LAWS OF THERMODYNAMICS 9

Compression and expansion of fluids - Theory of Multistage compression; Refrigeration principles and Applications

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply the concepts of heat, work, and energy conversion to calculate heat and work quantities for industrial processes.
- apply the basic concepts of first and second laws of thermodynamics for the design and analyse of the open and closed system in chemical process plants.

- predict the changes in the properties of real fluids undergoing changes in process plant equipment
- use empirical correlations and experimental date to evaluate thermodynamic quantities that relate to the vapour - liquid or liquid-liquid equilibria of ideal and non-ideal chemical mixtures
- determine equilibrium constants, standard enthalpy, gibbs free energy and equilibrium compositions for single and multiple reaction systems

TEXT BOOKS

1. Narayanan K.V., A Textbook of Chemical Engineering Thermodynamics, Prentice- Hall ofIndia Private Limited, New Delhi,2001.
2. Smith J.M., Van Ness H.C., Abbott M.M., Introduction to Chemical Engineering Thermodynamics, Seventh Edition, Tata McGraw Hill International Student Edition, 2007

REFERENCES

1. Dodge, B.F., Chemical Engineering Thermodynamics, McGraw Hill International Student Edition, 1960
2. Stanley I. Sandler, "Chemical, Biochemical and Engineering Thermodynamics", John-Wiley, 4th edition, 2006
3. Rao. Y.V.C., Chemical Engineering Thermodynamics, United press (India) ltd.1997
4. Hougen and Watson, "Chemical Process Principles" Vol. II, CBS Publishers, 2002.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	3	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	3	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	-	-	2	-	-	1	-	-	3	2
CO4	1	2	-	1	-	-	2	-	-	1	-	-	3	2
CO5	-	1	2	-	2	2	-	2	2	3	-	-	3	2

PT19503 MEDICINAL CHEMISTRY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- state the chemical basis of drug action including physicochemical and steric properties of drug.
- discuss the classification, chemical nomenclature, generic names, and synthesis of various medicinal agents.
- describe the structure activity relationship, biochemical/ molecular basis of mechanism of action and uses of drug.
- implement corresponding knowledge for the development of biologically and clinically active drugs
- compare the basic biological and pharmacological interactions by using both natural products and total synthesis of bioactive molecules.

UNIT I THEORETICAL ASPECTS OF DRUG ACTION 9

Types of drug action - Physiochemical parameters and Pharmacological activity, Non-empirical electronic parameters, Steric parameters and Stereo chemical aspects of drugs; Bioisosterism and Steric features of drugs, Drug distribution and Protein binding; Drug receptors - Receptor types and isolation, Drug receptor interaction, Theories of drug action, Mechanism of drug action.

UNIT II ELEMENTARY PRINCIPLES OF DRUG DESIGN 9

QSAR - Parameters involved in QSAR, Lipophilicity (Polarizability, Electronic and Steric parameters); Quantitative models; Hansch analysis, Free Wilson analysis and their relationships; Molecular Modeling - Introduction, Molecular methods, Known receptors unknown receptors.

UNIT III PHARMACODYNAMIC CLASS-I 9

Synthesis and Mechanism of action of compounds leading to the following classes of drugs - Adrenergic Agents - Isoprotemol. Antihypertensives, Anti-anginals, and Anti-arrhythmics; Enalapril, Veraparnil, Furosemide, Propranalol, Antihyperlipidemics and Anti-diabetics - Statins, Phenformin.

UNIT IV PHARMACODYNAMIC CLASS-II 9

Synthesis and Mechanism of action of compounds leading to the following classes of drugs - Analgesics and NSAIDS - Systemic development of Analgesics of Morphine; Local and General Anesthetics - Benzocaine, Procaine, Halothane.

UNIT V CHEMOTHERAPEUTIC CLASS 9

Synthesis and Mechanism of action of compounds leading to the following classes of drugs - Antibiotics – Beta-lactams, Aminoglycosides, Tetracyclines, Macrolides; Anti-tubercular and Anti-leprosy agents - Ethambutol, Dapsone; Anti-HIV agents – zidovudine; Anticancer drugs - Chlorambucil, vinca alkaloids, 5-flurouracil.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- define the importance of the physical properties of drugs with respect to the ionization, solubility, and efficacy of drugs
- define the importance of the physical properties of drugs with respect to the ionization, solubility and efficacy of drugs
- illustrate how changes in the chemical structure of drugs affect efficacy.
- practice a working knowledge of chemical structures and nomenclature
- apply the application of gained knowledge about the therapeutic classes of drugs.

TEXT BOOKS

1. Burger's Medicinal chemistry and drug design. 8th edition 2021
2. J.H. Block and J.M. Bcalc (Eds) Wilson and Giswold's textbook of organic medicinal and pharmaceutical chemistry, 12th edition 2011

REFERENCES

1. Ilango, K. and Valentina, P., "Text book of Medicinal Chemistry", Vol.1, 1st edition, Keerthi Publishers,2007.
2. Graham L. Patrick, An introduction to Medicinal Chemistry, 6th Edition, Oxford University Press, 2017.
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. Donald J. Abraham, Burger's Medicinal Chemistry and Drug Discovery, Vol V, 6th Edition, John Wileyand Sons, Inc.,2003.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programmes Outcomes (POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	-	1	-	-	-	-	1	-	-	1	-
CO2	2	2	2	2	-	-	-	1	-	-	-	-	2	-
CO3	3	3	3	-	3	-	-	-	-	-	-	-	1	-
CO4	1	1	2	2	2	-	-	-	-	-	-	-	-	2
CO5	1	1	1	1	1	2	-	-	-	2	-	-	2	2

PT19504 CELL AND MOLECULAR BIOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the basics of cell biology
- know about the transport across membrane and techniques to study cell
- learn about the nucleic acid
- know about the central dogma of molecular biology
- learn about the regulation, recombinant, amplification of DNA

UNIT I INTRODUCTION TO CELL BIOLOGY 9

Prokaryotic, Eukaryotic cells - Sub-cellular organelles and functions; Principles of membrane organization membrane proteins, Cytoskeletal proteins; Extra cellular matrix, Cell-cell junctions; Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle.

UNIT II TRANSPORT AND TECHNIQUES 9

Passive and Active Transport - Permeases, Ion channels, ATP pumps; Na+ / K+ / Ca+2Tpumps, Uniport, Symport antiporter system; Ligand gated / Voltage gated channels, Agonistsand Antagonists; Techniques used to cell study - Cell fractionation and Flow cytometry, Morphology and Identification of cells using microscopic studies like SEM, TEM and Confocal Microscopy; Localization of proteins in cells – Immunostaining.

UNIT III CHEMISTRY OF NUCLEIC ACIDS 9

Introduction to nucleic acids - Nucleic acids as genetic material, Structure and Physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA- Primary structure of DNA - Chemical and Structural qualities of 3',5'-Phosphodiester bond; Secondary Structure of DNA - Watson and Crick model, Chargaff's rule, X–ray diffraction analysis of DNA, Forces stabilizes DNA structure, Conformational variants of double helical DNA, Hogsteen base pairing, Triple helix, Quadruple helix, Reversible denaturation and Hyperchromic effect; Tertiary structure of DNA - DNA supercoiling.

UNIT IV CENTRAL DOGMA OF MOLECULAR BIOLOGY 9

Overview of Central dogma - Organization of Prokaryotic and Eukaryotic chromosomes - DNA replication, Overview of differences in Prokaryotic and Eukaryotic DNA replication, Telomere replication in Eukaryotes; D-loop and Rolling circle mode of replication; Mutagens - DNA mutations and their mechanism, Various types of repair mechanisms; Structure and function of mRNA, rRNA and tRNA; Characteristics of Promoter and Enhancer sequences - RNA synthesis - Initiation, Elongation and Termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription - Introduction to Genetic code - Elucidation of Genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and Eukaryotic ribosomes; Steps in

translation - Initiation, Elongation and Termination of protein synthesis; Inhibitors of protein synthesis; Posttranslational modifications and its importance.

UNIT V REGULATION, RECOMBINATION, AMPLIFICATION OF DNA **9**

Prokaryotic gene regulation – Lac and Trp operon, Regulation of Gene expression with reference to λ phage life cycle; Restriction and Modified enzymes - Characteristics of Cloning and Expression vector- Recombinant DNA - Insulin, Interferons - PCR and types - Maxam Gilberts and Sanger Coulson's DNA sequencing - Next generation sequencing technologies.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- explain the basics of cell biology
- have a knowledge on transport across membrane and techniques to study cell
- explain about the nucleic acid
- have a knowledge on central dogma of molecular biology
- have a knowledge about the regulation, recombinant, amplification of DNA

TEXT BOOKS

1. Weaver, Robert F. "Molecular Biology" IInd Edition, Tata McGraw-Hill, 2003.
2. Karp, Gerald "Cell and Molecular Biology: Concepts and Experiments" IVth Edition, John Wiley, 2005

REFERENCES

1. Alberts, Bruce etal., "Essential Cell Biology", IVth Edition, Garland Press (Taylor and Francis), 2004.
2. Tropp, Burton E. "Molecular Biology: Genes to Proteins". IIIrd Edition. Jones and Bartlett, 2008
3. Glick, B.R. and J.J. Pasternak. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010
4. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology "Greene Publishing Associates, NY, 1998

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	3	3	-	-	-	-	3	3	3
CO2	3	3	2	2	-	-	-	-		-	-	3	3	2
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
CO4	2	-	-	-	-	3	2	2	-	-		3	3	3
CO5	3	3	2	2	-	-	-	-	-	-	-	3	3	3

PT19505 TECHNOLOGY OF SOLID AND SEMISOLID DOSAGE FORMS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- impart the knowledge on the principles of solid and semisolid dosage forms formulation and development.
- summarize the concepts involved in troubleshooting and improvement of solid dosage forms, semi-solid and semi-liquid dosage forms
- describe the various pharmaceutical dosage forms and their manufacturing techniques
- provide the knowledge on the formulation and evaluations of dosage forms.
- select the appropriate method of achieving a successful dosage form formulation.

UNIT I SOLID DOSAGE FORMS -TABLETS 9

Types of tablets - Brief study of novel tablets, Formulation of tablets with detailed study of excipients; Theory of compression - Process of compression, Effect of friction, Force – Volume 149 relationships in compression (Heckel's plot); Tablet manufacturing techniques, Machinery for Small- and Large-Scale tablet manufacturing, In process controls, Processing problems, Evaluation parameters and Equipments; Coating of tablets - Objectives, Types of coating, Film forming materials, Formulation of coating solution, Equipment for coating, Coating process, Evaluation of coated tablets, Coating defects, Specialized coating process.

UNIT II SOLID DOSAGE FORMS – CAPSULES 9

Types of capsules - Size of capsules, Material for production of hard gelatin capsules, Formulation of hard gelatin capsules, Method of capsule filling, Problems and Remedies in capsule manufacturing soft gelatin capsule - Shell and Capsule content, Manufacturing equipments, Importance of base absorption and minimum/gm factors in soft capsule Quality control, Stability testing and Storage of capsule dosage forms; Other Solid dosage Forms - Brief study of effervescent powders and granules, Palletization technology and its applications.

UNIT III ADDITIVES AND EXCEPIENTS IN SOLID AND SEMISOLID DOSAGE FORMS 9

Disintegrants, Lubricants, Glidants and Anti adherents, Surfactants and Colors in Tablets, Swellable and Rigid Matrices – Controlled Release Matrices with Cellulose Ethers, Carrageenan in Solid Dosage Form Design, Direct Compression and the Role of Filler-binders; Vehicles, Stabilizers, Preservatives, Suspending agents, Emulsifying agents, Solubilizers.

UNIT IV SEMISOLID DOSAGE FORMS AND DISPERSIONS 9

Types - Mechanisms of drug penetration, Factor influencing penetration, Semisolid bases, and their Selection; General formulation of semisolids, Manufacturing procedure, Evaluation, and Packaging; Monophasic liquids like gargles, Mouth washes, Throat paint, Ear drops, Nasal drops, Liniments and Lotions, Enemas, and Collodions; Biphasic dosage forms - Suspensions and Emulsions, Advantages and Disadvantages, Classification, Test for the type of emulsion, Formulation, Stability, and Evaluation.

UNIT V PREFORMULATION CRITERIA AND FORMULATION CHALLENGES 9

Study of Physical and Chemical properties of drugs and their Effect on formulation - Stability, and Bioavailability; Stability studies, Importance of accelerated stability study, Effect of various environmental / Processing on stability of the formulation and Techniques for stabilization of products against the same; Formulation challenges – Multiple vitamin and Mineral dosage forms, Botanicals formulation into oral solid dosage forms, Special tablets formulation for slow oral dissolution, Osmotic systems, Tableting of multi particulate modified release systems.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the technology of various solid and semisolid dosage forms.
- recognize the formulation concepts and evaluate different dosage forms to meet out the requirements.
- recognize the formulation concepts and evaluate different dosage forms to meet out the requirements.
- organize the difference between theoretical and practical concept used in industry
- apprehend the advances in solid dosage forms, semi solid dosage forms and dispersions

TEXT BOOKS

1. Larry L. Augsburger, Stephen W. Hoag, Pharmaceutical dosage forms: tablets, vol 3, rational design and formulation, Informa healthcare USA, Inc, 2008 IIIrd edition
2. Aulton, Michael E. “Pharmaceutics: The Science of Dosage Form Design” IInd Ed., Churchill Livingstone, 2002.

REFERENCES

1. Remington’s Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania 1990.
2. Indian Pharmacopoiea, British Pharmacopoiea, United States Pharmacopoiea
3. Boca Raton, Coated Pharmaceutical Dosage Forms, K. H. Bauer, CRC Press, Med Pharm.
4. Lachman, Leon et al. “The Theory and Practice of Industrial Pharmacy” IIIrd Ed., Varghese Publishing House, 1987.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	1	-	-	-	-	-	-	1	-
CO2	2	1	1	1	-	1	-	-	-	-	-	-	-	1
CO3	3	2	2	2	1	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	1	1	-	-	-	-	-	-	2	1
CO5	3	2	3	-	2	-	-	-	-	-	-	-	3	2

PT19506 MEDICINAL CHEMISTRY LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable students to

- learn, understand, and perform various standardization techniques of natural products as per who guidelines.
- study different phytochemicals
- understand qualitative estimations of different groups and halogens
- study different physical constants and medicinal compounds
- study chemical synthesis and structural activity relationship of different class of drugs

LIST OF EXPERIMENTS

1. Morphology, microscopy and quantitative microscopy of medicinal plants: Macroscopic and microscopic identification of 4-5 commonly used medicinal plants.
2. Phytochemical methods, identification tests for various classes of phytoconstituents.
3. Paracetamol from para- nitro phenol or para- aminophenol.
4. Quinazolinone from anthranilic acid via benzoxazinone.
5. Quantification of phytochemicals in plant extracts by chromatography and spectroscopy.
6. Qualitative estimation of Methoxyl groups (Zeissel's method).
7. Qualitative estimation of Halogens (Strepheno's method).
8. Measurement of logP of a poorly water soluble and a highly water-soluble drug.
9. Physical constants like specific gravity, swelling factor, ash values, extractive values, refractive index, optical rotation.
10. Determination of the pKa of a drug (weak acid and weak base) by potentiometric titration and/or by UV/visible spectroscopy.
11. Determination of partition coefficient of any medicinal compound by shake flask method.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

- perform standardization of medicinal plant products.
- identify different types of medicinal plants and its products by morphology, physical and chemical characteristics.
- carry out chromatographic and spectroscopic analysis of medicinal plant products.
- exposure to process development
- knowledge of green chemistry

REFERENCES

1. Advacned medicinal chemistry lab guide by N. Raghu Prasad and M. Raghuram Rao
2. A.I. Vogel, Text Book of Practical Organic Chemistry, 5th Edition.

3. Mann F G, Saunders BC. Practical organic chemistry. 4th ed. New Delhi: Orient Longman; 2005.

4. A Text Book of Medicinal Chemistry Vol. I and II by Surendra N. Pandeya, S.G. Publisher, 6, Dildayal Nagar, Varanasi -10.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	2	-	-	-	-	-	-	-	3	2
CO2	2	-	3	2	3	-	-	-	-	-	-	-	3	3
CO3	3	2	3	3	1	-	-	-	-	-	-	-	3	3
CO4	2	2	3	2	-	-	-	-	-	-	-	-	3	2
CO5	2	2	-	3	2	-	-	-	-	-	-	-	3	2

PT19507 CELL AND MOLECULAR BIOLOGY LABORATRORY 0 0 4 2

COURSE OBJECTIVES

To enable students to

- to demonstrate various techniques to learn the morphology, identification, and propagation of cells.
- provide hands-on experience in performing basic molecular biology techniques.
- introduce students to the theory behind in each technique and to describe common applications of each methodology in biological research.
- will facilitate the students to take up specialized project in molecular biology and will be a pre-requisite for research work.

LIST OF EXPERIMENTS

1. Introduction to principles of sterile techniques and cell propagation
2. Principles of microscopy, phase contrast and fluorescent microscopy
3. Identification of given plant, animal, and bacterial cells and their components by microscopy
4. Leishman Staining
5. Giemsa Staining
6. Thin Layer Chromatography
7. Separation of Peripheral Blood Mononuclear Cells from blood
8. Preparation of genomic DNA
9. Preparation of Plasmid DNA
10. Agarose Gel Electrophoresis
11. Quantification of DNA (UV/Vis) and analysis of purity
12. Competent cell preparation

TOTAL PERIODS: 60

COURSE OUTCOMES

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

- to understand the basic techniques to work with cells
- demonstrate knowledge and understanding of the principles underpinning important techniques in molecular biology
- demonstrate the ability to carry out laboratory experiments and interpret the results.
- students will be aware of the hazardous chemicals and safety precautions in case of emergency

REFERENCES

1. Rickwood, D. and J.R. Harris “Cell Biology: Essential Techniques”, Johnwiley, 1996.
2. Davis, J.M. “Basic Cell Culture: A Practical Approach”, IRL, 1994
3. Sambrook, Joseph and David W. Russell “ The Condensed Protocols: From

Molecular Cloning: A Laboratory Manual" Cold Spring Harbor , 2006.

4. Ausubel, F.M. "Short Protocols in Molecular Biology", 4th Edition, John Wiley, 1999.

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	2	1	-	1	2	-	-	3	3	2
CO2	2	1	3	-	2	1	-	1	2	-	-	3	3	3
CO3	2	2	2	1	2	1	-	1	2	-	-	3	3	3
CO4	2	2	2	1	2	1	-	-	-	-	2	2	2	2

EN19501 CAREER DEVELOPMENT LABORATORY I 0 0 2 1

COURSE OBJECTIVES

To enable students to

- enhance their own potential strength and reduce weakness to survive in corporate world
- evaluate their own personality skills to face the interviews in a successful way
- solve the quantitative aptitude problems and improve their problem-solving skills
- solve the quantitative aptitude in advance level tests to get placed in Tier 1 companies
- improve their reasoning skills to get placed in reputed companies

UNIT I BASICS - SELF ANALYSIS 6

Introduction - Self Explorations-Who Am I; Know yourself; SWOT Analysis – Corporate resume building – Group Discussion: Level – 0 – Role Play: Team

UNIT II PERSONALITY DEVELOPMENT 6

Just A Minute (JAM): Level 0-Extempore – Johari Window Model – Goal Setting – Achievement worksheet – Group Discussion: Leve-1 - Mock Interview Practice: Level 0

UNIT III QUANTITATIVE APTITUDE I 6

Number System - LCM & HCF - Square root & Cube root – Percentage - Time - Speed & Distance

UNIT IV QUANTITATIVE APTITUDE II 6

Trains - Boats & Streams – Average – Ages – Area

UNIT V LOGICAL AND VERBAL REASONING 6

Series Completion: Number Series, Letter Series, Symbol Series - Blood Relation - Coding and Decoding - Logical Sequence – Analogy - Character Puzzles – Classification - Data Sufficiency

TOTAL PERIODS: 30

COURSE OUTCOMES

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

- demonstrate the interpersonal skills in Group Discussions
- enhance their verbal and written ability
- practice soft skills to excel in their jobs
- compute problems based on quantitative aptitude
- reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies

TEXT BOOKS

1. Agarwal, R.S.” a modern approach to Verbal & Non Verbal Reasoning”, S.Chand& Co Ltd, new delhi
2. Agarwal, R.S. “ Objective General English”, S.Chand&Co

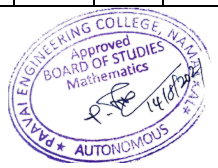
REFERENCES

1. Abhijit Guha, “Quantitative Aptitude “, Tata-Mcgraw Hill.

2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications
3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn And Bacon.
4. Infosys Campus Connect Program – students' guide for soft skills

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	-	2	3



PT19151 BASIC LABORATORY ANIMAL SCIENCE 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the fundamentals of laboratory animal science
- know about how to care the laboratory animals
- learn about the global regulations
- know about the preclinical research
- learn about the alternatives to animal testing

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 PERIODS: 45

COURSE OUTCOMES

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

- understand the fundamentals of laboratory animal science
- know about how to care the laboratory animals
- understand the global regulations
- know the preclinical research
- know the alternatives to animal testing

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

REFERENCES

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. Fundamentals of Laboratory Animal Science, Anqi Li, Jianglin Fan, CRC press,2017
4. Guide for the care and use of laboratory animals, 8th ed., (National Research Council), National Academies Press, 2011.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	2	2	-	-	-	-	-	-	-	3	3
CO2	2	2	3	2	1	-	-	-	-	-	-	-	2	3
CO3	3	2	3	2	2	-	-	-	-	-	-	-	3	2
CO4	2	2	2	1	2	1	-	-	-	-	2	2	2	2
CO5	2	2	2	1	2	1	-	-	-	-	2	2	3	2

PT19152 TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- discuss the fundamentals of fine chemicals and bulk drugs
- explain the basic concepts and principles in designing of equipment for various unit operations
- implement the knowledge of various parameters involved in the formulation and development of various dosage forms
- demonstrate about the plant design, production techniques and process chemistry involved in the drug industry.
- categorize the concept of the pharmaceutical industrial manufacturing practices, quality attributes of pharmacy products

UNIT I INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS 9

Characteristic features of fine chemicals manufacture - Concept of fine and Bulk drugs and their Manufacture, Evolution of process, Process selection - Process profile analysis, Factors influencing Process choice - Cleaner and Safer Technologies, Research and Development strategies in Pharmaceutical industries, Basic drug formulation, Radiopharmaceuticals

UNIT II UNIT PROCESSES 9

Chemical conversion processes - Alkylation, Carboxylation, Condensation and Cyclisation, Dehydration, Esterification, Halogenation, Oxidation, Sulfonation, Complex Chemical conversions, Industrial Fermentation products; Choice of raw materials and reagents, Development techniques for safe process design, Identification of highly energetic materials.

UNIT III PRODUCTION PLANTS 9

Types of production plants - Dedicated, Multipurpose, and Mixed plants, Equipments in multipurpose plants-Reactors, Filters, Centrifuges, Driers, Extractors and Evaporators, Production cost- capital investment costs, Operating costs, Designing of batch plants - production planning and Scheduling, Principles of good manufacturing practices.

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; Fermentation products.

UNIT V BULK DRUGS 9

Raw Materials, Production Techniques, Reaction Flow Sheet, Equipments, Utilities to produce drugs below – Paracetamol, Aspirin, Ibuprofen, Diazepam, Darvon, Niacinamide, Chloramphenicol and Erythromycin, Antimicrobial agent

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- describe the basic concept of fine chemicals and bulk drugs
- demonstrate on plant design, process development and chemical hazards in fine chemical and bulk drug industry.
- employ kinetics, thermodynamics, and plant construction materials to produce bulk drugs and fine chemicals
- utilize various parameters involved in the formulation and development of various dosage forms
- infer the quality aspects and good manufacturing practices in pharmaceutical industry.

TEXT BOOKS

1. Andrzej Cybulski, Jacob A. Moulijn, M.M. Sharma, Roger A. Sheldon "Fine Chemicals Manufacture: Technology and Engineering" Elseiver Science B.V, 2001.
2. Gopal Rao, M. and Sittig, M., "Dryden's Outlines of Chemical Technology", 3rd Edition, Affiliated East West Press Pvt. Ltd., 2001.

REFERENCES

1. Rawlins E.A, Bentleys Textbook of Pharmaceutics, A.I.T.B.S. Publisherand Distributors, Delhi, 1996.
2. Coulson and Richadson, "Chemical Engineering" Vol 6,3rd edition, Butterworth Heinemann, 2000
3. Shah, K.M., "Handbook of Industrial Chemistry", Vol. I and II, Multi-Tech Publishing Co, 1999
4. Pandey, G.N., "A Textbook of Chemical Technology", Vol. II, Vikas Publishing House (P) Ltd., 2000

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	-	-	-	-	1	-	-	-	-	-	1	1
CO2	1	2	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	2	-	-	-	2	-	-	-	-	-	-	3	-
CO4	3	3	1	-	-	2	1	-	-	-	-	-	3	-
CO5	3	3	2	2	2	2	2	1	-	-	-	-	3	3

PT19153 CHEMISTRY OF NATURAL PRODUCTS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- explain the chemistry and medicinal importance of natural compounds as lead molecules for new drug discovery.
- discuss about the classification, isolation, purification, and structural characterization of simple constituents from natural source.
- interpret general method of structural elucidation of compounds of natural origin.
- outline the medicinal and pharmaceutical uses of vitamins and flavonoids.
- develop theoretical knowledge of students in the chemistry of natural products and to explore this knowledge for practical applications.

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 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.

UNIT V TERPENES 9

Terpenes – special Isoprene rule, Mono, Diterpenes, Triterpenoids and Sesquiterpenes and Structural Elucidation of Citral, Carvone, Menthol and Camphor; Steroids – Cholesterol, Colour Reactions of Steroids, Stigmasterol, β-Sitosterol, Bile acids, Ergosterol, Diosgenin, Solasodine and Becogenin.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the chemistry of carbohydrates, heterocyclic compounds, amino acids, proteins, and nucleic acids.
- describe the fundamentals of terpenoids, alkaloids, vitamins, lipids, and steroids.
- summarize the biosynthesis, biological activity and stereochemistry of pharmaceutical products.
- summarize the biosynthesis, biological activity and stereochemistry of pharmaceutical products.
- categorise terepenes and steroids based on their types and structure.

TEXT BOOKS

1. CO.P. Agarwal, Chemistry of Natural Products (Vol.-1 and 2), 41st edition, Goel publishing House, 2014.
2. Gurdeep Chatwal, Organic Chemistry of Natural Products (Vol. 1 and 2), Himalaya Publishing House, 2015.

REFERENCES

1. CO.P. Agarwal, Chemistry of Natural Products (Vol.-1 and 2), 41st edition, Goel publishing House, 2014.
2. Gurdeep Chatwal, Organic Chemistry of Natural Products (Vol. 1 and 2), Himalaya Publishing House, 2015.
3. CO.P. Agarwal, Chemistry of Natural Products (Vol.-1 and 2), 41st edition, Goel publishing House, 2014.
4. Gurdeep Chatwal, Organic Chemistry of Natural Products (Vol. 1 and 2), Himalaya Publishing House, 2015.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	1	-	1	-	-	-	1	-	1	1	1
CO2	2	2	1	2	-	1	1	1	-	-	-	1	-	1
CO3	1	1	2	1	2	1	-	1	-	-	-	-	1	-
CO4	2	1	1	-	-	1	1	1	-	-	-	-	2	-
CO5	-	1	-	-	-	1	2	1	3	-	-	-	1	2

PT19154 ENZYME TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- provide the students with the basics of enzymes and its characteristics
- learn enzyme kinetics and models for enzymatic reactions.
- impart knowledge on immobilization and kinetics of immobilized enzyme reactions.
- learn enzyme production and purification process
- endow the students with the clinical and industrial applications of enzymes

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes - Mechanisms of enzyme action; Concept of Active site and Energetics of enzyme substrate complex formation; Specificity of enzyme action; Principles of catalysis – Collision theory, Transition state theory; Role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION 9

Kinetics of single substrate reactions - Estimation of Michelis – Menten parameters, Multisubstrate reactions - Mechanisms and Kinetics; Turnover number; Types of inhibition and Models – Substrate, Product; Allosteric regulation of enzymes, Monod Changeux Wyman model, pH and Temperature effect on enzymes and Deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION AND BIOSENSORS 9

Physical and Chemical techniques for Enzyme Immobilization – Edsorption, Matrix entrapment, Encapsulation, Cross-linking, Covalent binding etc., - examples, Advantages and Disadvantages; Analysis of film and Pore diffusion effects on kinetics of immobilized enzyme reactions; Formulation of Dimensionless groups and Calculation of effectiveness factors.

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES 9

Production and Purification of crude enzyme extracts from plant, Animal, and Microbial sources; Methods of characterization of enzymes; Development of enzymatic assays

UNIT V INDUSTRIAL AND CLINICAL APPLICATIONS OF ENZYMES 9

Industrial Enzymes - Thermophilic Enzymes, Amylases, Lipases, Proteolytic Enzymes in meat and leather industry, Enzymes used in various fermentation processes, Cellulose degrading enzymes, Metal degrading enzymes; Clinical enzymes - Enzymes as Thrombolytic agents, Anti-inflamatory agents, Strptokinasae, Asparaginase, Isoenzymes like CK and LDH, Transaminases (AST, ALT), Amylases, Cholinesterases, Phosphatases; Immobilization of enzymes, ELIZA; Biosensors; Enzyme Engineering and Site Directed Mutagenesis.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the various enzyme and enzyme reactions, and the key steps of enzyme reactions towards various concepts in pharmaceutical technology.
- applying theoretical aspects of kinetics and understand the importance and utility of enzyme kinetics towards research.
- understand the concepts of the immobilization and kinetics of immobilized enzyme reactions.
- applying the ideas on processing, production and purification of enzymes at an industrial scale will be helpful to work technologically.
- utility of enzyme has been increased steadily in food, pharmaceutical and chemical industries and thus this study will provide simple and easy method of implementation.

TEXT BOOKS

1. Trevor Palmer, Enzymes IInd Horwood Publishing Ltd
2. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

REFERENCES

1. James. E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
2. James M. Lee, Biochemical Engineering, PHI, USA.
3. Michael Shuler and FikretKargi. “Bioprocess Engineering: Basic Concepts”, 2nd Edition, Prentice Hall, and Englewood Cliffs, NJ, 2002.
4. Wiseman, Enzyme Biotechnology, Ellis Horwood Pub.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	1	3	2
CO5	3	3	-	-	1	-	-	-	-	-	-	-	3	2

PT19601 BIOPROCESS ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- provide the students with the basics of bioreactor engineering.
- develop bioengineering skills to produce biochemical products.
- impart knowledge on design and operation of fermentation processes with all its prerequisites.
- identify problems and seek practical solutions for large scale implementation of bioprocess.
- apply modeling and simulation of bioprocess as so to reduce costs and to enhance the quality of products and systems.

UNIT I OVERVIEW OF FERMENTATION PROCESSES 9

Overview of fermentation industry - General requirements of fermentation processes, Basic configuration of Fermentor (CSTR) and Ancillaries, Main parameters to be monitored and Controlled in Fermentation processes; Biomass estimation– Direct and Indirect methods.

UNIT II RAW MATERIALS AND MEDIA DESIGN OF BIOPROCESS 9

Criteria for good medium - Medium requirements for Fermentation processes, Carbon, Nitrogen, Minerals, Vitamins and Other complex nutrients, Oxygen requirements, Medium formulation of optimal growth and Product formation - Examples of Simple and Complex media, Design of various commercial media for industrial Fermentations – Medium optimization methods.

UNIT III CONFIGURATION OF BIOREACTORS 9

Ideal reactors and its characteristics - Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in wastewater treatment; Two stage cultivation; Packed bed reactor, Airlift reactor; Introduction to fluidized bed reactor bubble column reactors.

UNIT IV BIOREACTOR SCALE – UP 9

Mass transfer includes transport phenomena in bioprocesses - Factors affecting oxygen transfer rate in bioreactors; Techniques for measurement of volumetric oxygen transfer coefficient; Fluid rheology and Factors affecting bioreactor processes; Flow Patterns in agitated tanks - Mechanism and Power requirements of mixing, Scale up of mixing systems

UNIT V RECOMBINANT CELL CULTIVATION 9

Different host vector system for recombinant cell cultivation strategies and advantages - *E. coli*, yeast *Pichia pastoris / Saccharomyces cereviseae*, Animal cell cultivation, Plant cell cultivation, Insect cell cultivation; High cell density cultivation, Process strategies, Reactor considerations in the above system.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply engineering principles to systems containing biological catalysts to meet the needs of the society.
- select appropriate bioreactor configurations and operation modes based upon the nature of bioproducts and cell lines and other process criteria.
- plan a research career or to work in the pharmaceutical industry with strong foundation about bioreactor design and scale-up.
- integrate research lab and industry; identify problems and seek practical solutions for large scale implementation of bioprocess.
- convert the promises of molecular biology and genetic engineering into new processes to make bio-products in economically feasible way.

TEXT BOOKS

1. Shuler, Michael L. and Fikret Kargi, "Bioprocess Engineering ", Prentice Hall, 1992.
2. Doran, Pauline "of Bioprocess Engineering Principles ". Elsevier, 1995

REFERENCES

1. Anton Moser, "Bioprocess Technology, Kinetics and Reactors", , Springer Verlag.
2. Peter F. Stanbury, Stephen J. Hall and A. Whitaker, Principles of Fermentation Technology, Science and Technology Books.
3. Bailey, James E. and David F. Ollis, "Biochemical Engineering Fundamentals", IInd Edition. McGraw Hill , 1986.
4. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	3	-	-	-	-	-	2	-	-	2	2
CO2	3	3	2	3	-	-	-	-	-	2	-	-	2	2
CO3	3	3	2	2	-	-	2	-	-	2	-	-	2	1
CO4	1	2	-	1	-	-	2	-	1	3	-	2	3	3
CO5	-	2	-	1	2	-	-	-	-	-	-	-	-	2

PT19602 GENETIC ENGINEERING AND GENOMICS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- develop the individual multi-dimensionally in physical, intellectual, emotional, and spiritual dimensions.
- facilitate individuals think about and reflect on different values.
- understand what recombinant DNA technology is
- know about DNA libraries
- study sequencing

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9

Manipulation of DNA – Restriction and Modification enzymes, Design of Linkers and Adaptors; Characteristics of Cloning and Expression vectors based on Plasmid and Bacteriophage; Vectors for Insect, Yeast and Mammalian system; Prokaryotic and Eukaryotic host systems; Introduction of recombinant DNA in to host cells and Selection methods

UNIT II DNA LIBRARIES 9

Construction of Genomic and cDNA libraries - Artificial Chromosomes – BACs and YACs; Chromosomal walking, Screening of DNA libraries using nucleic acid probes and Antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA 9

Maxam Gilbert's and Sanger's methods of DNA sequencing - Inverse PCR, Nested PCR, AFLPPCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, Inverse PCR, Colony PCR, Single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taq Man assay, Molecular beacons; Site directed mutagenesis

UNIT IV CURRENT STATUS OF GENOME SEQUENCING PROJECTS 9

Status of genome sequencing projects - Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Two hybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of Genome analysis and Genomics.

UNIT V FUNCTIONAL GENOMICS 9

Genome annotation - ORF and Functional Prediction, Gene finding, Substractive DNA Library Screening; Differential Display and Representational difference analysis, SAGE, TOGA; Introduction to DNA microarray.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the structure formation and function of dna, rna and proteins.
- understand the principle of gene regulation
- understand the concepts of genetics, gene cloning, dna sequencing and pcr.
- understand the various genome mapping and sequencing methods
- inculcate genomic markers, microarray technology and methods for proteomics.

TEXT BOOKS

1. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, 3rd Ed. (Blackwell Publishing)
2. Primrose, S.B. and Twyman. "Principles of Genome Analysis and Genomics". 7th Edition, Blackwell Publishing, 2006

REFERENCES

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology "Greene Publishing Associates, NY, 1988
2. Hunt, Stephen P. and Frederick J. Livesey. "Functional Genomics". Oxford University Press,2000.
3. Cantor, Charles R. and Cassandra L. Smith. "Genomics: The Science and Technology Behind the Human Genome Project". John Wiley and Sons, 1999
4. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, 1993.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	2	2	2	-	-	-	-	-	1	3	3
CO2	3	-	-	-	3	-	-	2	-	-	1	3	3	3
CO3	1	2	3	2	2	2	-	-	-	-	-	-	3	2
CO4	2	3	1	2	1	-	-	-	-	-	-	2	2	2
CO5	1	2	2	3	2	1	-	-	-	-	1	2	2	2

PT19603 PROTEIN ENGINEERING AND PROTEOMICS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- discuss the structure, functional correlation, and the prediction of properties of protein based on its sequence
- recall the translation and post translational modification processes
- illustrate the role of analytical methods to determine protein structure and protein – protein interactions
- observe the similarities in structure at basal level in a group of having similar function, thereby predicting the strategies to modify and design novel proteins.
- provide updated knowledge about recombinant proteins and its application in therapeutics

UNIT I STRUCTURAL CHEMISTRY OF AMINO ACIDS, PROTEINS 9

Chemistry of Proteins - Chemistry of amino acids and Peptides; Peptide Bond, pH titration curve for Amino acids; Primary, Secondary (alpha helix, beta sheet, Ramachandran plot), Tertiary (Ribonuclease); Quaternary and Super secondary structure of protein, Protein denaturation and Functions.

UNIT II PROTEIN ENGINEERING 9

Introduction to steps of Protein design and Engineering - Protein splicing and its application; Solid phase peptide synthesis, Production of Novel Proteins; Random and Site directed mutagenesis, Methods for Expressing Recombinant Proteins; Characterization of Proteins structure - Crystallography and X-Ray Diffraction, Spectroscopy (UV-VIS, NMR and Fluorescence Spectroscopy) and Calorimetric Methods; Industrial applications of Protein Engineering (Engineering of Stability, affinity for substrate, Protease Specificity, Cofactor requirements of Protein).

UNIT III PROTEIN STABILITY AND FOLDING 9

Overview of protein structure - Higher level structure, Protein stability, Mechanism of protein folding (Types, Level, Thermodynamics, Anfinsen's dogma and Levinthol paradoxand kinetics), Folding Rate, Molten globule; Techniques for studying of protein folding; NMR, CD spectroscopy, Proteolysis, Optical tweezers; Computational method; Location and Functions of Molecular chaperones, Chaperonin and Co-chaperons, HSP chaperone system in Ecoli and Human; Proteasomes and Proteosome mediated protein degradation; Protein folding errors - Alzheimer's, prions and Mad Cow (BSE, CJD), Cystic Fibrosis and Cancer; Polyketides and Non-ribosomal peptides; Combinational manipulation of polyketides and Non-ribosomal peptides; Application of protein folding to design new drug.

UNIT IV PROTEOMICS 9

Introduction to proteomics - Two-dimensional electrophoresis (2-D PAGE) - Protein pre-fractionation and Sample preparation, IEF, SDS-PAGE, Visualization of protein spot; Protein identification by mass

spectrometry - ESI-TOF, MALDI-TOF, MS/MS, PMF, Protein sequencing; Post translational modification, Application of proteome analysis

UNIT V PROTEOMICS IN DRUG DISCOVERY, DELIVERY, AND DIAGNOSIS 9

Proteomics in Drug Development - Diagnosis of diseases by Proteomics; Protein array; Discovery of new biomarker; Identification of protein-protein interactions and Protein complexes; Proteomics in drug delivery, Functional genomics: Reverse genetics, Transcription and Replication of negative strand viruses

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- describe the organization of protein structure.
- identify various chemical interactions that stabilize protein structure
- understand the interactions in the protein core important for stability
- protein design principles and database analysis
- implement techniques and database search to analyse complex protein samples

TEXT BOOKS

1. R.M. Twyman ; Principles of Proteomics, Bioscientific Publishers
2. Daniel C. Liebler, Introduction to Proteomics: Tools for the New Biology, Humana Press

REFERENCES

1. Protein engineering and design by Paul R. Carey, academic press, 1996, 361 pages.
2. B.Alberts,D.Bray, J.Lewis et al, Molecular Biology of the Cell, Garland Pub. N.Y 1983
3. Biochemistry and Molecular Biology Practical by Wilson and Walker
4. Branden, C., Tooze, R., Introduction of Protein structure, Garland, 1st Edition, 1993.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	2	2	1	-	-	-	1	-	-	2	-
CO2	1	2	2	1	3	-	-	-	-	-	-	-	1	2
CO3	1	-	2	-	3	-	3	-	-	2	-	2	2	2
CO4	1	2	-	1	1	1	-	-	-	-	1	-	1	-
CO5	2	1	2	-	3	-	-	-	-	2	2	1	2	3

PT19604 IMMUNOLOGY AND IMMUNOTECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the basics of immune system
- know about the humoral and cellular immunity
- learn about immune tolerance and hypersensitivity
- know about the cellular immunological technique
- learn about the applied immunology

UNIT I INTRODUCTION TO IMMUNE SYSTEM 9

Organization and Classification of Immune system – Immune cells and Organs; Innate and Acquired immunity; Toll receptors and Responses, Classification of antigens – Chemical and Molecular nature; Haptens, Adjuvants; Cytokines; Complement pathway, Antigen presenting cells; Major histocompatibility complex

UNIT II HUMORAL AND CELLULAR IMMUNITY 9

Development - Maturation, Activation, Regulation, Differentiation, and Classification of T-cells and B cells, Antigen processing and Presentation, Theory of clonal selection, TCR; Antibodies - Structure and Functions; Antibodies - Genes and Generation of diversity; Antigen - Antibody reactions

UNIT III IMMUNITY, IMMUNE TOLERANCE AND HYPERSENSITIVITY 9

Inflammation - Protective immune responses to virus, Bacteria, Fungi and Parasites; Immune tolerance, Immuno deficiencies; Transplantation – genetics of transplantation; Laws of transplantation; Allergy and Hypersensitivity – Types of Hypersensitivity, Autoimmunity, Auto immune disorders and Diagnosis

UNIT IV CELLULAR IMMUNOLOGICAL TECHNIQUES 9

PBMC separation from the blood – Ficoll-hypaque method, Identification of lymphocytes based on CD marker, FACS - Lymphoproliferation assay, Cr5I release assay, Macrophage cultures detection assays, Rosette assay, Cytokine bioassays - IL2, IFNγ, TNFα; Mixed lymphocyte reaction, HLA typing, Agglutination and Precipitation tests, Coomb's test, ELISA types – ELISPOT– Plaque forming cell assay, Epitope mapping, Antigen detection assay, SDS-PAGE - Immunoblotting and Immunoprecipitation – Immunofluorescence and Immunohistochemistry; Measurement of Ag-Ab interaction.

UNIT V APPLIED IMMUNOLOGY 9

Production of antibodies – Polyclonal, Monoclonal, Hybridoma technology; Antibody – Isolation and Identification; Vaccines (Protein based vaccines, DNA vaccines, Plant based vaccines, Edible vaccine, Recombinant antigens as vaccines, Multivalent subunit vaccine; Reverse vaccinology – New Types of Replicating vaccines), Cancer Immunotheraphy and Immunosupressive therapy, Cytokine therapy and Immunoglobulin therapy.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- explain the basics of immune system
- understand the humoral and cellular immunity
- understand immune tolerance and hypersensitivity
- have a knowledge on the cellular immunological technique
- explain the applied immunology

TEXT BOOKS

1. Peter J Delves, Seamus J Martin, Dennis R Burtn and Ivan M Roitt., Roitts Essential Immunology, 13th Edition, Wiley –Blackwell, 2016.
2. Judith A. Owen, Jenni Punt and Sharon Stranford, "Kuby Immunology", W.H. Freeman and Company, 7th Edition, 2013

REFERENCES

1. Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt, "Roitt's Essential Immunology" Wiley-Blackwell Publication, 12th Edition, 2011
2. Robert R. Rich, Thomas A Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew and Cornelia M. Weyand, "Clinical Immunology-Principles and Practice" Elsevier, 4th Edition, 2013.
3. Weir, D.M. and Stewart, John "Immunology", VIIIth Edition, Churchill Pvt. Ltd., 2000.
4. Abbas, A.K. etal., "The Cellular and Molecular Immunology", VI Edition, Sanders / Elsevier, 2007.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	2	1	-	1	2	-	-	3	2	3
CO2	2	1	3	-	2	1	-	1	2	-	-	3	3	2
CO3	2	2	2	1	2	1	-	1	2	-	-	3	3	3
CO4	2	2	2	1	2	1	-	1	2	-	-	3	2	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	2

PT19605 BIOPROCESS ENGINEERING LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable students to

- give training on enzyme characterization, immobilization and medium optimization methods.
- investigate the growth of microorganisms in different systems under different conditions.
- apply earlier learned knowledge about mass transfer in bio reactors
- apply earlier learned knowledge about sterilization kinetics.
- implemented the knowledge by analogy when solving problems typical for the bio industry or for research

LIST OF EXPERIMENTS:

1. Enzyme kinetics – Determination of Michaelis - Menten parameters
2. Enzyme immobilization – Gel entrapment and Cross-linking
3. Batch Sterilization kinetics
4. Residence time distribution
5. Estimation of KLa – Dynamic Gassing-out method
6. Estimation of KLa – Sulphite Oxidation Method
7. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
8. Protein purification by ammonium sulphate precipitation
9. Optimization by Plackett Burman Design optimization by Response Surface Methodology

TOTAL PERIODS: 60

COURSE OUTCOMES

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

- explain about enzyme kinetics and characterization and how to use them for practical applications.
- investigate, design and conduct experiments, analyze and interpret data, and apply the laboratory skills to solve complex bioprocess engineering problems.
- creative, innovative and adaptable engineers as leaders or team members in their organizations and society.
- perform competently in chemical and bioprocess industries and become important contributors to national development.
- evaluate the growth kinetics of microorganisms and become adept with medium optimization techniques.

REFERENCES

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, , Springer Verlag.

2. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals” 2 ndEdition, McGraw – Hill, 1988.
3. Michael L. Shuler and Fikret Kargi, Bioprocess Engineering, Basic Concept, 2nd Edition, Prentice Hall PTR, 2002.
4. Peppler, H.J. and D. Perlman “Microbial Technology” (vol. I Microbial Processes and Vol. I Fermentation Technology)” 2 nd Edition, Academic Press / Elsevier, 2004Inc.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	1	2	-	-	-	-	-	-	2	1	-
CO2	2	3	-	2	-	-	-	-	-	-	-	1	-	1
CO3	-	3	-	-	2	-	-	-	3	-	-	3	-	-
CO4	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO5	-	-	2	-	-	2	-	-	-	2	-	-	-	2

PT19606 IMMUNOGENETICS LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable students to

- give practical training in the functioning of immune system.
- give laboratory training in different immunological and immune technological techniques.
- provide hands-on experience in performing basic recombinant dna techniques.
- introduce students to the theory behind in each technique.
- applications of each methodology in biological research.

LIST OF EXPERIMENTS:

1. Identification of immune cells in a blood smear
2. Identification of blood group
3. Testing for typhoid antigens by Widal test
4. Immunodiffusion – Ouchterlony Double Diffusion
5. Immuno electrophoresis – Rocket or Counter Current immune electrophoresis
6. Enzyme Linked Immuno Sorbent Assay (ELISA)
7. Isolation of peripheral blood mononuclear cells
8. Isolation of monocytes from blood
9. Preparation of plasmid DNA, Elution of DNA from agarose gels
10. Restriction digestion, Ligation of DNA into expression vectors
11. Transformationand Selection of recombinants – Blue white screening assay
12. Western blotting, Southern blotting
13. PCR amplification of genes

TOTAL PERIODS: 60

COURSE OUTCOMES

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

- knowledge and understand to identify immune system cells and tissues.
- knowledge on immunological /clinical tests.
- isolate lymphocytes and monocytes.
- describe the main principles, methods for preparation and cloning of dna in various organisms.
- express clearly about the gene amplification and methods for analysis of dna, such as hybridization, restriction analysis and gene expressions.

REFERENCES

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
2. Kuby J, Immunology, WH Freeman and Co., 2000.
3. Ashim K. Chakravarthy, Immunology, TataMcGraw-Hill, 1998.

4. Old RW, Primrose SB, “Principles Of Gene Manipulation, An Introduction To Genetic Engineering “, Blackwell Science Publications, 1993.
5. Ansubel FM, Brent R, Kingston RE, Moore DD, “Current Protocols In Molecular Biology “, Greene Publishing Associates, NY, 1988.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	2	1	-	1	2	-	-	3	3	2
CO2	2	1	3	-	2	1	-	1	2	-	-	3	3	3
CO3	2	2	2	1	2	1	-	1	2	-	-	3	3	3
CO4	2	2	2	1	2	1	-	-	-	-	2	2	2	2
CO5	-	-	-	-	-	1	-	-	-	-	-	3	-	-

EN19601 CAREER DEVELOPMENT LABORATORY II 0 0 2 1

COURSE OBJECTIVES

To enable students to

- enhance their own potential strength and reduce weakness to survive in corporate world
- evaluate their own personality skills to face the interviews in a successful way
- solve the quantitative aptitude problems and improve their problem-solving skills
- solve the quantitative aptitude in advance level tests to get placed in Tier 1 companies
- improve their reasoning skills to get placed in reputed companies

UNIT I CORPORATE READINESS 6

Writing Skills: EmailWriting - Paragraph writing -Time Management – Stress Management – JAM: Level 1 - Self Introduction – JAM: Level 2 – Buddy Presentation - Role Play: Individual

UNIT II INTERVIEW SKILLS 6

Group Discussion: Level II – Group Discussion: Level III – General – Interview Techniques - Selection process - Grooming - Dress code - Body Language – Mock Interview Practice: Level 1

UNIT III QUANTITATIVE APTITUDE I 6

Simplification - Time and work - Pipes and cisterns - Ratio and Proportion – Partnership

UNIT IV QUANTITATIVE APTITUDE II 6

Simple interest and Compound interest - Profit and loss - Permutation and combination Probability - Calendar

UNIT V LOGICAL AND VERBAL REASONING 6

Seating arrangement – Direction - Arithmetic reasoning – Syllogisms - Making Judgments - Statements and conclusions - Matching definition - Cause and effect

TOTAL PERIODS: 30

COURSE OUTCOMES

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

- demonstrate the interpersonal skills in Group Discussions
- enhance their verbal and written ability
- practice soft skills to excel in their jobs
- compute problems based on quantitative aptitude
- reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies

TEXT BOOKS

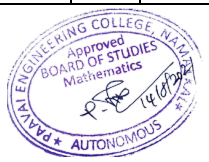
1. Agarwal, R.S.” a modern approach to Verbal & Non Verbal Reasoning”, S.Chand& Co Ltd, new delhi
2. Agarwal, R.S. “ Objective General English”, S.Chand&Co

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-McGraw Hill.
2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications
3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn and Bacon.
4. Infosys Campus Connect Program – students' guide for soft skills

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	-	2	3



PT19251 CHEMICAL REACTION ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- define chemical reactors and reaction systems.
- discuss about biodiversity in marine environment and their resources
- outline the conversion and yield for chemical reactions.
- develop the appropriate selection technique for intended problem.
- learn conceptual design of separation processes and design of equipment involved.

UNIT I SCOPE OF CHEMICAL KINETICS and CHEMICAL REACTION ENGINEERING 9

Broad outline of chemical reactors - Rate equations; Concentration and Temperature dependence; Development of rate equations for different Homogeneous reactions; Industrial scale reactors.

UNIT II IDEAL REACTORS 9

Isothermal batch - Flow, Semi-batch reactors; Performance equations for single reactors; Multiple reactor systems; Multiple reactions.

UNIT III IDEAL FLOW AND NON-IDEAL FLOW 9

RTD in non-ideal flow - Non-ideal flow models; Reactor performance with non-ideal flow.

UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS 9

Resistances and Rate equations - Heterogeneous catalysis; Reactions steps; Resistances and Rate equations.

UNIT V FIXED BED AND FLUID BED REACTORS 9

G/l reactions on solid catalysis - Trickle bed, Slurry reactors; Three phase - fluidized beds; Reactors for fluid- fluid reactions; Tank reactors.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- outline of industrial chemical reactors and chemical kinetics.
- design and construct the ideal reactors of batch and semi-batch reactors
- analyze the performance of non-ideal reactors using compartment model, tanks-in series model and dispersion model.
- evaluate the rate equations of gas-solid, gas-liquid reactions.
- apply the chemical kinetics in different types of industrial reactors.

TEXT BOOKS

1. Levenspiel O. “Chemical Reaction Engineering”, 3r dEdition. JohnWiley.1990
2. Fogler H.S. “Elements of Chemical Reaction Engineering”, Prentice Hall India.2006

REFERENCES

1. Missen R.W., Mims C.A., Saville B.A. "Introduction to Chemical Reaction Engineering And Kinetics", JohnWiley.1999
2. Irving J. Dunn and Zurich, 2003. Biological Reaction Engineering. John Wiley and Sons.
3. Narayanan, K.V., 2001. A Textbook of Chemical Engineering Thermodynamics, Prentice Hall India.
4. Gavhane K.A., Chemical Reaction Engineering – I, Nirali Prakashan Publishers, 2009.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	2	3	-	-	1	-	-	2	-	1	3	2
CO2	3	2	1	3	-	-	1	-	-	2	-	1	3	2
CO3	3	3	2	3	-	-	1	-	-	2	-	1	2	3
CO4	3	3	2	3	-	2	2	-	-	2	-	1	3	3
CO5	1	2	-	2	-	-	-	-	-	1	-	-	-	3

PT19252 ENGINEERING OF BIOMATERIAL SCIENCE 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the basics of biomaterials
- know about the different types of biomaterials
- learn about the tissue engineering
- know about the tissue architecture
- learn about the clinical application

UNIT I INTRODUCTION 9

History of biomaterials - General Properties of Biomaterials, Classes of materials used in medicine, Properties of materials - Bulk and Surface properties and their Characterization; Mechanical Properties of Biomaterials; Classes of materials used in medicine - Metals, Polymers, Hydrogels Bioresorbable and Biodegradable Materials

UNIT II METALIC, CERAMIC AND POLYMERIC BIOMATERIALS 9

Stainless steel - Titanium, Alloys, Cardiovascular Orthopaedic and Dental applications; Corrosion of Bio-metals, Types of Valve Prostheses, Cardiac Stent- Bio-Ceramics, Bio–inert ceramics, Bio– active ceramics, Biodegradable ceramics, Alumina, Zirconia, Hydroxyapatite; Types of polymers - Sterilization, Structure, Bio-compatibility relationship, Stability; Examples of polymers used in medicine - Hydrogels and drug delivery systems - Sutures, Adhesives, and Hydro colloids - Super absorbents - Artificial skin and blood.

UNIT III ASSESSMENT AND HOST REACTION TO BIOMATERIALS 9

In- vitro and In- vivo assessment of tissue compatibility - Testing of blood-materials interactions, Degradation of materials in the biological environment, Effects of the Biological environment on metals, Polymers and Ceramics; Host reaction, Inflammation, Wound healing and the Foreign body response, System toxicity and Hypersensitivity, Blood coagulation and Blood-material Interactions - Tumorigenesis, Implant associated infection.

UNIT IV STANDARDS FOR BIOMATERIALS 9

World standards, Indian Standards; Specifications - General specifications, Classification of Specifications

UNIT V CLINICAL APPLICATION 9

Stem cell therapy, Molecular therapy - In vitro organogenesis, Neurodegenrative diseases, Spinal cord Injury, Heart disease, Diabetes, Burns and Skin ulcers, Muscular dystrophy, Orthopedicapplications; Stem cells and Gene therapy Physiological models, Tissue engineered therapies, Product characterization, Components, Safety, Efficacy.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- explain the basics of biomaterials
- have a knowledge on different types of biomaterials
- explain about the tissue engineering
- have a knowledge on tissue architecture
- have a knowledge about the clinical application.

TEXT BOOKS

1. Michael F. Ashby, Hugh Shercliff, David Cebon, "Materials: engineering, science, processing and design", 2013, 3rd Edition, Elsevier Ltd, Cambridge.N John Dinardo, ―Nanoscale Charecterisation of surfaces and Interfaces, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.
2. Bernhard O.Palsson,Sangeeta N.Bhatia,"Tissue Engineering" Pearson Publishers 2009.
3. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.

REFERENCES

1. Ratner, Hoffman, Schoen, Lemons, "Biomaterials Science",2012, 1st Edition, Academic Press, Massachusetts.
2. Steven M. Kurtz , "PEEK Biomaterials Handbook",2011, 1st Edition, Elsevier, Atlanta.
3. Bernard N. Kennedy (editor). New York : Nova Science Publishers, 2008.Stem cell transplantation, tissue engineering, and cancer applications
4. Raphael Gorodetsky, Richard Schäfer. Cambridge : RSC Publishing, c2011.Stem cell based tissue repair.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	3	-	-	3	-	-	-	-	-	-	3	2
CO2	-	-	3	-	-	3	-	-	-	-	-	-	2	2
CO3	-	-	-	-	3	-	-	-	-	-	-	3	3	2
CO4	3	-	-	-	3	-	-	-	-	-	-	-	3	3
CO5	-	-	-	-	3	-	-	2	-	-	-	-	2	3

PT19253 COSMETIC TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- know the origin of cosmetics and applications of cosmetic excipients
- understand the structure and functions of hair and skin
- develop new formulations for skin and hair care products
- learn the different analysis methods of cosmetics
- know the regulations followed in cosmetic industry

UNIT I INTRODUCTION TO COSMETICS AND COSMETIC EXCIPIENTS 9

Early history of cosmetics, Types of cosmetics, Cosmetic excipients – Surfactants, Emulsifiers, Emollients, Rheology modifiers, Preservatives, Applications of cosmetic excipients

UNIT II SKIN BIOLOGY AND HAIR 9

Skin - Structure of skin – Epidermis, dermis, Hypodermis; Functions of skin, Types of skin, skin problems – Dermatitis, Blemishes, Wrinkles, Acne, Body odour; Structure of hair, Hair growth cycle; Hair problems – Dandruff, Hair fall

UNIT III PRINCIPLES OF FORMULATIONS FOR SKIN AND HAIR CARE PRODUCTS 9

Formulation – Facewash, Moisturizing Cream, Vanishing cream, Sunscreen and their Sensory Advantages and Disadvantages; Chemistry and Formulation – Shampoo, Conditioners, Hair oil, Hair dye, Deodorants, Perfume.

UNIT IV ANALYSIS OF COSMETICS 9

Physical analysis - Patch test, In vitro, In vivo, Viscosity, pH; Chemical analysis - Gravimetric method, Spectroscopy, Chromatography, Titrimetric method, Colorimetric method, Microbiological analysis - Pour plate, Spread plate, Streak plate, Membrane filtration.

UNIT V COSMETIC REGULATIONS 9

Indian regulatory requirements – Labelling, Regulatory provisions of cosmetics, CDSCO, FDA; Misbranded cosmetics, Spurious cosmetics, Banned cosmetics; Offences and Penalties; European union for cosmetics, CPNP, PIF, GMP for cosmetic products in Europe.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- know the types of cosmetics and applications of cosmetic excipients
- understand the functions of skin and hair

- formulate products for skin and hair
- apply different techniques for analyzing the cosmetics
- understand the rules and regulations of cosmetics

TEXT BOOKS

1. Ralph Gordon Harry, John Bernard Wilkinson, Raymond Jack Moore, Harry's cosmetology, 9th edition, chemical publishing,
2. Sanju nanda, arun nanda, Roop k.khar ,"cosmetic technology",1st edition, birla publications

REFERENCES

1. Sagarin, "cosmetics", Volume 1 and 3
2. P.P sharma," cosmetic formulation, manufacturing and quality control".,4th edition, vandana publications pvt ltd
3. Norman. F. Estrin,"Cosmetic industry –scientific and regulatory foundations", Marcel Dekker,1984
4. John W Cooper and Colin Gunn, "Cooper and Gunn's Dispensing for Pharmaceutical Students",London, 12th ed, Pitman Medical Pub. Co. 2008.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2	-	-	-	-	-	-	-	3	2
CO2	2	2	1	-	2	-	-	-	-	-	-	-	3	3
CO3	2	-	2	3	2	-	-	-	-	-	-	-	2	3
CO4	1	3	2	2	2	-	-	2	-	-	-	-	3	2
CO5	3	3	3	3	2	-	-	-	-	-	-	-	3	2

PT19254 PHARMACEUTICAL BIOTECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- give strong foundation and advanced information on drugs
- understand the core responsibilities for the development of drugs
- impart knowledge on monitoring the preparation of medicines according to the norms.
- gain knowledge in physicochemical properties and pharmacology
- learn about the formulation of commonly used biopharmaceuticals.

UNIT I INTRODUCTION 9

Drug sources - Discovery and Development phases, Drugs and Cosmetics Act and Regulatory aspects; Role of patents in the drug industry, Biopharmaceutical classification system, Drug Target, Drug metabolism; Pharmacokinetics, Pharmacodynamics; Bioavailability, Bioequivalence; Toxicity studies – Pharmacogenomics.

UNIT II ADVANCED DRUG DELIVERY SYSTEMS 9

Controlled release dosage forms, Rationale – Principle and Factor influencing, Design and Fabrication – Microencapsulation, Liposomes, Niosomes; Transdermal drug delivery – Ocular,
Vaginal and Uterine controlled release.

UNIT III BIOSIMILARS 9

Biosimilar medicine – Importance, INN nomenclature system, Key trends in biosimilar product development, Production of biosimilar products, Difficulties with biosimilar drugs; Nonclinical and Clinical study; Regulation and Approval process; Future prospects.

UNIT IV BIOETHICS 9

Bioethics, Biosafety and IPR related issues for biotechnological product - Introduction, Biological safety cabinet, Primary containment for Biohazards; Biosafety levels, Biosafety levels of Specific microorganisms, Recommended Biosafety level for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India, Roles of Institutional biosafety committee.

UNIT V CASE STUDIES ON BIOPHARMACEUTICALS 9

Erythropoietin, Insulin, Somatotropin, Interleukin, Interferon, GMCSF, Blood clotting Factors; Tissue plasminogen activator; Monoclonal antibodies and Engineered antibodies.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the various parameters for the current and future biotechnology related products on the regulated pharma industries.
- explain on novel biotechnological and pharmaceutical products, current medicines and their applications in therapeutic and diagnostic fields.
- current applicaions of biotechnology and advances in various areas of pharmaceutical biotechnology.
- understand the legal steps involved in progressing a new drug to market.
- demonstrate on the current regulatory acts and safety norms of the modern pharmaceutical industries.

TEXT BOOKS

1. Crommelin Dwan J.A., Robert D. Sindelar and Bernd Meibohm, "Pharmaceutical Biotechnology: Fundamentals and application", Springer, 4th Edition, 2013.
2. Gary Walsh, "Pharmaceutical Biotechnology-Concepts and Application", John Wiley and Sons Publishers, 1st Edition, 2007.

REFERENCES

1. James Swarbrick, "Encyclopedia of Pharmaceutical Technology", CRC Press, 4th Edition, 2013.
2. Shein-Chung Chow, "Biosimilars: Design and Analysis of Follow-on Biologics", CRC Press, 3rd Edition, 2013.
3. Finkel, Richard, etal., "Lippincott's Illustrated Reviews Pharmacology" IVth Edition. Wolters Kluwer / Lippincott Williams and Wilkins, 2009.
4. Shayne Cox Gad, "Pharmaceutical Manufacturing Handbook: Production and Processes", Wiley, 2nd Edition, 2011.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	2	-	1	2	-	-	1	-	2	3	-
CO2	-	2	3	-	-	-	2	-	2	-	1	-	2	1
CO3	3	-	2	3	-	2	-	2	-	-	-	2	1	2
CO4	2	2	-	2	-	-	2	1	-	-	-	1	-	3
CO5	1	2	2	2	-	-	-	1	-	1	-	-	1	3

PT19901 SAFETY AND HEALTH EVALUATION 3 0 0 3

COURSE OBJECTIVES

To enable students to

- define the concepts and methods of safety.
- explain in detail about safety audit and its importance.
- outline importance of investigation and reporting about accident.
- distinguish between biological and ergonomical hazards.
- assess about occupational health and toxicology in work environment.

UNIT I CONCEPTS AND TECHNIQUES 9

History of Safety movement - Evolution of modern safety concept, General concepts of management, Planning for safety for optimization of productivity - Productivity, Quality and Safety, Line and Staff functions for safety, Budgeting for safety, Safety policy; Incident Recall Technique (IRT), Disaster control, Job safety analysis, Safety survey, Safety inspection, Safety sampling, Evaluation of performance of supervisors on safety.

UNIT II SAFETY AUDIT – INTRODUCTION 9

Components of safety audit - Types of audit, Audit methodology, Non-conformity reporting (NCR), Audit checklist and Report; Review of inspection, Remarks by government agencies, Consultants; Experts – perusal of accident and Safety records, Formats; Implementation of audit indication, Liaison with departments to ensure co-ordination; Check list; Identification of unsafe acts of workers and Unsafe conditions in the shop floor.

UNIT III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident - Reportable and Non-reportable accidents, Reporting to statutory authorities; Principles of accident prevention; Accident investigation and Analysis; Records for accidents, Departmental accident reports, Documentation of accidents; Unsafe act and Condition; Domino sequence; Supervisory role; Role of safety committee; Cost of accident.

UNIT IV BIOLOGICAL AND ERGONOMICAL HAZARDS 9

Classification of Biohazardous agents – Examples - Bacterial agents, Rickettsia and Chlamydial agents, Viral agents, Fungal, Parasitic agents, Infectious diseases; Biohazard control program, Employee health program - laboratory safety program - animal care and Handling, Biological safety cabinets, Building design; Work Related Musculoskeletal Disorders – carpal tunnel syndrome CTS, Tendon pain, Disorders of the neck, Back injuries

UNIT V OCCUPATIONAL HEALTH AND TOXICOLOGY 9

Concept and Spectrum of health, Functional units and Activities of occupational health services - Preemployment and Post-employment medical examinations, Occupational related diseases, Levels of prevention of diseases, Notifiable occupational diseases such as Silicosis, Asbestosis, Pneumoconiosis,

Siderosis, Anthracosis, Aluminosis and Anthrax, Lead-nickel, Chromium and Manganese toxicity, Gas poisoning (such as CO, Ammonia, Coal and Dust etc) their effects and Prevention – cardio pulmonary resuscitation, Audiometric tests, Eye tests, Vital function tests; Industrial toxicology, Local, Systemic and Chronic effects, Temporary and Cumulative effects, Carcinogens entry into human systems

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- recall the concepts and methods of safety and its important in work environment.
- describe in detail about the importance of safety and significance of safety audit.
- estimate in detail about the consequence of accident and to prepare report on the accident.
- inspect and distinguish among biological hazards and psychological and physiological hazards in working environment.
- estimate in detail about work related health and toxicology in working environment.

TEXT BOOKS

1. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997
2. Lees, F.P., "Loss Prevention in Process Industries" Butterworth publications, London, 2nd edition, 1990.

REFERENCES

1. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981
2. Relevant India Acts and Rules, Government of India.
3. Encyclopedia of "Occupational Health and Safety", Vol.I and II, published by International Labour Office, Geneva, 1985.
4. Handbook of "Occupational Safety and Health", National Safety Council, Chicago, 1982.

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CO1	1	1	1	1	-	1	1	-	-	-	-	1	1	1
CO2	2	1	2	2	1	1	2	-	1	-	-	1	-	1
CO3	1	2	2	1	1	2	2	1	-	-	-	2	-	1
CO4	1	2	2	2	1	2	2	1	-	1	-	1	-	1
CO5	1	1	1	1	1	1	3	1	-	1	1	2	-	1

PT19902 MEDICINAL NATURAL PRODUCTS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the techniques in the cultivation and production of crude drugs
- know the systems of medicine existing in India
- understand the extraction of plant drugs
- understand the importance of plant drugs
- understand the preservation technique in preservation of crude drugs

UNIT I INTROUDCTION TO MEDICINAL NATURAL PRODUCTS 9

History and scope of Pharmacognosy; Source of the drug of natural origin; Classification of drug - Organized andunorganized drugs; Different systems of medicine existing in India their basic principles and their relation to
pharmacognosy.

UNIT II MARINE NATURAL PRODUCTS 9

Chemistry and biology of marine natural products; marine chemical ecology; marine biomedicinals and marine toxins -bacteria, microalgae, rhodophyta, chlorophyta, porifera, corals; biosynthesis of marine natural products

UNIT III EXTRACTION OF PLANT DRUGS 9

Introduction to tissue culture with reference to phytopharmaceuticals; Extraction and isolation of phytoconstituents –conventional, modern techniques; Steroids from natural sources.

UNIT IV SCREENING OF NATURAL DRUGS 9

Screening of drugs for pharmacological activity; Protocols and screening methods - antidiabetic, autoinflammatory, diuretic activity; An overview of current status of plants used as - anticancer, antihepatotoxic, antimalarial, antihypertensive agents; Important drugs affecting C.N.S. system.

UNIT V EVALUATION AND PRESERVATION OF DRUGS 9

Commercial aspects of drug production; preservation and storage of crude drugs; Changes occurring in drying and comminution; Adulteration and evaluation of crude drugs; Deterioration of drugs due to insects and pests.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- know the basics of pharmacognosy
- understand the importance of marine natural products

- adapt the knowledge on extraction of various plant drugs
- understand screening and preservation of natural drugs
- apply the knowledge on evaluate the drugs

TEXT BOOKS

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders and Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.

REFERENCES

1. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
2. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi
3. Anatomy of Crude Drugs by M.A. Iyengar
4. Textbook of Pharmacognosy by T.E. Wallis

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CO1	3	3	2	3	3	1	-	1	-	-	-	-	2	3
CO2	2	3	2	-	2	-	2	-	-	-	-	-	3	3
CO3	3	2	2	3	-	-	2	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	3	-	2	3
CO5	2	3	3	2	1	3	3	1	-	2	3	-	3	3