



HAND BOOK: 2020-21

K L COLLEGE OF PHARMACY



K L University Vision:

To be a globally renowned university.

K L University Mission:

To impart quality higher education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens with intrinsic values.

M1 - To impart quality higher education

M2 - To undertake research and extension with emphasis on application and innovation

M3- Cater to the emerging societal needs through all-round development of students of all sections

M4 - To be globally competitive and socially responsible citizens with intrinsic values.

KL University Academic Goals

1. To offer academic flexibility by means of Choice based credit systems and the like
2. To identify and introduce new specializations that offer programs in emerging areas therein.
3. To incorporate into the curriculum the application orientation and use high standards of competence for academic delivery
4. To design and implement educational system adhering to outcome based international models
5. To introduce and implement innovation in teaching and learning process to strengthen academic delivery
6. To offer academic programs at UG, PG, Doctoral, Post-Doctoral which are industry focused and incorporates trans-discipline, inter-discipline aspects of the education system.
7. To deliver higher education that includes technologies and meeting the global requirements

Vision and Mission of the Department

Vision: Lead the future of global healthcare and well-being of the communities we serve.

Mission: To produce quality Pharmacy professionals having strong theoretical foundation, innovative ideas, good design experience by bridging industry-academic gap in Pharma Sector through the use of technology and innovative teaching and exposure to research and progress with social ethics.

Mission Statements

M1. Education: Provide the most comprehensive and highest quality education for pharmaceutical sciences in a learning environment that embraces diversity, equity, integrity, ethics, moral courage and accountability.

M2. Community service: Conduct health education programs to the community to prevent disease and improve public health and well-ness by fostering an environment that promotes the safe, efficacious, and cost-effective use of medications.

M3. Research: Develop a passion for discovery and innovations with multidisciplinary collaborative research and engage in creative partnerships locally and globally to advance health education, research, and practice.

M4. Entrepreneurship: Encourage and support resourcefulness, originality, imagination, ingenuity, and vision in our students, faculty, and staff. Foster the development of entrepreneurs who have the ability to dream, inspire and innovate and courage to envisage the commercial success and socio economic productivity of innovations.

Program Educational Objectives (PEO's) - B.Pharm

PEO1	To produce pharmacist workforce competent for the society.
PEO2	To produce pharmacy graduates with employable skills and high technical competence in pharmaceutical industry and health care sectors
PEO3	To inculcate research activity and develop passion for discovery and innovations
PEO4	To develop entrepreneurship qualities that support growth of pharmaceutical intellectual property and contribute for economic development throughout the world

Program Outcomes (PO's) - B.Pharm

PO1	Pharmacy Knowledge: Provide basic knowledge for understanding the principles and their applications in the area of Pharmaceutical Sciences and Technology.
PO2	Technical Skills: Develop an ability to use various instrument and equipment with an in-depth knowledge on standard operating procedures for the same.
PO3	Modern Tool Usage: Develop/apply appropriate techniques, resources, and IT tools including prediction and modeling to complex health issues and medicine effect with an understanding of the limitations.
PO4	Research and Development: To demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Pharmaceutical Sciences and Technology
PO5	Lifelong Learning: Develop an aptitude for continuous learning and professional development with ability to engage in pharmacy practice and health education programs
PO6	Communication: Communicate effectively on health care activities with the medical community and with society at large, to comprehend drug regulations, write health reports and provide drug information
PO7	The Pharmacist and Society: Apply reasoning informed by the contextual knowledge to comprehend medical prescription, perform patient counseling and issue or receive clear instructions on drug safety and the consequent responsibilities relevant to the professional pharmacy practice.
PO8	Ethics: Follow the code of ethics and commit to professional values and responsibilities and norms of the pharmacy practice.

Programme Specific Outcomes (PSO's) - B.Pharm

PSO1	Pharmaceutical product development: To apply the knowledge of manufacturing, formulation and quality control of various pharmaceutical and cosmetic products in the form of powders, tablets. Capsules, parenteral, solutions, suspensions, emulsions, creams, lotions and aerosols etc.
PSO2	Invention and Entrepreneurship: Find the application of modern tools to integrate health care systems, design an effective product with commercial advantage and societal benefit, perform risk analysis and become entrepreneur.

Mapping of PEOs and POs

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	√	√			
PO2		√	√		
PO3		√		√	
PO4			√	√	
PO5	√				√
PO6	√				√
PO7		√			√
PO8					
PSO1		√	√		
PSO2			√	√	

Academic Goals

G1	To offer academic flexibility by means of Choice based credit systems and the like.
G2	To identify and introduce new specializations and offer programs in emerging areas therein
G3	To incorporate into the curriculum the Application orientation and use high standards of competence for academic delivery
G4	To design and implement educational system adhering to outcome based International models.
G5	To introduce and implement innovation in teaching and learning process to strengthen academic delivery
G6	To offer academic programs at UG, PG, doctoral, Post-Doctoral which are industry focused, and incorporates Trans-discipline, inter-discipline aspects of the education system
G7	To deliver higher education that includes technologies and meeting the global requirements

MAPPING OF GOALS WITH MISSION:

S.No.	M1	M2	M3	M4
G1	✓			✓
G2	✓	✓	✓	
G3	✓			
G4			✓	✓
G5			✓	✓
G6	✓			✓
G7	✓			✓

MAPPING OF PEOs WITH GOALS:

PEO	G1	G2	G3	G4	G5	G6	G7
1	✓	✓	✓	✓	✓	✓	✓
2	✓	✓				✓	✓
3			✓	✓	✓	✓	✓
4			✓	✓	✓	✓	✓

		Pharmacokinetics (Theory)																		
59	20PY3231T	Pharmaceutical Biotechnology (Theory)		3	1	0	0	4	-	1			2					2		
60	20PY3232T	Quality Assurance (Theory)		3	1	0	0	4	-	3								2		
61	19UC3205	Campus to Corporate		0	0	4	0	2	-	1			1	2	2	2	2			
62	20PY4157	Instrumental Methods of Analysis (Theory)		3	1	0	0	4	-		2		1							
63	20PY4161	Instrumental Methods of Analysis (Practical)		0	0	4	0	2	-		2							3		
64	20PY4158	Industrial Pharmacy I (Theory)		3	1	0	0	4	-	2								3		
65	20PY4159	Pharmacy Practice (Theory)		3	1	0	0	4	-				2			3				
66	20PY4160	Novel Drug Delivery System (Theory)		3	1	0	0	4	-		3							3	2	
67																				
68	20PY4137PS	Practice School*		0	0	12	0	6	-		2			1						
69	20PY4238T	Biostatistics and Research Methodology (Theory)		3	1	0	0	4	-				2							
70	20PY4239T	Social and Preventive Pharmacy (Theory)		3	1	0	0	4	-							2				
71	20PY4240ET	Pharma Marketing Management (Theory)	EL					0		-					3				2	
72	20PY4241ET	Pharmaceutical Regulatory Science (Theory)	EL					0		-	3								2	
73	20PY4242ET	Pharmacovigilance (Theory)	EL					0		-					3				2	
74	20PY4243ET	Quality Control and Standardization of Herbals (Theory)	EL	3	1		0		4	-		3							2	
75	20PY4244ET	Computer Aided Drug Design (Theory)	EL	3	1		0		4	-			3						2	
76	20PY4245ET	Cell and Molecular Biology (Theory)	EL					0		-		2		3						
77	20PY4246ET	Cosmetic Science (Theory)	EL					0		-									3	2
78	20PY4247ET	Experimental Pharmacology (Theory)	EL					0		-		2		3						

I/IV B. Pharmacy Odd Semester
20PY1101T - HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Explain the gross morphology, structure and functions of various organs of the human body.	1,4	1,2
CO2	Describe the various homeostatic mechanisms and their imbalances.	1,4	1,2
CO3	Identify the various tissues and organs of different systems of human body.	1,4	1,2
CO4	Understand the organ functions	1,4	1,2

Introduction to human body, Cellular level of organization, tissue level of organization, Integumentary system, Skeletal system, Joints, Body fluids and blood, Lymphatic system, Peripheral nervous system, Special senses, Cardiovascular system

Syllabus

Introduction to human body: Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

Cellular level of organization: Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine. **Tissue level of organization:** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

Integumentary system: Structure and functions of skin. **Skeletal system:** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system. Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction. **Joints:** Structural and functional classification, types of joints movements and its articulation.

Body fluids and blood: Body fluids, composition and functions of blood, hemopoiesis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticuloendothelial system. **Lymphatic system:** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system. **Peripheral nervous system:** Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves.

Special senses: Structure and functions of eye, ear, nose and tongue and their disorders.

Cardiovascular system: Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.

Recommended Books (Latest Editions)

- Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brother's medical publishers, New Delhi.
- Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
- Physiological basis of Medical Practice-Best and Taylor. Williams & Wilkins Co, Riverview, MI USA
- Text book of Medical Physiology- Arthur Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
- Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
- Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
- Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.

- Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

- Physiological basis of Medical Practice-Best and Taylor. Williams & Wilkins Co, Riverview, MI USA
- Text book of Medical Physiology- Arthur C. Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
- Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkata

**I/IV B. Pharmacy Odd Semester
20PY1101P– HUMAN ANATOMY AND PHYSIOLOGY-I (Practical)**

**L-T-P/S: 0-0-4 Credits: 2 Contact Hours:4
Mapping of Course Outcomes with PO/PSO:**

CO#	Course Outcome	PO/PSO	BTL
CO	Perform the various experiments related to physiology and health.	1,2	2,3

Syllabus:

- Study of compound microscope
- Microscopic study of epithelial and connective tissue
- Microscopic study of muscular and nervous tissue
- Identification of axial bones
- Identification of appendicular bones
- Introduction to hemocytometry
- Enumeration of white blood cell (WBC) count
- Enumeration of total red blood corpuscles (RBC) count
- Determination of bleeding time
- Determination of clotting time
- Estimation of hemoglobin content
- Determination of blood group
- Determination of erythrocyte sedimentation rate (ESR)
- Determination of heart rate and pulse rate
- Recording of blood pressure

**I/IV B. Pharmacy Odd Semester
20PY1102T - PHARMACEUTICAL ANALYSIS (Theory)**

**L-T-P/S: 3-1-0 Credits: 4 Contact Hours:4
Mapping of Course Outcomes with PO/PSO:**

CO#	Course Outcome	PO/PSO	BTL
CO1	understand the principles of volumetric and electro chemical analysis	1,4	1,2

CO2	you various volumetric and electrochemical titrations	1,4	1,2
CO3	develop analytical skills	1,4	1,2
CO4	Reporting analytical result and data integrity	1,4	1,2

Scope of Pharmaceutical analysis, expression of concentration, Preparation and standardization of various molar and normal solutions, Errors, pharmacopeias standards. Acid base titration, Non aqueous titration, Precipitation titrations, Gravimetry. Complexometric titration, Redox titrations, diazotisation titration. Electrochemical methods of analysis, Conductometry, Potentiometry and Polarography.

Syllabus

Pharmaceutical analysis- Definition and scope, Different techniques of analysis, Methods of expressing concentration, Primary and secondary standards. Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate. **Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures.

Acid base titration: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves.

Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl. **Precipitation titrations:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Gravimetry:** Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.

Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate. Basic Principles, methods and application of diazotisation titration. **Redox titrations:** Concepts of oxidation and reduction.

Types of redox titrations (Principles and applications). Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate

Electrochemical methods of analysis: Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications. **Potentiometry** - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications. **Polarography** - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications.

Recommended Books: (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. John H. Kennedy, Analytical chemistry principles
6. Indian Pharmacopoeia.

I/IV B. Pharmacy Odd Semester 20PY1102P. PHARMACEUTICAL ANALYSIS (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Perform various analytical experiments	1,2	2,3

Syllabus:

- 1 Preparation and standardization of Sodium hydroxide, Sulphuric acid, Sodium

- thiosulfate, Potassium permanganate & Ceric ammonium sulphat
- 2 Assay of the following compounds along with Standardization of Titrant: Ammonium chloride by acid base titration, Ferrous sulphate by Cerimetry, Copper sulphate by Iodometry, Calcium gluconate by complexometry, Hydrogen peroxide by Permanganometry, Sodium benzoate by non-aqueous titration & Sodium Chloride by precipitation titration
 - 3 Determination of Normality by electro-analytical methods: Conductometric titration of strong acid against strong base, Conductometric titration of strong acid and weak acid against strong base & Potentiometric titration of strong acid against strong base

I/IV B. Pharmacy Odd Semester
20PY1103T- GENERAL PHARMACEUTICS (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Know the history of profession of pharmacy	1,4	1,2
CO2	Understand the basics of different dosage forms	1,4	1,2
CO3	Understand the pharmaceutical incompatibilities and pharmaceutical calculations	1,4	1,2
CO4	Understand the professional way of handling the prescription	1,4	1,2

Pharmacy education, different dosage forms. Prescription, Dose Calculations, Powders, Liquid dosage forms (both monophasic and biphasic), suppositories, semisolid dosage forms, Pharmaceutical incompatibilities.

Syllabus

Historical background and development of profession of pharmacy: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. **Dosage forms:** Introduction to dosage forms, classification and definitions. **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription. **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.

Pharmaceutical calculations: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions. **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques.

Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions. **Biphasic liquids:** **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome. **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome. **Suppositories:** Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. **Pharmaceutical incompatibilities:** Definition, classification, physical, chemical and therapeutic incompatibilities with examples. **Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi

solid dosages forms

Recommended Books: (Latest Editions)

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The Science & Dosage Form Design, Churchill Livingstone, Edinburgh.
4. Indian pharmacopoeia.
5. British pharmacopoeia.
6. Lachmann. Theory and Practice of Industrial Pharmacy, Lea & Febiger Publisher, The University of Michigan.
7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.
12. Francoise Nieloud and Gilberte Marti-Mestres:
13. Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

**I/IV B. Pharmacy Odd Semester
20PY1103P - GENERAL PHARMACEUTICS (Practical)**

L-T-P/S: 0-0-4		Credits: 2		Contact Hours:4	
CO#	Course Outcome	PO/PSO	BTL		
CO	Apply the knowledge to prepare various conventional dosage forms	1,2	2,3		

Syllabus:

- 1 **Syrups : Syrup IP'66 & Compound syrup of Ferrous Phosphate BPC'68**
- 2 **Elixirs:** Piperazine citrate elixir & Paracetamol pediatric elixir
- 3 **Linctus:** Terpin Hydrate Linctus IP'66 & Iodine Throat Paint (Mandles Paint)
- 4 **Solutions: Strong solution of ammonium acetate, Cresol with soap solution & Lugol's solution**
- 5 **Suspensions:** Calamine lotion, Magnesium Hydroxide mixture & Aluminium Hydroxide gel
- 6 **Emulsions:** Turpentine Liniment & Liquid paraffin emulsion
- 7 **Powders and Granules:** ORS powder (WHO) & Effervescent granules c)Dusting powderd)Divded powders
- 8 **Suppositories:** Glycero gelatin suppository, Coca butter suppository & Zinc Oxide suppository
- 9 **Semisolids:** Sulphur ointment & Non staining-iodine ointment with methyl salicylate
- 10 **Carbopal gel Gargles and Mouthwashes:** Iodine gargle & Chlorhexidine mouthwash

**I/IV B. Pharmacy Odd Semester
20PY1104T - PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals	1,4	1,2
CO2	erstand the medicinal and pharmaceutical importance of inorganic compounds	1,4	1,2
CO3	Know the preparation and analysis of inorganic medicinal compounds	1,4	1,2
CO4	Know their diagnostic applications	1,4	1,2

Impurities in pharmaceutical substances. History of pharmacopoeia, limit tests. Preparations and assay for the different pharmaceutical inorganic. Acids, bases and buffers used in pharmacy, major extra and intracellular electrolytes. Dental products. Gastrointestinal agents, acidifiers. Cathartics: antimicrobials. Expectorants, hematinic, poison and antidote, astringents, radiopharmaceuticals.

Syllabus:

Impurities in pharmaceutical substances: History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate. **General methods of preparation**, assay for the compounds superscripted with **asterisk (*)**, properties and medicinal uses of inorganic compounds belonging to the following classes.

Acids, Bases and Buffers: Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. **Major extra and intracellular electrolytes:** Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.

Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.

Gastrointestinal agents: Acidifiers: Ammonium chloride* and Dil. HCl. **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium. Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture. **Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite. **Antimicrobials:** Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations.

Miscellaneous compounds: Expectorants: Potassium iodide, Ammonium chloride*. **Emetics:** Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate. **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite³³³. **Astringents:** Zinc Sulphate, Potash Alum. **Radiopharmaceuticals:** Radio activity, Measurement of radioactivity, Properties of α , β , γ radiations, Half-life, radio isotopes and study of radio isotopes - Sodium iodide I¹³¹, Storage conditions, precautions & pharmaceutical application of radioactive substances.

Recommended Books (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
4. M.L Schroff, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

I/IV B. Pharmacy Odd Semester

20PY1104P - PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Apply the knowledge to prepare various inorganic pharmaceuticals	1,2	2,3

Syllabus:

- Limit tests for following ions:** Limit test for Chlorides and Sulphates. Modified limit test for Chlorides and Sulphates. Limit test for Iron. Limit test for Heavy metals. Limit test for Lead. Limit test for Arsenic
- Identification test:** Magnesium hydroxide, Ferrous sulphate, Sodium bicarbonate, Calcium gluconate, Copper sulphate
- Test for purity:** Swelling power of Bentonite, Neutralizing capacity of aluminum hydroxide gel, Determination of potassium iodate and iodine in potassium Iodide
- Preparation of inorganic pharmaceuticals:** Boric acid, Potash alum & Ferrous sulphate

I/IV B. Pharmacy Odd Semester 20PY1105T - COMMUNICATION SKILLS (Theory)

L-T-P/S: 2-0-0

Credits: 2

Contact Hours:2

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the practical knowledge of using action words in sentence construction.	1,4	1,2
CO2	Apply and analyse the right kind of pronunciation with regards to speech sounds and able to get different types of pronunciations.	1,4	1,2
CO3	Apply the concept of fundamental principle of counting to solve the problems on linear, circular permutations and also for the problems on selections. Apply the concept of probability, while doing the problems on Leap year & Non-Leap year problems, coins, dice, balls and cards.	1,4	1,2
CO4	Analyze the given conditions and finding out all the possible arrangements in linear & circular order. Analyze the given numbers or letters to find out the hidden analogy and apply that analogy to find solutions. Finding the odd man out by observing the principle which makes the others similar.	1,4	1,2

Concept of communication skills, its barriers, perspectives, elements and styles. Understanding basic listening skills, writing skills and interview skills.

Syllabus

Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context. **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers. **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment
Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.
Communication Styles: Introduction, The Communication Styles Matrix with example for each -

Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style

Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations. **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication. **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message

Interview Skills: Purpose of an interview, Do's and Dont's of an interview. **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery. **Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

Recommended Books: (Latest Edition)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals –PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011
11. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

I/IV B. Pharmacy Odd Semester 20PY1105P - COMMUNICATION SKILLS (Practical)

L-T-P/S: 0-0-2

Credits: 1

Contact Hours:2

Syllabus:

- 1 **Basic communication covering the following topics:** Meeting People, Asking Questions, Making Friends, What did you do?, Do's and Dont's
- 2 **Pronunciations covering the following topics:** Pronunciation (Consonant Sounds), Pronunciation and Nouns, Pronunciation (Vowel Sounds)
- 3 **Advanced Learning:** Listening Comprehension / Direct and Indirect Speech, Figures of Speech, Effective Communication, Writing Skills, Effective Writing, Interview Handling Skills, E-Mail etiquette, Presentation Skills

I/IV B. Pharmacy Odd Semester 20PY1106RBT - REMEDIAL BIOLOGY (Theory)

L-T-P/S: 2-0-0

Credits: 2

Contact Hours:2

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO1	Introduce biology to non biology students	1,4	1,2
CO2	w the classification and salient features of five kingdoms of life	1,4	1,2

CO3	understand the basic components of anatomy & physiology of plant	1,4	1,2
CO4	know understand the basic components of anatomy & physiology animal with special reference to human	1,4	1,2

Living organisms, Morphology of Flowering plants, Body fluids and circulation, Digestion and Absorption, Breathing and respiration, Excretory products and their elimination, Neural control and coordination, Chemical coordination and regulation, Human reproduction, Plants and mineral nutrition, Plant growth and development, Tissues.

Syllabus

Living world: 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, Protista, Fungi, Animalia and Plantae, Virus. **Morphology of Flowering plants:** Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotyledones.

Body fluids and circulation: Composition of blood, blood groups, coagulation of blood. Composition and functions of lymph. Human circulatory system. Structure of human heart and blood vessels. Cardiac cycle, cardiac output and ECG. **Digestion and Absorption:** Human alimentary canal and digestive glands. Role of digestive enzymes. Digestion, absorption and assimilation of digested food. **Breathing and respiration:** Human respiratory system. Mechanism of breathing and its regulation. Exchange of gases, transport of gases and regulation of respiration. Respiratory volumes

Excretory products and their elimination: Modes of excretion, Human excretory system- structure and function, Urine formation, Renin 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

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. **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.

Text Books

1. Text book of Biology by S. B. Gokhale
2. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.
3. A Text book of Biology by B.V. Sreenivasa Naidu
4. A Text book of Biology by Naidu and Murthy
5. Botany for Degree students By A.C.Dutta.
6. Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthkrishnan.
7. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate
8. Practical human anatomy and physiology. by S.R.Kale and R.R.Kale.
9. Biology practical manual according to National core curriculum. Biologyforum of Karnataka. Prof .M.J.H.Shafi

I/ IV B. Pharmacy Odd Semester 20PY1106RBP - REMEDIAL BIOLOGY (Practical)

L-T-P/S: 0-0-2

Credits: 1

Contact Hours:2

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
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CO	Perform various biology experiments	1,2	2,3
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Syllabus:

- 1 Introduction to experiments in biology: Study of Microscope, Section cutting techniques, Mounting and staining, Permanent slide preparation
- 2 Study of cell and its inclusions
- 3 Study of Stem, Root, Leaf, seed, fruit, flower and their modifications
- 4 Detailed study of frog by using computer models
- 5 Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flower
- 6 Identification of bones
- 7 Determination of blood group
- 8 Determination of blood pressure
- 9 Determination of tidal volume

I/IV B. Pharmacy Odd Semester 19H1106RMT - REMEDIAL MATHEMATICS (Theory)

L-T-P/S: 2-0-0

Credits: 2

Contact Hours:2

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Introduce essential of mathematics to biology students.	1,4	1,2
CO2	Know the theory and their application in Pharmacy	1,4	1,2
CO3	Solve the different types of problems by applying theory	1,4	1,2
CO4	Appreciate the important application of mathematics in Pharmacy	1,4	1,2

Study of partial fractions, logarithms, functions, matrices, determinants, calculus differentiation, analytical geometry and differential equation and their application in clinical kinetics and pharmacokinetics.

Syllabus

Partial fraction: Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics. **Logarithms:** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function:** Real Valued function, Classification of real valued functions, **Limits and continuity:** Introduction, Limit of a function, Definition of limit of a function ($\epsilon - \delta$ definition),

$$\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = na^{n-1}, \quad \lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1,$$

Matrices and Determinant: Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix, Singular and non-

singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations.

Calculus Differentiation : Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of x^n w.r.tx, where n is any rational number, Derivative of e^x , Derivative of $\log_e x$, Derivative of a^x , Derivative of trigonometric functions from first principles (**without Proof**), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application. **Analytical Geometry Introduction**: Signs of the Coordinates, Distance formula, **Straight Line**: Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line. **Integration**:

Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application.

Differential Equations: Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations. Laplace Transform**: Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations**

Recommended Books (Latest Edition)

1. Differential Calculus by Shanthinarayan
2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
3. Integral Calculus by Shanthinarayan
4. Higher Engineering Mathematics by Dr.B.S.Grewal

**I/IV B. Pharmacy Even Semester
20PY1207T - HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO1	Explain the gross morphology, structure and functions of various organs of the human body.	1,4	1,2
CO2	Describe the various homeostatic mechanisms and their imbalances.	1,4	1,2
CO3	Identify the various tissues and organs of different systems of human body.	1,4	1,2
CO4	Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.	1,4	1,2

Introduction to nervous system and detailed study of central nervous system. Detailed study of digestive system, respiratory system, urinary system, endocrine system and reproductive system. Introduction to genetics.

Syllabus

Nervous system: Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)

Digestive system: Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT. **Energetics:** Formation and role of ATP, Creatinine Phosphate and BMR.

Respiratory system: Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration, Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods. **Urinary system:** Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

Endocrine system: Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders. **Reproductive system:** Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition. **Introduction to genetics:** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance.

Recommended Books (Latest Editions)

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
4. Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata

I/IV B. Pharmacy Even Semester 20PY1207P - HUMAN ANATOMY AND PHYSIOLOGY (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO	Apply the knowledge to perform various physiology experiments	1,2	2,3

Syllabus:

- 1 To study the integumentary and special senses using specimen, models, etc.
- 2 To study the nervous system using specimen, models, etc.,

- 3 To study the endocrine system using specimen, models, etc
- 4 To demonstrate the general neurological examination
- 5 To demonstrate the function of olfactory nerve
- 6 To examine the different types of taste.
- 7 To demonstrate the visual acuity
- 8 To demonstrate the reflex activity
- 9 Recording of body temperature
- 10 To demonstrate positive and negative feedback mechanism.
- 11 Determination of tidal volume and vital capacity.
- 12 Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
- 13 Recording of basal mass index
- 14 Study of family planning devices and pregnancy diagnosis test.
- 15 Demonstration of total blood count by cell analyser
Permanent slides of vital organs and gonads

I/IV B. Pharmacy Even Semester
20PY1208T - PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	write the structure, name and the type of isomerism of the organic compound	1,4	1,2
CO2	write the reaction, name the reaction and orientation of reactions	1,4	1,2
CO3	Account for reactivity/stability of compounds,	1,4	1,2
CO4	Identify/confirm the identification of organic compound	1,4	1,2

Classification of organic compounds, Alkanes, Alkenes, Conjugated, Alkyl halides, Alcohols, Carbonyl compounds* (Aldehydes and ketones), Carboxylic acids & Its derivatives, and Aliphatic amines.

Syllabus

Classification, nomenclature and isomerism: Classification of Organic Compounds. Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds), Structural isomerisms in organic compounds

Alkanes*, Alkenes* and Conjugated dienes*: SP³ hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP² hybridization in alkenes, E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbo-cations, Saytzeffs orientation and evidences. E1 versus E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement

Alkyl halides*: SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions. Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. **Alcohols*:** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol

Carbonyl compounds* (Aldehydes and ketones): Nucleophilic addition, Electrometric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde. **Carboxylic acids*:** Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids, amide and ester. Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid. **Aliphatic amines* -** Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine

Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
9. Reaction and reaction mechanism by Ahluwalia/Chatwal.

I/IV B. Pharmacy Even Semester 20PY1208P - PHARMACEUTICAL ORGANIC CHEMISTRY –I (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Apply the knowledge to synthesize various organic compounds	1,2	2,3

Syllabus:

- 1 Systematic qualitative analysis of unknown organic compounds like
 1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc
 2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
 3. Solubility test
 4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
 5. Melting point/Boiling point of organic compounds
 6. Identification of the unknown compound from the literature using melting point/boiling point.
 7. Preparation of the derivatives and confirmation of the unknown compound by melting point/boiling point.

8. Minimum 5 unknown organic compounds to be analyzed systematically.
- 2 Preparation of suitable solid derivatives from organic compound
- 3 Construction of molecular models

**I/IV B. Pharmacy Even Semester
20PY1209T - BIOCHEMISTRY (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the principles of chemistry in biology	1,4	1,2
CO2	Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.	1,4	1,2
CO3	Understand the metabolism of nutrient molecules in physiological and pathological conditions.	1,4	1,2
CO4	Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.	1,4	1,2

Detailed study of biomolecules and bioenergetics. Study of various metabolic pathways related to carbohydrates, Lipids, proteins and Nucleic acids. Study of genetic information transfer and concept of enzymes.

Syllabus

Biomolecules: Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. **Bioenergetics:** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic AMP

Carbohydrate metabolism: Glycolysis – Pathway, energetics and significance Citric acid cycle-Pathway, energetics and significance, HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency, Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance, Hormonal regulation of blood glucose level and Diabetes mellitus. **Biological oxidation:** Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate level phosphorylation Inhibitors ETC and oxidative phosphorylation/Uncouplers

Lipid metabolism: β -Oxidation of saturated fatty acid (Palmitic acid), Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid)

Biological significance of cholesterol and conversion of cholesterol, into bile acids, steroid hormone and vitamin D, Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity. **Amino acid metabolism:** General reactions of amino acid metabolism:

Transamination, deamination & decarboxylation, urea cycle and its disorders, Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alpeptonuria, tyrosinemia), Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline. Catabolism of heme; hyperbilirubinemia and jaundice

Nucleic acid metabolism and genetic information transfer: Biosynthesis of purine and pyrimidine nucleotides, Catabolism of purine nucleotides and Hyperuricemia and Gout disease Organization of mammalian genome, Structure of DNA and RNA and their functions DNA replication (semi conservative model) Transcription or RNA synthesis. Genetic code, Translation or Protein synthesis and inhibitors. **Enzymes:** Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Line Weaver Burke plot), Enzyme inhibitors with examples, Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation, Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes –Structure and biochemical functions.

Recommended Books (Latest Editions)

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murray, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.
4. Biochemistry by D. Satyanarayan and U. Chakrapani
5. Textbook of Biochemistry by Rama Rao.
6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna. Practical Biochemistry by Harold Varley.

I/IV B. Pharmacy Even Semester 20PY1209P - BIOCHEMISTRY (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Apply the knowledge to estimate various biochemical parameters in physiological systems	1,2	2,3

Syllabus:

- 1 Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
- 2 Identification tests for Proteins (albumin and Casein)
- 3 Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
- 4 Qualitative analysis of urine for abnormal constituents
- 5 Determination of blood creatinine
- 6 Determination of blood sugar
- 7 Determination of serum total cholesterol
- 8 Preparation of buffer solution and measurement of pH
- 9 Study of enzymatic hydrolysis of starch
- 10 Determination of Salivary amylase activity
- 11 Study the effect of Temperature on Salivary amylase activity.
- 12 Study the effect of substrate concentration on salivary amylase activity.

I/IV B. Pharmacy Even Semester 20PY1210T - PATHOPHYSIOLOGY (THEORY)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the conditions leading to a disease	1,4	1,2
CO2	Describe the etiology and pathogenesis of the selected disease states;	1,4	1,2

CO3	Name the signs and symptoms of the diseases; and	1,4	1,2
CO4	Mention the complications of the diseases.	1,4	1,2

Study of basic principles of cell injury, cell adaptation and the basic mechanism involved in the process of inflammation and repair. Pathophysiology related to disorders and diseases of cardiovascular, respiratory, renal, endocrine, nervous, GIT and skeletal systems. Pathophysiology involved in cancer, infectious and sexually transmitted diseases.

Syllabus

Basic principles of Cell injury and Adaptation: Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage), Morphology of cell injury-Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance. **Basic mechanism involved in the process of inflammation and repair:** Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis.

Cardiovascular System: Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis). **Respiratory system:** Asthma, Chronic obstructive airways diseases. **Renal system:** Acute and chronic renal failure.

Haematological Diseases: Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalassemia, hereditary acquired anemia, hemophilia. **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones. **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.

Gastrointestinal system: Peptic Ulcer, Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout. **Principles of cancer:** classification, etiology and pathogenesis of cancer. **Diseases of bones and joints:** Rheumatoid Arthritis, Osteoporosis, Gout. **Principles of Cancer:** Classification, etiology and pathogenesis of Cancer. **Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections. **Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhoea.

Recommended Books (Latest Editions)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;
5. William and Wilkins, Baltimore; 1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston; Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

1. The Journal of Pathology. ISSN: 1096-9896 (Online)
2. The American Journal of Pathology. ISSN: 0002-9440
3. Pathology. 1465-3931 (Online)
4. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
5. Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

I/IV B. Pharmacy Even Semester
20PY1211T - COMPUTER APPLICATIONS IN PHARMACY (Theory)

L-T-P/S: 3-0-0

Credits: 3

Contact Hours:3

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	know the various types of application of computers in pharmacy	1,4	1,2
CO2	w the various types of databases	1,4	1,2
CO3	know the various applications of databases in pharmacy	1,4	1,2
CO4	Know the web based tools for pharmacy practice	1,4	1,2

Study of number system, concept of Information Systems, software and web technologies. Application of computers in Pharmacy and preclinical development. Bioinformatics.

Syllabus

Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One’s complement, Two’s complement method, binary multiplication, binary division. **Concept of Information Systems and Software:** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project

Web technologies: Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products. Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

Application of computers in Pharmacy – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring. Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System

Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery. **Computers as data analysis in**

Preclinical development: Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)

Recommended books (Latest edition):

1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishersand Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
4. Microsoft office Access - 2003, Application Development Using VBA, SQLServer, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi - 110002

I/IV B. Pharmacy Even Semester
20PY1211P - COMPUTER APPLICATIONS IN PHARMACY
(Practical)

L-T-P/S: 0-0-2

Credits: 1

Contact Hours:2

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Apply the knowledge to design and develop digital tools for pharmaceutical applications	1,2	2,3

Syllabus:

- 1 Design a questionnaire using a word processing package to gather information about a particular disease.
- 2 Create a HTML web page to show personal information.
- 3 Retrieve the information of a drug and its adverse effects using online tools
- 4 Creating mailing labels Using Label Wizard , generating label in MS WORD
- 5 Create a database in MS Access to store the patient information with the required fields Using access
- 6 Design a form in MS Access to view, add, delete and modify the patient recording the database
- 7 Generating report and printing the report from patient database
- 8 Creating invoice table using – MS Access
- 9 Drug information storage and retrieval using MS Access
- 10 Creating and working with queries in MS Access
- 11 Exporting Tables, Queries, Forms and Reports to web page
- 12 Exporting Tables, Queries, Forms and Reports to XML pages

**I/IV B. Pharmacy Even Semester
20PY1212T - ENVIRONMENTAL SCIENCES (Theory)**

L-T-P/S: 3-0-0

Credits: 3

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the importance of Environmental education and conservation of natural resources.	1,4	1,2
CO2	Understand the importance of ecosystems and biodiversity.	1,4	1,2
CO3	Apply the environmental science knowledge on solid waste management, disaster management and EIA process.	1,4	1,2

Study of multidisciplinary nature, renewable and nonrenewable sources, natural sources and associated problems, understand the concept, structure and function of different ecosystems and study of environmental pollution

Syllabus

The Multidisciplinary nature of environmental studies Natural Resources. Renewable and non-renewable resources:

Natural resources and associated problems: a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Introduction,

types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Environmental Pollution: Air pollution; Water pollution; Soil pollution

Text Book:

1. Anubha Kaushik, C.P.Kaushik, “Environmental Studies” , New Age International, (2007).
2. Benny Joseph, “Environmental Studies”, Tata McGraw-Hill companies, New Delhi, (2009).

**I/IV B. Pharmacy Even Semester
20UC1202-ENGLISH PROFICIENCY**

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO1	Explain the gross morphology, structure and functions of various organs of the human body.	1,4	1,2
CO2	Describe the various homeostatic mechanisms and their imbalances.	1,4	1,2
CO3	Identify the various tissues and organs of different systems of human body.	1,4	1,2
CO4	Understand the organ functions	1,4	1,2

Study on basic English sounds and different communications like verbal, non-verbal and interpersonal collaborations.

Syllabus

Basic English Sounds: Distinctive sounds of English; Assimilation, Contraction, Elision, Twinning; Stress, Syllables, Word- stress; Tone and Intonation, Rising, Falling, Rise-fall and Fall-rise. Pronunciation and Enunciation. Sound, Word, Sentence Drills

Oral Communication: Roll of oral communication in pharmacy practice, Significance of oral communication and barriers of communication, Lenoir process of communication

Types of communication: diagonal communication, horizontal communication, vertical communication (up-downward communication, downward-up communication), electronic communication, mass communication and media communication

Non-Verbal Communication: Non-verbal vs verbal communication, Elements of non-verbal communication, Distracting non-verbal communication, Detecting non-verbal cues in others, Dealing with sensitive issues, Overcoming non-verbal distracting factors.

Communication Skills and Inter Professional Collaboration: Case studies, Pharmacist working in collaboration with physicians (Knapps model), Confrontational relationships and procedural obstacles (Duck’s phase model), Barriers and facilitators to collaborative partnership, Four key characteristics of effective collaboration (sharing, partnering, interdependency and power)

Reference Books:

1. Dictionary of Technical Terms
2. Dr. Meenakshi Raman and Dr. Sangeetha Sarma: *Technical Communication*.Oxford University Press: Delhi.2016.
3. The Ultimate Verbal and Vocabulary Builder. Texas: Lighthouse Review.2000.
4. Rajeev Vasisth: *Interactive Vocabulary Drills*. New Delhi: Arihant Publications Limited. 2011.
5. Language Laboratory Teacher Manual, KLEFU

II/IV B. Pharmacy Odd Semester
20PY2113T - PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	write the structure, name and the type of isomerism of the organic compound	1,4	1,2
CO2	write the reaction, name the reaction and orientation of reactions	1,4	1,2
CO3	account for reactivity/stability of compounds,	1,4	1,2
CO4	prepare organic compounds	1,4	1,2

Benzene and its derivatives, Phenols, Aromatic Amines, Aromatic Acids, Fats and Oils, Polynuclear hydrocarbons and Cyclo alkanes.

Syllabus

Benzene and its derivatives: Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule, Reactions of benzene - nitration, sulphonation, halogenation- reactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction, Structure and uses of DDT, Saccharin, BHC and Chloramine

Phenols* - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols. **Aromatic Amines*** - Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts. **Aromatic Acids*** –Acidity, effect of substituents on acidity and important reactions of benzoic acid.

Fats and Oils: Fatty acids – reactions. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.

Polynuclear hydrocarbons: Synthesis, reactions. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives. **Cyclo alkanes*:** Stabilities – Baeyer's strain theory, limitation of Baeyer's straintheory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only.

Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

II/IV B. Pharmacy Odd Semester
20PY2113P - PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Apply the knowledge to synthesize various organic compounds	1,2	2,3

Syllabus:

- 1 **Experiments involving laboratory techniques:** Recrystallization & Steam distillation
- 2 **Determination of following oil values (including standardization of reagents)**
Acid value, Saponification value & Iodine value
- 3 **Preparation of compounds:**
 - a. Benzanilide/Phenyl benzoate/Acetanilide from Aniline/Phenol/Aniline by acylation reaction.
 - b. 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/
 - c. Acetanilide by halogenation (Bromination) reaction.
 - d. 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.
 - e. Benzoic acid from Benzyl chloride by oxidation reaction.
 - f. Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
 - g. 1-Phenyl azo-2-naphthol from Aniline by diazotization and coupling reactions.
 - h. Benzil from Benzoin by oxidation reaction.
 - i. Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction
 - j. Cinnamic acid from Benzaldehyde by Perkin reaction
 - k. *P*-Iodo benzoic acid from *P*-amino benzoic acid

II/IV B. Pharmacy Odd Semester 20PY2114T - PHYSICAL PHARMACEUTICS-I (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the principles of physical chemistry in pharmaceutical technology	1,4	1,2
CO2	Understand various physicochemical properties of drug molecules in the designing the dosage forms	1,4	1,2
CO3	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations	1,4	1,2
CO4	Understand the use of physicochemical properties in the formulation development and evaluation of dosage forms.	1,4	1,2

Study the physical and chemical properties of drug molecules like solubility, states of matter, surface, interfacial phenomenon, complexation, protein binding, pH, buffers and isotonicity used for designing the dosage forms.

Syllabus

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its

limitations and applications

States of Matter and properties of matter: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols– inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid- crystalline, amorphous & polymorphism. **Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications

Surface and interfacial phenomenon: Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.

Complexation and protein binding: Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants. pH, buffers and Isotonic solutions: Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C and ManavalanR.
8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

**II/IV B. Pharmacy Odd Semester
20PY2114P - PHYSICAL PHARMACEUTICS – I (Practical)**

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.	1,2	2,3

Syllabus:

- 1 Determination the solubility of drug at room temperature
- 2 Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
- 3 Determination of Partition co- efficient of benzoic acid in benzene and water
- 4 Determination of Partition co- efficient of Iodine in CCl₄ and water
- 5 Determination of % composition of NaCl in a solution using phenol-water system by CST method
- 6 Determination of surface tension of given liquids by drop count and drop weight method

- 7 Determination of HLB number of a surfactant by saponification method
- 8 Determination of Freundlich and Langmuir constants using activated char coal
- 9 Determination of critical micellar concentration of surfactants
- 10 Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
- 11 Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

II/IV B. Pharmacy Odd Semester
20PY2115T - PHARMACEUTICAL MICROBIOLOGY (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand methods of identification, cultivation and preservation of various microorganisms	1,4	1,2
CO2	understand the importance and implementation of contrast option in pharmaceutical processing and industry	1,4	1,2
CO3	Learn sterility testing of pharmaceutical products.	1,4	1,2
CO4	Understand microbiological standardization of Pharmaceuticals.	1,4	1,2

Introduction to microbiology, Study of bacteria, sterilization techniques. Study of Fungi and Viruses. Disinfectants, antiseptics, Sterility testing, Microbiological assays, Standardization of antibiotics, vitamins and amino acids, Application of cell cultures in pharmaceutical industry and research.

Syllabus

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, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.

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. Equipment employed in large scale sterilization. Sterility indicators.

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. For bacteriostatic and bactericidal actions, Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic. Types of spoilage, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in

pharmaceutical industry and research.

Recommended Books (Latest edition)

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.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Pepler: Microbial Technology.
9. I.P., B.P., U.S.P.- latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

II/IV B. Pharmacy Odd Semester 20PY2115P – PHARMACEUTICAL MICROBIOLOGY (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Apply microbiological testing tools in pharmaceutical products.	1,2	2,3

Syllabus:

- 1 Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
- 2 Sterilization of glassware, preparation and sterilization of media.
- 3 Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
- 4 Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).
- 5 Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
- 6 Microbiological assay of antibiotics by cup plate method and other methods.
- 7 Motility determination by Hanging drop method.
- 8 Sterility testing of pharmaceuticals.
- 9 Bacteriological analysis of water.
- 10 Biochemical test

II/IV B. Pharmacy Odd Semester 20PY2116T – PHARMACEUTICAL ENGINEERING (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	To know various unit operations used in Pharmaceutical industries.	1,4	1,2
CO2	understand the material handling techniques.	1,4	1,2
CO3	Understand various processes involved in pharmaceutical manufacturing process.	1,4	1,2
CO4	Acquire knowledge on operation of pharmaceutical manufacturing equipment	1,4	1,2

Flow of fluids, size reduction, size separation, heat transfer, Evaporation, Distillation, Drying, Distillation, drying, mixing, filtration, centrifugation, material plant construction.

Syllabus

Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer. **Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill. **Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank. **Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. **Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator. **Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation.

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer. **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter. **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge. **Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

Recommended Books: (Latest Editions)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering – McCabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.

7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

II/IV B. Pharmacy Odd Semester
20PY2116P - PHARMACEUTICAL ENGINEERING (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Demonstrate the ability to use and operate pharmaceutical manufacturing equipment	1,2	2,3

Syllabus:

- 1 Determination of radiation constant of brass, iron, unpainted and painted glass.
- 2 Steam distillation – To calculate the efficiency of steam distillation.
- 3 To determine the overall heat transfer coefficient by heat exchanger.
- 4 Construction of drying curves (for calcium carbonate and starch).
- 5 Determination of moisture content and loss on drying.
- 6 Determination of humidity of air – i) from wet and dry bulb temperatures –use of Dew point method.
- 7 Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
- 8 Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of varioussize frequency curves including, arithmetic and logarithmic probability plots.
- 9 Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
- 10 Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
- 11 Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity
- 12 To study the effect of time on the Rate of Crystallization.
- 13 To calculate the uniformity Index for given sample by using Double Cone Blender.

II/IV B. Pharmacy Odd Semester
20UC2103: PROFESSIONAL COMMUNICATION SKILLS (Theory)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Able to spot the common grammatical errors related to Sentence Structure, Preposition, Concord, Relative and Conditional Clauses, and Parallel Structures. The learner should be efficient to construct a context-determined text in addition to learning	9,10	3

	Technical Writing Skills. One should be enabled to use English Language efficiently in the written medium to communicate Personal as well as Professional.		
CO2	Able to read, understand, and interpret a text intrinsically as well as extrinsically. The learner can browse a text quickly to come-up with a gist and personal interpretation. One is able to create a healthy work-environment and prove to be an asset or one of the most reliable resources to the Organization. As a professional, one is mature to bridge the gulf between the existing behavior/lifestyle and the expected corporate behaviour cum lifestyle.	8	4
CO3	Apply the concepts of Time and Work, the students will be able to solve the questions related to Men-Time-Work, problems based on wages, pipes and cisterns. Apply the concepts of Time and Distance and solve the problems related to average speed, relative speed, problems based on trains, boats, circular tracks, races and games.	1	3
CO4	Apply Venn diagrams to the given statements to find out whether the given conclusions can be deduced from the given statements. Apply the logical implications and also the negations of various connectives to find the solutions. Analyze the given data and representing the data in the form of Venn Diagrams to find relations between any given set of elements.	1,5	3

Grammar and Usage, Writing Skills, Reading Comprehension, Soft Skills, Quantitative Aptitude

Syllabus

Grammar and Usage: Error Analysis. **Writing Skills:** Topic sentence, Linkers, Connectors and Transition, Paragraph Writing, Letter Writing

Reading Comprehension: Techniques, Skimming and Scanning, Vertical Reading, Reading Perception Tests (RPT): (Graphic) Reading Perception Tests (RPT), Semantic Interpretation of the Text, Reading Speed Enhancement. **Soft Skills:** Interpersonal Skills, Adjusting Your Attitude-Arrogance has no Place in the Workplace, Cultural Sensitivity in the Workplace, Corporate Culture: Learning How to Fit In.

Quantitative Aptitude: Time and Work, Time and Distance. **Reasoning:** Deductions, Logical Connectives, Venn Diagrams

Reference Books:

1. Gajendra Singh Chauhan and Smita Kashiramka. Technical Communication. Delhi: Cengage Learning India. 2018.
2. Andrea Penruddocke and Christopher A. Warnasch. English for the Real World. USA: Living Language. 2004
3. Gerald J. Alfred, Charles T. Brusaw and Walter E. Oliu. *Hand Book of Technical Writing*. USA: Bedford. 2000.
4. Asher Cashdan: *Language, Reading and Learning*. Oxford: Basil Blackwell. 1979.

II/IV B. Pharmacy Even Semester

20PY2217T - PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours: 4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
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CO1	understand the methods of preparation and properties of organic compounds	1,4	1,2
CO2	Understand the stereo chemical aspects of organic compounds and stereo chemical reactions	1,4	1,2
CO3	know the medicinal uses and other applications of organic compounds	1,4	1,2
CO4	Introduce to asymmetric synthesis	1,4	1,2

Stereo isomerism, Heterocyclic compounds, Reactions of synthetic importance.

Syllabus

Stereo isomerism: Optical isomerism – Optical activity, enantiomerism, diastereo-isomerism, meso compounds Elements of symmetry, chiral and achiral molecules, DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers. Reactions of chiral molecules. Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute. Geometrical isomerism: Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions.

Heterocyclic compounds: Nomenclature and classification, Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene. Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene

Synthesis, reactions and medicinal uses of following compounds/derivatives, Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives. **Reactions of synthetic importance:** Metal hydride reduction (NaBH_4 and LiAlH_4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation.

Recommended Books (Latest Editions)

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
3. Heterocyclic Chemistry by Raj K. Bansal
4. Organic Chemistry by Morrison and Boyd
5. Heterocyclic Chemistry by T.L. Gilchrist

II/IV B. Pharmacy Even Semester 20PY2218T - MEDICINAL CHEMISTRY – I (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	understand the chemistry of drugs with respect to their pharmacological activity	1,4	1,2
CO2	Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs	1,4	1,2
CO3	know the Structural Activity Relationship (SAR) of different class of drugs	1,4	1,2
CO4	write the chemical synthesis of some drugs	1,4	1,2

Preparation of drugs/ intermediates: 1,3-pyrazole, 1,3-oxazole, Benzimidazole, Benzotriazole, 2,3-

diphenyl quinoxaline, Benzocaine, Phenytoin, Phenothiazine & Barbiturate. Assay of drugs: Chlorpromazine, Phenobarbitone, Atropine, Ibuprofen, Aspirin & Furosemide Determination of Partition coefficient for any two drugs.

Syllabus

Introduction to Medicinal Chemistry: History and development of medicinal chemistry Physicochemical properties in relation to biological action, Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism. **Drug metabolism:** Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.

Drugs acting on Autonomic Nervous System: Adrenergic Neurotransmitters: Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution. **Sympathomimetic agents: SAR of Sympathomimetic agents:** Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. Indirect acting agents: Hydroxy-amphetamine, Pseudoephedrine, Propylhexedrine. Agents with mixed mechanism: Ephedrine, Metaraminol. **Adrenergic Antagonists: Alpha adrenergic blockers:** Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide. **Beta adrenergic blockers:** SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

Cholinergic neurotransmitters: Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution. **Parasympathomimetic agents: SAR of Parasympathomimetic agents Direct acting agents:** Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine. **Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):** Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium, Tacrine, Ambenonium, Isoflurophate, Echothiophate iodide, Parathione, Malathion. **Cholinesterase reactivator:** Pralidoxime chloride. **Cholinergic Blocking agents: SAR of cholinolytic agents Solanaceous alkaloids and analogues:** Atropine, Hyoscyamine, Scopolamine, Homatropine, Ipratropium bromide*. **Synthetic cholinergic blocking agents:** Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

Drugs acting on Central Nervous System: Sedatives & Hypnotics: Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem **Barbiturates:** SAR of barbiturates, Barbitol*, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Pentobarbital, Secobarbital **Miscellaneous:** Amides & imides: Glutethimide. Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde. **Antipsychotics: Phenothiazines:** SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. **Ring Analogues of Phenothiazines:** Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. **Fluorobuteroenones:** Haloperidol, Droperidol, Risperidone. **Beta amino ketones:** Molindone hydrochloride. **Benzamides:** Sulpieride. **Anticonvulsants:** SAR of Anticonvulsants, mechanism of anticonvulsant action **Barbiturates:** Phenobarbitone, Methabarbitol. **Hydantoin:** Phenytoin*, Mephentyoin, Ethotoin **Oxazolindione diones:** Trimethadione, Paramethadione **Succinimides:** Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas:** Phenacemide, Carbamazepine* **Benzodiazepines:** Clonazepam. **Miscellaneous:** Primidone, Valproic acid, Gabapentin, Felbamate. **General anesthetics: Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. **Ultra short acting barbiturates:** Methohexital sodium*, Thiethyl sodium, Thiopental sodium. **Dissociative anesthetics:** Ketamine hydrochloride.* **Narcotic and non-narcotic analgesics: Morphine and related drugs:** SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anileridine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate. **Narcotic antagonists:** Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride. **Anti-inflammatory agents:** Sodium

salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

II/IV B. Pharmacy Even Semester 20PY2218P - MEDICINAL CHEMISTRY – I (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Perform chemical synthesis of some drugs	1,2	2,3

Syllabus:

- 1 **Preparation of drugs/ intermediates:** 1,3-pyrazole, 1,3-oxazole, Benzimidazole, Benzotriazole, 2,3- diphenyl quinoxaline, Benzocaine, Phenytoin, Phenothiazine & Barbiturate
- 2 **Assay of drugs: Chlorpromazine, Phenobarbitone, Atropine, Ibuprofen, Aspirin & Furosemide**
- 3 **Determination of Partition coefficient for any two drugs**

II/IV B. Pharmacy Even Semester 20PY2219T - PHYSICAL PHARMACEUTICS-II (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the principles of physical chemistry in pharmaceutical technology	1,4	1,2
CO2	Understand various physicochemical properties of drug molecules in the designing the dosage forms	1,4	1,2
CO3	Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations	1,4	1,2
CO4	Understand the use of physicochemical properties in the formulation development and evaluation of dosage forms.	1,4	1,2

Colloidal and coarse dispersions, rheology, micromeretics and stability of the pharmaceutical product.

Syllabus

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action.

Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers. **Deformation of solids:** Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus.

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method

Micromeritics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin, Sixth edition
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C, and Manavalan R.

II/IV B. Pharmacy Even Semester 20PY2219P - PHYSICAL PHARMACEUTICS- II (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.	1,2	2,3

Syllabus:

- 1 Determination of particle size, particle size distribution using sieving method
- 2 Determination of particle size, particle size distribution using Microscopic method
- 3 Determination of bulk density, true density and porosity
- 4 Determine the angle of repose and influence of lubricant on angle of repose
- 5 Determination of viscosity of liquid using Ostwald's viscometer

- 6 Determination sedimentation volume with effect of different suspending agent
- 7 Determination sedimentation volume with effect of different concentration of single suspending agent
- 8 Determination of viscosity of semisolid by using Brookfield viscometer
- 9 Determination of reaction rate constant first order.
- 10 Determination of reaction rate constant second order
- 11 Accelerated stability studies

**II/IV B. Pharmacy Even Semester
20PY2220T - PHARMACOLOGY-I (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the pharmacological actions of different categories of drugs	1,4	1,2
CO2	Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.	1,4	1,2
CO3	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.	1,4	1,2
CO4	Understand the effect of drugs on physiological systems	1,4	1,2

General Pharmacology, Pharmacokinetics, Pharmacodynamics, Drug interactions, Pharmacology of drugs acting on peripheral nervous system and central nervous system.

Syllabus

General Pharmacology: Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and noncompetitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination

General Pharmacology: Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action. Adverse drug reactions. Drug interactions (pharmacokinetic and pharmacodynamic). Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

Pharmacology of drugs acting on peripheral nervous system: Organization and function of ANS. b. Neurohumoral transmission, co-transmission and classification of neuro transmitters. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anesthetic agents. Drugs used in myasthenia gravis and glaucoma

Pharmacology of drugs acting on central nervous system: Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. General anesthetics and pre-anesthetics. Sedatives, hypnotics and centrally acting muscle relaxants. Anti-epileptics, Alcohols and disulfiram, Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. Drugs used in Parkinsons disease and Alzheimer’s disease. CNS stimulants and nootropics. Opioid analgesics and

antagonists, Drug addiction, drug abuse, tolerance and dependence.

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rangand Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6. K.D. Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert,
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan,

II/IV B. Pharmacy Even Semester 20PY2220P - PHARMACOLOGY-I (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Observe the effect of drugs on animals by simulated experiments	1,2	2,3

Syllabus:

- 1 Introduction to experimental pharmacology.
- 2 Commonly used instruments in experimental pharmacology.
- 3 Study of common laboratory animals.

- 4 Maintenance of laboratory animals as per CPCSEA guidelines
- 5 Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
- 6 Study of different routes of drugs administration in mice/rats.
- 7 Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
- 8 Effect of drugs on ciliary motility of frog oesophagus
- 9 Effect of drugs on rabbit eye.
- 10 Effects of skeletal muscle relaxants using rota-rod apparatus.
- 11 Effect of drugs on locomotor activity using actophotometer.
- 12 Anticonvulsant effect of drugs by MES and PTZ method
- 13 Study of stereotype and anti-catatonic activity of drugs on rats/mice.
- 14 Study of anxiolytic activity of drugs using rats/mice.
- 15 Study of local anesthetics by different methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

II/IV B. Pharmacy Even Semester 20PY2221T - PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	to know the techniques in the cultivation and production of crude drugs	1,4	1,2
CO2	to know the crude drugs, their uses and chemical nature	1,4	1,2
CO3	know the evaluation techniques for the herbal drugs	1,4	1,2
CO4	Understand the microscopic and morphological features of crude drugs	1,4	1,2

Introduction to Pharmacognosy, Classification of drugs, Quality control of Drugs of Natural Origin, Cultivation, Collection, Processing and storage of drugs of natural origin, Conservation of medicinal plants Plant tissue culture, Pharmacognosy in various systems of medicine, Introduction to secondary metabolites, Plant Products, Primary metabolites, Carbohydrates, Proteins and Enzymes, Lipids(Waxes, fats, fixed oils), Marine Drugs.

Syllabus

Introduction to Pharmacognosy: Definition, history, scope and development of Pharmacognosy Sources of Drugs – Plants, Animals, Marine & Tissue culture. Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).

Classification of drugs: Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs. **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

Cultivation, Collection, Processing and storage of drugs of natural origin: Cultivation and Collection of drugs of natural origin Factors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants

Conservation of medicinal plants Plant tissue culture: Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines

Pharmacognosy in various systems of medicine: Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. **Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs. **Plant Products:** Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens.

Primary metabolites: General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: **Carbohydrates:** Acacia, Agar, Tragacanth, Honey **Proteins and Enzymes :** Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).

Lipids (Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax. **Marine Drugs:** Novel medicinal agents from marine sources

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers& Distribution, New Delhi.

- Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
- Herbal drug industry by R.D. Choudhary (1996), 1st Edn, Eastern Publisher, New Delhi.
- Essentials of Pharmacognosy, Dr.SH.Ansari, 2nd edition, Birla publications, New Delhi, 2007
- Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
- Anatomy of Crude Drugs by M.A. Iyengar

II/IV B. Pharmacy Even Semester
20PY2221P - PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Perform the microscopic experiments and morphological evaluation of crude drugs	1,2	2,3

Syllabus:

- Analysis of crude drugs by chemical tests: (i) Tragacanth (ii) Acacia (iii) Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil
- Determination of stomatal number and index
- Determination of vein islet number, vein islet termination and palisade ratio.
- Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
- Determination of Fiber length and width
- Determination of number of starch grains by Lycopodium spore method
- Determination of Ash value
- Determination of Extractive values of crude drugs
- Determination of moisture content of crude drugs
- Determination of swelling index and foaming

II/IV B. Pharmacy Even Semester
20UC2204- CORPORATE COMMUNICATION SKILLS

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

III/IV B. Pharmacy Odd Semester
20PY3122T - MEDICINAL CHEMISTRY II (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	understand the chemistry of drugs with respect to their pharmacological activity	1,4	1,2
CO2	understand the drug metabolic pathways, adverse effect and therapeutic value of drugs	1,4	1,2
CO3	know the Structural Activity Relationship (SAR) of different	1,4	1,2

	class of drugs		
CO4	write the chemical synthesis of some drugs	1,4	1,2

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs, Structure activity relationship of selective class of drugs and synthesis of some important drugs. Antihistaminic agents, Gastric Proton pump inhibitors, Anti-neoplastic agents. Anti-anginal: Vasodilators, Diuretics, Anti-hypertensive Agents. Anti-arrhythmic Drugs, Anti-hyper-lipidemic agents, Coagulant & Anticoagulants, Drugs used in Congestive Heart Failure, Drugs acting on Endocrine system, Oral contraceptives, Corticosteroids, Thyroid and antithyroid drugs. Antidiabetic agents, Local Anesthetics.

Syllabus

Antihistaminic agents: Histamine, receptors and their distribution in the human body. **H1-antagonists:** Diphenhydramine* Dimenhydrinate, Doxylamine, Clemastine, Diphenyl-phthaline, Tripelenamine, Chlorcyclizine, Meclizine, Buclizine, Chlorpheniramine, Triprolidine*, Phenidamine, Promethazine*, Trimeprazine, Cyproheptadine, Azatidine, Astemizole, Loratadine, Cetirizine, Levocetazine Cromolynsodium. **H2-antagonists:** Cimetidine*, Famotidine, Ranitidin. **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole. **Anti-neoplastic agents:** **Alkylating agents:** Meclorothamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepea, **Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine. **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin, **Plant products:** Etoposide, Vinblastin sulphate, Vincristin sulphate

Miscellaneous: Cisplatin, Mitotane.

Anti-anginal: Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole. **Calciumchannelblockers:** Verapamil, Bepridil, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. **Diuretics:** Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorophenamide. **Thiazides:** Chlorthiazide*, Hydrochlorothiazide, Hydroflume-thiazide, Cyclothiazide, **Loop diuretics:** Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol. **Anti-hypertensive Agents:** Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazinehydrochloride.

Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcaïnide hydrochloride, Amiodarone, Sotalol. **Anti-hyper-lipidemic agents:** Clofibrate, Lovastatin, Cholesteramine and Cholestipol. **Coagulant & Anticoagulants:** Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel. **Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan. **Drugs acting on Endocrine system:** Nomenclature, Stereochemistry and metabolism of steroids. **Sex hormones:** Testosterone, Nandralone, Progesterones, Oestriol, Oestradiol, Oestrone, Diethyl stilbestrol. **Drugs for erectile dysfunction:** Sildenafil, Tadalafil. **Oral contraceptives:** Mifepristone, Norgestrel, Levonorgestrol, **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone. **Thyroid and antithyroid drugs:** L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

Antidiabetic agents: **Insulin and its preparations, Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acarbose, Voglibose. Local Anesthetics: SAR of Local anesthetics, Benzoic Acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine. Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate. Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine. Miscellaneous: Phenacaine, Dipiperodon, and Dibucaine.***

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. I to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

III/IV B. Pharmacy Odd Semester 20PY3123T: Industrial Pharmacy-I (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours: 4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Know the design and layout of various procedures in pharmaceutical industry	1,4	1,2
CO2	Know the various pharmaceutical dosage forms and their manufacturing techniques.	1,4	1,2
CO3	Know various considerations in development of pharmaceutical dosage forms	1,4	1,2
CO4	Understand the quality control of solid, liquid and semisolid dosage forms	1,4	1,2

Preformulation Studies, BCS classification of drugs, Tablets, Tablet coating, Liquid orals, Hard gelatin capsules, Soft gelatin capsules, Pellets, Parenteral Products, Ophthalmic Preparations, Cosmetics, Pharmaceutical Aerosols, Packaging Materials Science.

Syllabus

Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. **Physical properties:** Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism. **Chemical Properties:** Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant. Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

Tablets: Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipment and tablet tooling. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. Quality control tests: In process and finished product tests. **Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia **Capsules:** **Hard gelatin capsules:** Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. **Soft gelatin capsules:** Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications. **Pellets:** Introduction, formulation

requirements, pelletization process, equipment for manufacture of pellets

Parenteral Products: Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity, Production procedure, production facilities and controls, aseptic processing, Formulation of injections, sterile powders, large volume parenterals and lyophilized products. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products. **Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

Cosmetics: Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens. **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies. **Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

Recommended Books: (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J.B. Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
7. Pharmaceutics- The science of dosage form design by M.E. Aulton, Churchill Livingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea & Febiger, Philadelphia, 5th edition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

III/IV B. Pharmacy Odd Semester 20PY3123P - Industrial Pharmacy-I (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours: 4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality	1	2,3

Syllabus

1. Preformulation studies on paracetamol/aspirin/or any other drug
2. Preparation and evaluation of Paracetamol tablets
3. Preparation and evaluation of Aspirin tablets
4. Coating of tablets- film coating of tablets/granules
5. Preparation and evaluation of Tetracycline capsules
6. Preparation of Calcium Gluconate injection
7. Preparation of Ascorbic Acid injection
8. Quality control test of (as per IP) marketed tablets and capsules
9. Preparation of Eye drops/ and Eye ointments
10. Preparation of Creams (cold / vanishing cream)
11. Evaluation of Glass containers (as per IP)

III/IV B. Pharmacy Odd Semester 20PY3124T - PHARMACOLOGY-II (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours: 4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the mechanism of drug action and its relevance in the treatment of different diseases	1,4	1,2
CO2	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.	1,4	1,2
CO3	Understand the effect of drugs on physiological systems	1,4	1,2
CO4	Appreciate correlation of pharmacology with related medical sciences	1,4	1,2

Pharmacology of drugs acting on cardiovascular system, urinary system, endocrine system, Autocoids and related drugs,

Syllabus

Pharmacology of drugs acting on cardiovascular system: Introduction to hemodynamic and electrophysiology of heart. Drugs used in congestive heart failure Anti-hypertensive drugs. Anti-anginal drugs. Anti-arrhythmic drugs. Anti-hyperlipidemic drugs.

Pharmacology of drugs acting on cardiovascular system: Drug used in the therapy of shock. Hematinics, coagulants and anticoagulants. Fibrinolytics and anti-platelet drugs. Plasma volume expanders. **Pharmacology of drugs acting on urinary system:** Diuretics, Anti-diuretics. **Autocoids and related drugs:** Introduction to autocoids and classification, Histamine, 5-HT and their antagonists. Prostaglandins, Thromboxanes and Leukotrienes. Angiotensin, Bradykinin and Substance P. Non-steroidal anti-inflammatory agents, Anti-gout drugs, Antirheumatic drugs

Pharmacology of drugs acting on endocrine system: Basic concepts in endocrine pharmacology., Anterior Pituitary hormones- analogues and their inhibitors. Thyroid hormones- analogues and their inhibitors. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D. Insulin, Oral Hypoglycemic agents and glucagon. ACTH and corticosteroids.

Pharmacology of drugs acting on endocrine system: Androgens and Anabolic steroids. Estrogens, progesterone and oral contraceptives. Drugs acting on the uterus. **Bioassay:** Principles and applications of bioassay. b. Types of bioassay Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert.
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan

III/IV B. Pharmacy Odd Semester 20PY3124P - PHARMACOLOGY-II (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Perform various invitro experiments to demonstrate receptor actions using isolated tissue preparation	1	2,3

Syllabus

1. Introduction to in-vitro pharmacology and physiological salt solutions.
2. Effect of drugs on isolated frog heart.
3. Effect of drugs on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DRC of acetylcholine using frog rectus abdominis muscle.
6. Effect of physostigmine and atropine on DRC of acetylcholine using frogrectus abdominis muscle and rat ileum respectively.
7. Bioassay of histamine using guinea pig ileum bymatching method.
8. Bioassay of oxytocin using rat uterine horn by interpolationmethod.
9. Bioassay of serotonin using rat fundus strip bythree point bioassay.
10. Bioassay of acetylcholine using rat ileum/colon by four pointbioassay.
11. Determination of PA₂ value of prazosin using rat anococcygeus muscle (by Schilds plot method).
12. Determination of PD₂ value using guinea pigileum.
13. Effect of spasmogens and spasmolytics using rabbit jejunum.
14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.
15. Analgesic activity of drug using central and peripheral methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

III/IV B. Pharmacy Odd Semester 20PY3125T - PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	To know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents	1,4	1,2
CO2	to understand the preparation and development of herbal formulation.	1,4	1,2
CO3	to understand the herbal drug interactions	1,4	1,2
CO4	Understand the isolation procedures and identification of phytoconstituents	1,4	1,2

Metabolic pathways in higher plants and their determination, Alkaloids, Phenylpropanoids and Flavonoids, Steroids, Cardiac Glycosides & Triterpenoids, Volatile oils, Tannins, Resins, Glycosides, Iridoids, Other terpenoids & Naphthaquinones, Basics of Phytochemistry

Syllabus

Metabolic pathways in higher plants and their determination: Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites: **Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium, **Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta **Steroids, Cardiac Glycosides & Triterpenoids:** Liquorice, Dioscorea, Digitalis **Volatile oils:** Mentha, Clove, Cinnamon, Fennel, Coriander, **Tannins:** Catechu, Pterocarpus **Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh,

Colophony **Glycosides:** Senna, Aloes, Bitter Almond **Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids

Isolation, Identification and Analysis of Phytoconstituents: Terpenoids: Menthol, Citral, Artemisin, Glycosides: Glycyrrhetic acid & Rutin Alkaloids: Atropine, Quinine, Reserpine, Caffeine, Resins: Podophyllotoxin, Curcumin.

Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine **Basics of Phytochemistry:** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers& Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), 1st Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

III/IV B. Pharmacy Odd Semester

20PY3125P - PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	To carryout isolation and identification of phytoconstituents	1	2,3

Syllabus

1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander
2. Exercise involving isolation & detection of active principles
 - a. Caffeine - from tea dust.
 - b. Diosgenin from Dioscorea
 - c. Atropine from Belladonna
 - d. Sennosides from Senna
3. Separation of sugars by Paper chromatography
4. TLC of herbal extract
5. Distillation of volatile oils and detection of phytoconstituents by TLC
6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh
7. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander
8. Exercise involving isolation & detection of active principles

- a. Caffeine - from tea dust.

Recommended books: (Latest Edition)

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-by M.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publication
9. Bare Acts of the said laws published by Government.

**III/IV B. Pharmacy Odd Semester
20PY3126T - PHARMACEUTICAL JURISPRUDENCE (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours: 4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.	1,4	1,2
CO2	Various Indian pharmaceutical Acts and Laws	1,4	1,2
CO3	The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals	1,4	1,2
CO4	The code of ethics during the pharmaceutical practice	1,4	1,2

Detailed study of Objectives, definitions, rules of drug and cosmetics act (1940), Pharmacy act (1948), medicinal and toilet preparation act(1955),narcotic drugs and psychotropic act (1985), Drugs and Magic Remedies Act, Prevention of Cruelty to animals Act-1960, National Pharmaceutical Pricing Authority, Pharmaceutical Legislations, Medical Termination of Pregnancy Act, Right to Information Act and introduction to code of ethics, intellectual property act.

Syllabus

Drugs and Cosmetics Act, 1940 and its rules 1945: Objectives, Definitions, Legal definitions of schedules to the Act and Rules, Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties. Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license

Drugs and Cosmetics Act, 1940 and its rules 1945. Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties, Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties. Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors
Pharmacy Act –1948: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and penalties. **Medicinal and Toilet Preparation Act –1955:** Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences

and Penalties. **Narcotic Drugs and Psychotropic substances Act-1985 and Rules:** Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties

Study of Salient Features of Drugs and Magic Remedies Act and its rules: Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties.

Prevention of Cruelty to animals Act-1960: Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties. **National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO)- 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM).

Pharmaceutical Legislations – A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee. **Code of Pharmaceutical ethics** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath. Medical Termination of Pregnancy Act. **Right to Information Act. Introduction to Intellectual Property Rights (IPR)**

III/IV B. Pharmacy Odd Semester 20UC3005 – APTITUDE BUILDER (Theory)

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the strategies and techniques for conversations in different contexts. Analyze the different parameters and formats of written technical communication and apply in everyday work and life.	8	3
CO2	Analyze the concepts of critical and analytical reading skills. Apply the strategies and techniques learnt in handling interviews in different contexts.	8	3
CO3	Apply the concepts of Ratio & Proportion, Percentages, Profit & Loss, Simple & Compound Interest	1,5	3
CO4	Analyze the series of numbers or letters to predict the next number in the series or to find the analogy. Analyze the data to find the codes in the process of encoding and decoding. Apply the given set of conditions to select a team from a group of members.	1	4

Critical Reading, Writing Skills, Trinity Guild Hall, Quantitative Aptitude, Reasoning

Syllabus:

Critical Reading: Reading to Identify the Theme, Reading to Identify the Central Idea; Reading to Identify the Tone, Reading to Identify Writer's Attitude, Reading to Identify Parallel Ideas, Reading to Identify Logical Conclusions.

Writing Skills: Note- making and Note- taking, Report Writing.

Presentation Skills- Preparing for the Presentation, Audience Analysis, Processing Information, Ice-breakers, Quotations, Presentation Structure, Say what you want to say- Say it, Say what you have said to say, Preparing for Question Hour, Funnel Effect and How to Overcome it.

Trinity Guild Hall - Communication Skills - Graded Evaluation and Testing-1-8 grades

Quantitative Aptitude: Ratio and Proportion, Percentages, Profit and Loss, Simple Interest and Compound Interest

Reasoning: Number and Letter Series, Number and Letter Analogy, Coding and decoding, Odd man out. Selections

Reference Books:

1. Dr. Meenakshi Raman and Dr. Sangeetha Sarma: *Technical Communication*. Oxford University Press: Delhi. 2016.
2. M. Ashraf Rizvi: *Effective Technical Communication*. New Delhi: McGraw Hill Education (India) Private Limited
3. Tom Rath: *Strengths Finder 2.0*. New York: Gallup Press. 2007.
4. C. Weaver. *Reading Process and Practice*. Portsmouth US: Heinemann Educational Books. 1988.

**III/IV B. Pharmacy Even Semester
20PY3227T - MEDICINAL CHEMISTRY – III (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours: 4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO1	Understand the importance of drug design and different techniques of drug design.	1,4	1,2
CO2	Understand the chemistry of drugs with respect to their biological activity.	1,4	1,2
CO3	Know the metabolism, adverse effects & therapeutic value of drugs.	1,4	1,2
CO4	Know the importance of SAR of drugs.	1,4	1,2

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs, Structure activity relationship of selective class of drugs and synthesis of some important drugs. Antibiotics, β -Lactam antibiotics, Aminoglycosides, Tetracyclines.

Macrolide, Miscellaneous, Prodrugs, Antimalarials. Anti-tubercular Agents: Synthetic anti tubercular agents. Urinary tract anti-infective agents: Antiviral agents. Antifungal agents, Anti-protozoal Agents, Anthelmintics, Sulphonamides and Sulfones, Folate reductase inhibitors, Introduction to Drug Design, Combinatorial Chemistry.

Syllabus

Antibiotics: Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **β -Lactam antibiotics:** Penicillin, Cephalosporins, β -Lactamase inhibitors, Monobactams **Aminoglycosides:** Streptomycin, Neomycin, Kanamycin, **Tetracyclines:** Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

Antibiotics: Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **Macrolide:** Erythromycin Clarithromycin, Azithromycin. **Miscellaneous:** Chloramphenicol*, Clindamycin.

Prodrugs: Basic concepts and application of prodrugs design. **Antimalarials:** Etiology of malaria.

Quinolines: SAR, Quinine, Primaquine, Chloroquine*, Amodiaquine, Pamaquine*, Quinacrine, Mefloquine. **Biguanides and dihydro triazines:** Cycloguanil pamoate, Proguanil. **Miscellaneous:** Pyrimethamine, Artesunate, Artemether, Atovaquone

Anti-tubercular Agents: Synthetic anti tubercular agents: Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.* **Antitubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycin, Capreomycin sulphate. Urinary tract anti-infective agents: **Quinolones:**

SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin, **Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine. Antiviral agents: Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine

trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

Antifungal agents: Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin. **Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*. **Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine. **Anthelmintics:** Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin. **Sulphonamides and Sulfones:** Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxazole*, Sulphadiazine, Mefenide acetate, Sulfasalazine. **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole. **Sulfones:** Dapsone*. Introduction to Drug Design: Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques. **Combinatorial Chemistry:** Concept and applications chemistry: solid phase and solution phase synthesis.

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

III/IV B. Pharmacy Even Semester 20PY3227P - MEDICINAL CHEMISTRY- III (Practical)

L-T-P/S: 0-0-4

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO	Perform synthesis and SAR of drugs.	1	2,3

Syllabus

- I Preparation of drugs and intermediates:** Sulphanilamide, 7-Hydroxy, 4-methyl coumarin, Chlorobutanol, Triphenyl imidazole, Tolbutamide & Hexamine
- II Assay of drugs:** Isonicotinic acid hydrazide, Chloroquine, Metronidazole, Dapsone, Chlorpheniramine maleate & Benzyl penicillin
- III Preparation of medicinally important compounds or intermediates by Microwave irradiation technique**
- IV Drawing structures and reactions using chem draw®**
- V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinski's RO5)**
- VI Preparation of medicinally important compounds or intermediates by Microwave irradiation technique**
- VII Drawing structures and reactions using chem draw®**

**III/IV B. Pharmacy Even Semester
20PY3228T - PHARMACOLOGY-III (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO1	understand the mechanism of drug action and its relevance in the treatment of different infectious diseases	1,4	1,2
CO2	comprehend the principles of toxicology and treatment of various poisonings and	1,4	1,2
CO3	appreciate correlation of pharmacology with related medical sciences.	1,4	1,2
CO4	To be able to ascertain the pharmacodynamics of medicinal agents	1,4	1,2

Pharmacology of drugs acting on Respiratory system, Chemotherapy, Immunopharmacology, Principles of toxicology, General principles of treatment of poisoning, Chrono-pharmacology.

Syllabus

Pharmacology of drugs acting on Respiratory system: Anti -asthmatic drugs, Drugs used in the management of COPD, Expectorants and antitussives, Nasal decongestants & Respiratory stimulants. Pharmacology of drugs acting on the Gastrointestinal Tract: Antiulcer agents. Drugs for constipation and diarrhoea. Appetite stimulants and suppressants. Digestants and carminatives. Emetics and anti-emetics.

Chemotherapy: General principles of chemotherapy. Sulfonamides and cotrimoxazole. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides, Antitubercular agents, Antileprotic agents, Antifungal agents, Antimalarial drugs & Antiamoebic agents.

Chemotherapy: Urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy. **Immunopharmacology:** Immunostimulants, Immunosuppressant, Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

Principles of toxicology: Definition and basic knowledge of acute, subacute and chronic toxicity. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity

General principles of treatment of poisoning, Clinical symptoms and management of barbiturates, morphine, organophosphorus compound and lead, mercury and arsenic poisoning. **Chrono-**

pharmacology: Definition of rhythm and cycles. Biological clock and their significance leading to chronotherapy.

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs. The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert,
8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,
9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,
10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

**III/IV B. Pharmacy Even Semester
20PY3228P - PHARMACOLOGY-III (Practical)**

L-T-P/S: 0-0-4

Credits: 2

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO	Perform various invitro experiments to demonstrate receptor actions using isolated tissue preparation	1	2,3

Syllabus

1. Dose calculation in pharmacological experiments
2. Antiallergic activity by mast cell stabilization assay
3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
4. Study of effect of drugs on gastrointestinal motility
5. Effect of agonist and antagonists on guinea pig ileum
6. Estimation of serum biochemical parameters by using semi-auto analyser
7. Effect of saline purgative on frog intestine
8. Insulin hypoglycemic effect in rabbit
9. Test for pyrogens (rabbit method)
10. Determination of acute oral toxicity (LD50) of a drug from a given data
11. Determination of acute skin irritation / corrosion of a test substance
12. Determination of acute eye irritation / corrosion of a test substance
13. Calculation of pharmacokinetic parameters from a given data
14. Biostatistics methods in experimental pharmacology (student's t test, ANOVA)
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

Note: *Experiments are demonstrated by simulated experiments/videos*

**III/IV B. Pharmacy Even Semester
20PY3229T - HERBAL DRUG TECHNOLOGY (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	understand raw material as source of herbal drugs from cultivation to herbal drug product	1,4	1,2
CO2	know the WHO and ICH guidelines for evaluation of herbal drugs	1,4	1,2
CO3	know the herbal cosmetics, natural sweeteners, nutraceuticals	1,4	1,2
CO4	appreciate patenting of herbal drugs, GMP .	1,4	1,2

Herbs as raw materials, Biodynamic Agriculture, Indian Systems of Medicine, Nutraceuticals, Herbal-Drug and Herb-Food Interactions, Herbal Cosmetics, Herbal excipients, Herbal formulations, Evaluation of Drugs, Patenting and Regulatory requirements of natural products, Regulatory Issues, Schedule T.

Syllabus

Herbs as raw materials: Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs, Selection, identification and authentication of herbal materials Processing of herbal raw material. **Biodynamic Agriculture:** Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides. **Indian Systems of Medicine:** Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy, Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma.

Nutraceuticals: General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastrointestinal diseases. Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina. **Herbal-Drug and Herb-Food Interactions:** General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

Herbal Cosmetics: Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products. **Herbal excipients:** Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. **Herbal formulations:** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. **Patenting and Regulatory requirements of natural products:** Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy, Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. **Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs. **General Introduction to Herbal Industry:** Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. **Schedule T – Good Manufacturing Practice of Indian systems of medicine:** Components of GMP (Schedule – T) and its objectives, Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.

Recommended Books: (Latest Editions)

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

III/IV B. Pharmacy Even Semester 20PY3229P - HERBAL DRUG TECHNOLOGY (Practical)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO	Preparation of various herbal formulations	1	2,3

Syllabus

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista
3. Evaluation of excipients of natural origin
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
6. Monograph analysis of herbal drugs from recent Pharmacopoeias
7. Determination of Aldehyde content
8. Determination of Phenol content
9. Determination of total alkaloids
10. To perform preliminary phytochemical screening of crude drugs.
11. Determination of the alcohol content of Asava and Arista
12. Evaluation of excipients of natural origin
13. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.

III/IV B. Pharmacy Even Semester
20PY3230T - BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.	1,4	1,2
CO2	Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.	1,4	1,2
CO3	To understand the concepts of bioavailability and bioequivalence of drug products and their significance.	1,4	1,2
CO4	Understand various pharmacokinetic parameters, their significance & applications.	1,4	1,2

Introduction to Biopharmaceutics, Absorption, Distribution, protein binding, Elimination, Bioavailability and Bioequivalence, Pharmacokinetics, Multicompartment models, Nonlinear Pharmacokinetics.

Syllabus

Introduction to Biopharmaceutics.

Absorption: Mechanisms of drug absorption through GIT, factors influencing drug absorption through GIT, absorption of drug from non per oral extra-vascular routes.

Distribution: Tissue permeability of drugs, binding of drugs, apparent volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, clinical significance of protein binding of drugs.

Elimination: Drug metabolism and basic understanding of metabolic pathways, renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, non-renal routes of drug excretion of drugs.

Bioavailability and Bioequivalence: Definition and objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlation, bioequivalence studies protocol, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

Pharmacokinetics: Definition and introduction to pharmacokinetics, compartment models, non-compartment models, physiological models.

One compartment open model. (a) Intravenous injection (Bolus) (b) Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - K_E , $t_{1/2}$, V_d , AUC, K_a , Cl_T and Cl_R : definitions, methods of eliminations, understanding of their significance and application.

Multicompartment models: Two compartment open model - IV bolus. Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

Clinical Pharmacokinetics: Dose adjustment in renal impaired patients

Recommended Books: (Latest Editions)

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari
3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition, Prentice-Hall International edition, USA
4. Bio pharmaceuticals and Pharmacokinetics-A Treatise, By D. M. Brahmankar . Jaiswal, Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: By Milo Gibaldi Donald, R. Merceel Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Biopharmaceutics; By Swarbrick
8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and
9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, Pennsylvania 1989.
11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Robert F Notari Marcel Dekker Inn, New York and Basel, 1987.
12. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvania

III/IV B. Pharmacy Even Semester
20PY3231T - PHARMACEUTICAL BIOTECHNOLOGY (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understanding the importance of Immobilized enzymes in Pharmaceutical Industries	1,4	1,2
CO2	Genetic engineering applications in relation to production of pharmaceuticals	1,4	1,2
CO3	Importance of Monoclonal antibodies in Industries	1,4	1,2
CO4	Appreciate the use of microorganisms in fermentation technology	1,4	1,2

Introduction to Biotechnology, Protein Engineering, cloning vectors, Recombinant DNA technology, Types of immunity, General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity, Immuno blotting techniques, Mutation, Fermentation methods, Blood Products.

Syllabus

Brief introduction to Biotechnology with reference to Pharmaceutical Sciences. Enzyme Biotechnology- Methods of enzyme immobilization and applications. Biosensors- Working and applications of biosensors in Pharmaceutical Industries. Brief introduction to Protein Engineering. Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. Basic principles of genetic engineering.

Study of cloning vectors, restriction endonucleases and DNA ligase. Recombinant DNA technology. Application of genetic engineering in medicine. Application of r DNA technology and genetic engineering in the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin. Brief introduction to PCR

Types of immunity- humoral immunity, cellular immunity, Structure of Immunoglobulins, Structure and Function of MHC, Hypersensitivity reactions, Immune stimulation and Immune suppressions. General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. Storage conditions and stability of official vaccines. Hybridoma technology- Production, Purification and Applications. Blood products and Plasma Substitutes.

Immuno blotting techniques- ELISA, Western blotting, Southern blotting. Genetic organization of Eukaryotes and Prokaryotes. Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. Introduction to Microbial biotransformation and applications. Mutation: Types of mutation/mutants. Fermentation methods and general requirements, study of media, equipment, sterilization methods, aeration process, stirring. Large scale production fermenter design and its various controls. Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin, Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.

Recommended Books (Latest edition):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
2. RA Goldshy et. al., : Kuby Immunology.
3. J.W. Goding: Monoclonal Antibodies.
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.
5. Zaborsky: Immobilized Enzymes, CRC Press, Degrland, Ohio.
6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.
7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

**III/IV B. Pharmacy Even Semester
20PY3232T - QUALITY ASSURANCE (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	understand the cGMP aspects in a pharmaceutical industry	1,4	1,2
CO2	appreciate the importance of documentation	1,4	1,2
CO3	understand the scope of quality certifications applicable to pharmaceutical industries	1,4	1,2
CO4	understand the responsibilities of QA & QC departments	1,4	1,2

Quality Assurance and Quality Management concepts: Total Quality Management (TQM), ICH Guidelines, Quality by design (QbD), ISO 9000 & ISO14000, NABL accreditation. Organization and personnel, Equipment and raw materials. Quality Control, Good Laboratory Practices, Complaints. Document maintenance in pharmaceutical industry, Calibration and Validation: Warehousing.

Syllabus

Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP. **Total Quality Management (TQM):** Definition, elements, philosophies. **ICH Guidelines:** purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines. **Quality by design (QbD):** Definition, overview, elements of QbD program, tools **ISO 9000 & ISO14000:** Overview, Benefits, Elements, steps for registration **NABL accreditation:** Principles and procedures **Organization and personnel:** Personnel responsibilities, training, hygiene and personal records. **Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. **Equipment and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials. **Quality Control:** Quality control test for containers, rubber closures and secondary packing materials. **Good Laboratory Practices:** General Provisions, Organization and Personnel,

Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities **Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.

Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records. **Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation. **Warehousing:** Good warehousing practice, materials management

Recommended Books: (Latest Edition)

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guidelines and Related materials Vol I WHO Publications.
4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P P Sharma.
6. ISO 9000 and Total Quality Management – Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices – Marcel Deckker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

**IV/IV B. Pharmacy Odd Semester
20PY4133T - INSTRUMENTAL METHODS OF ANALYSIS
(Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO1	Know about various instruments and standard operating procedures	1,4	1,2
CO2	Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis	1,4	1,2
CO3	Understand the chromatographic separation and analysis of drugs.	1,4	1,2
CO4	Understand the principle and application of advanced analytical instruments.	1,4	1,2

Analytical techniques, Spectroscopic and Chromatographic techniques. UV-Visible spectroscopy, Fluorimetry, IR spectroscopy, Flame Photometry, Atomic absorption spectroscopy, Nepheloturbidometry. Chromatographic techniques, Adsorption and partition column chromatography, Thin layer chromatography, Paper chromatography, Gas chromatography, High performance liquid chromatography, Ion exchange chromatography, Gel chromatography, Affinity chromatography and Electrophoresis techniques.

Syllabus

UV Visible spectroscopy: Electronic transitions, chromophores, auxochromes, spectral shifts, solvent

effect on absorption spectra, Beer and Lambert's law, Derivation and deviations. Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Applications - Spectrophotometric titrations, Single component and multi component analysis. Fluorimetry: Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications

IR spectroscopy: Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations. Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications. **Flame Photometry**-Principle, interferences, instrumentation and applications. **Atomic absorption spectroscopy**- Principle, interferences, instrumentation and applications. **Nepheloturbidometry**-Principle, instrumentation and applications

Introduction to chromatography: Adsorption and partition column chromatography-Methodology, advantages, disadvantages and applications. **Thin layer chromatography**- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications.

Paper chromatography-Introduction, methodology, development techniques, advantages, disadvantages and applications. **Electrophoresis**– Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications.

Gas chromatography- Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications. High performance liquid chromatography: Introduction, theory, instrumentation, advantages and applications. Ion exchange chromatography- Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications. Gel chromatography- Introduction, theory, instrumentation and applications

Affinity chromatography- Introduction, theory, instrumentation and applications

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K.Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

IV/IV B. Pharmacy Odd Semester

20PY4133P - INSTRUMENTAL METHODS OF ANALYSIS (Practical)

L-T-P/S: 0-0-4

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/ PSO	BTL
CO	Perform quantitative & qualitative analysis of drugs using various analytical instruments.	1	2,3

Syllabus

- 1 Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds
- 2 Estimation of dextrose by colorimetry
- 3 Estimation of sulfanilamide by colorimetry

- 4 Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy
- 5 Assay of paracetamol by UV- Spectrophotometry
- 6 Estimation of quinine sulfate by fluorimetry
- 7 Study of quenching of fluorescence
- 8 Determination of sodium by flame photometry
- 9 Determination of potassium by flame photometry
- 10 Determination of chlorides and sulphates by nephelo turbidometry
- 11 Separation of amino acids by paper chromatography
- 12 Separation of sugars by thin layer chromatography
- 13 Separation of plant pigments by column chromatography
- 14 Demonstration experiment on HPLC
- 15 Demonstration experiment on Gas Chromatography

IV/IV B. Pharmacy Odd Semester
20PY4134T - INDUSTRIAL PHARMACY-II (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Know the process of pilot plant and scale up of pharmaceutical dosage forms	1,4	1,2
CO2	Understand the process of technology transfer from lab scale to commercial batch	1,4	1,2
CO3	Know different Laws and Acts that regulate pharmaceutical industry	1,4	1,2
CO4	Understand the approval process and regulatory requirements for drug products	1,4	1,2

The process of pilot plant scale up of techniques of pharmaceutical dosage forms and the process of technology transfer from lab scale to commercial batch. Regulation of pharmaceutical industry, approval process, regulatory requirements for drug products, quality management and certifications pharmaceutical products.

Syllabus

Pilot plant scale up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology.

Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipment, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation -confidentiality agreement, licensing, MoUs, legal issues.

Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals. **Regulatory requirements for drug approval:** Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research

/ BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.

Quality management systems: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP.

Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.

Recommended Books: (Latest Editions)

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http://en.wikipedia.org/wiki/Regulatory_Affairs.
2. International Regulatory Affairs Updates, 2005. available at <http://www.iraup.com/about.php>
3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.
4. Regulatory Affairs brought by learning plus, inc. available at <http://www.cgmp.com/ra.htm>.

**IV/IV B. Pharmacy Odd Semester
20PY4135T - PHARMACY PRACTICE (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	know various drug distribution methods in a hospital	1,4	1,2
CO2	appreciate the pharmacy stores management and inventory control	1,4	1,2
CO3	monitor drug therapy of patient through medication chart review and clinical review	1,4	1,2
CO4	obtain medication history interview and counsel the patients	1,4	1,2

Hospital and its organization, Adverse drug reaction, Community Pharmacy, Drug distribution system in a hospital, Hospital formulary, Therapeutic drug monitoring, Medication adherence: Causes of medication non-adherence, pharmacist role in the Patient medication history interview, Pharmacy and therapeutic committee, Drug information services, Patient counseling, Prescribed medication order and communication skills, Budget preparation and implementation, Over the counter (OTC) sales, Investigational use of drugs, Interpretation of Clinical Laboratory Tests.

Syllabus

Hospital and its organization: Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions. Hospital pharmacy and its organization: Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists. Adverse drug reaction: Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management. Community Pharmacy: Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drugstore.

Drug distribution system in a hospital: Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs. Hospital formulary: Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary. Therapeutic drug monitoring: Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. Medication adherence: Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence. Patient medication history interview: Need for the patient medication history interview, medication interview forms. Community pharmacy management: Financial, materials, staff, and infrastructure requirements.

Pharmacy and therapeutic committee: Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation. Drug information services: Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information. Patient counseling: Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist. Education and training program in the hospital: Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

Prescribed medication order and communication skills: Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.

Budget preparation and implementation: Budget preparation and implementation: Clinical Pharmacy: Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern. Over the counter (OTC) sales: Introduction and sale of over the counter, and Rational use of common over the counter medications. Drug store management and inventory control. Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure. Investigational use of drugs: Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee. Interpretation of Clinical Laboratory Tests: Blood chemistry, hematology, and urinalysis.

Recommended Books (Latest Edition):

1. Merchant S.H. and Dr. J.S.Quadry. *A textbook of hospital pharmacy*, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. *A textbook of Clinical Pharmacy Practice-essential concepts and skills*, 1st ed. Chennai: Orient Longman Private Limited; 2004.
3. William E. Hassan. *Hospital pharmacy*, 5th ed. Philadelphia: Lea & Febiger; 1986.
4. Tipnis Bajaj. *Hospital Pharmacy*, 1st ed. Maharashtra: Career Publications; 2008.
5. Scott LT. *Basic skills in interpreting laboratory data*, 4th ed. American Society of Health System Pharmacists Inc; 2009.
6. Parmar N.S. *Health Education and Community Pharmacy*, 18th ed. India: CBS Publishers & Distributers; 2008.

Journals:

1. Therapeutic drug monitoring. ISSN: 0163-4356
2. Journal of pharmacy practice. ISSN: 0974-8326
3. American journal of health system pharmacy. ISSN: 1535-2900 (online)
4. Pharmacy times (Monthly magazine)

IV/IV B. Pharmacy Odd Semester
20PY4136T - NOVEL DRUG DELIVERY SYSTEMS (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Know about current developments in drug delivery technologies	1,4	1,2
CO2	To understand various approaches for development of novel drug delivery systems.	1,4	1,2
CO3	To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation.	1,4	1,2
CO4	To be able to design or recommend a drug delivery system	1,4	1,2

Various approaches for development of novel drug delivery systems like controlled drug delivery system, microencapsulation, mucosal drug delivery system, implantable drug delivery system, transdermal drug delivery system, nasopulmonary drug delivery system, gastroretentive drug delivery systems, targeted drug delivery, ocular drug delivery systems, intrauterine drug delivery systems.

Syllabus

Controlled drug delivery systems: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

Microencapsulation: Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications. **Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems.

Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implants and osmotic pump.

Transdermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches.

Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications.

Nasopulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers.

Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications. **Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts. **Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications.

Recommended Books: (Latest Editions)

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim

4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Journals

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian Drugs (IDMA)
3. Journal of Controlled Release (Elsevier Sciences)
4. Drug Development and Industrial Pharmacy (Marcel & Decker)
5. International Journal of Pharmaceutics (Elsevier Sciences)

IV/IV B. Pharmacy Odd Semester 20UC0010 – UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS (Theory)

L-T-P/S: 2-0-0

Credits: 2

Contact Hours:3

Introduction to Value Education, Harmony in the Human Being, Harmony in the Family and Society, Harmony in the Nature (Existence), Implications of the Right Understanding – a Look at Professional Ethics

Syllabus

Introduction to Value Education: Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - The Basic Human Aspirations, Right Understanding, Relationship and Physical Facilities, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations. **Harmony in the Human Being:** Understanding the Human Being as Co-existence of Self ('I') and Body, Discriminating between the Needs of the Self and the Body, The Body as an Instrument of 'I', Understand Harmony in the Self ('I'), Harmony of the Self ('I') with the Body, Program to Ensure Sanyam and Svasthya. **Harmony in the Family and Society:** Harmony in the Family - the Basic Unit of Human Interaction, Values in Human-to-Human Relationships, 'Trust' – the Foundational Value in Relationships, 'Respect' – as the Right Evaluation, Understand Harmony in the Society, Vision for the Universal Human Order. **Harmony in the Nature (Existence):** Understand Harmony in the Nature, Interconnectedness, Self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing 'Existence is Co-existence' at All Levels, The Holistic Perception of Harmony in Existence. **Implications of the Right Understanding – a Look at Professional Ethics:** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models - Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Text Book:

1. R R Gaur, R Sangal and G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 1st Ed, Excel Books.

IV/IV B. Pharmacy Even Semester 20PY4238T – BIOSTATISTICS AND RESEARCH METHODOLOGY (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the importance of statistics in research	1,4	1,2
CO2	Understanding the regression, probability and parametric tests	1,4	1,2

CO3	Know the importance of non-parametric tests	1,4	1,2
CO4	Case studies and practical approach	1,4	1,2

Importance of biostatistics in drug design and understand and apply the statistic of measures of central tendency, measures of dispersion, correlation, regression, probability, parametric and non parametric tests in pharmaceutical research. Study the importance of research, its designing like factorial design, response surface methodology and statistical analysis software.

Syllabus

Introduction: Statistics, Biostatistics, Frequency distribution, **Measures of central tendency:** Mean, Median, Mode- Pharmaceutical examples **Measures of dispersion:** Dispersion, Range, standard deviation, Pharmaceutical problems, **Correlation:** Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples

Regression: Curve fitting by the method of least squares, fitting the lines $y = a + bx$ and $x = a + by$, Multiple regression, standard error of regression- Pharmaceutical Examples **Probability:** Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties – problems, Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples, **Parametric test:** t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference

Non-Parametric tests: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test. **Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism. **Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph **Designing the methodology:** Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.

Blocking and confounding system for Two-level factorials, **Regression modeling:** Hypothesis testing in Simple and Multiple regression models **Introduction to Practical components of Industrial and Clinical Trials Problems:** Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach. Design and Analysis of experiments: **Factorial Design:** Definition, 2^2 , 2^3 design. Advantage of factorial design **Response Surface methodology:** Central composite design, Historical design, Optimization Techniques

Recommended Books (Latest edition):

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.
2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,
4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

IV/IV B. Pharmacy Even Semester 20PY4239T - SOCIAL AND PREVENTIVE PHARMACY

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.	1,4	1,2
CO2	Have a critical way of thinking based on current healthcare development.	1,4	1,2

CO3	Evaluate alternative ways of solving problems related to health and pharmaceutical issues	1,4	1,2
CO4	Design a better health care service system	1,4	1,2

Concept of health and disease, Social and health education, Sociology and health, Hygiene and health, Preventive medicine, National health programs, its objectives, functioning and outcome of the following.

Syllabus

Concept of health and disease: Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick. **Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.

Sociology and health: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health. **Hygiene and health:** personal hygiene and health care; avoidable habits

Preventive medicine: General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse

National health programs, its objectives, functioning and outcome of the following: HIV AND AIDS control programme, TB, Integrated disease surveillance program(IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.

National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program. Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.

Recommended Books (Latest edition):

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, JAYPEE Publications
2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, JAYPEE Publications
3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, JAYPEE Publications
4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, , JAYPEE Publications
5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, BANARSIDAS BHANOT PUBLISHERS.
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

Recommended Journals:

1. Research in Social and Administrative Pharmacy, Elsevier, Ireland

IV/IV B. Pharmacy Even Semester 20PY4240ET - PHARMA MARKETING MANAGEMENT (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	to provide an understanding of sales and marketing of pharmaceutical products.	1,4	1,2
CO2	Know about various policies for drug inventory management	1,4	1,2
CO3	Know about retail and wholesale marketing	1,4	1,2
CO4	Understand business potential and development in product sales and manufacturing	1,4	1,2

Marketing, Analyzing the Market, Product decision, Promotion, Pharmaceutical marketing, channels, Professional sales representative, Pricing, Emerging concepts in marketing

Syllabus

Marketing: Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior. Pharmaceutical market:

Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. \Analyzing the Market; Role of market research.

Product decision: Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry. Promotion: Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.

Pharmaceutical marketing channels: Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. Professional sales representative (PSR): Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.

Pricing: Meaning, importance, objectives, and determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority). Emerging concepts in marketing: Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.

Recommended Books: (Latest Editions)

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
2. Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill
4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)
6. Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt:Global Perspective, IndianContext,Macmilan India, New Delhi.
7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi
8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.

IV/IV B. Pharmacy Even Semester

20PY4241ET - PHARMACEUTICAL REGULATORY SCIENCE (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Know about legal aspects and quality policies for drug manufacturing	1,1	1,2
CO2	Know about the process of drug discovery and development	1,1	1,2
CO3	Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals	1,1	1,2
CO4	Know the regulatory approval process and their registration in Indian and international markets	1,1	1,2

New Drug Discovery and development, Regulatory Approval Process, Regulatory authorities and agencies, Registration of Indian drug product in overseas market, Clinical trials, Regulatory Concepts

Syllabus

New Drug Discovery and development

Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

Regulatory Approval Process

Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

Regulatory authorities and agencies

Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

Registration of Indian drug product in overseas market

Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD) research.

Clinical trials

Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials

Regulatory Concepts

Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

Recommended books (Latest edition):

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences, Vol.185. Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc.
5. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.
6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams
8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
9. Drugs: From Discovery to Approval, Second Edition By Rick Ng

IV/IV B. Pharmacy Even Semester
20PY4242ET - PHARMACOVIGILANCE (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Why drug safety monitoring is important?	1,4	1,2
CO2	History and development of pharmacovigilance	1,4	1,2
CO3	National and international scenario of pharmacovigilance	1,4	1,2
CO4	Dictionaries, coding and terminologies used in pharmacovigilance	1,4	1,2

Introduction to Pharmacovigilance, adverse drug reactions, Basic terminologies used in pharmacovigilance, Drug and disease classification, Basic drug information resources, Safety data generation, Guidelines for Pharmacovigilance.

Syllabus

Introduction to Pharmacovigilance: History and development of Pharmacovigilance, Importance of safety monitoring of Medicine, WHO international drug monitoring programme, Pharmacovigilance Program of India (PvPI). Introduction to adverse drug reactions, Definitions and classification of ADRs, Detection and reporting, Methods in Causality assessment, Severity and seriousness assessment, Predictability and preventability assessment, Management of adverse drug reactions. Basic terminologies used in pharmacovigilance: Terminologies of adverse medication related events, Regulatory terminologies.

Drug and disease classification: Anatomical, therapeutic and chemical classification of drugs. International classification of diseases, Daily defined doses, International Non-proprietary Names for drugs, Drug dictionaries and coding in pharmacovigilance, WHO adverse reaction terminologies MedDRA and Standardised Med DR Aqueries, WHO drug dictionary, Eudravigilance medicinal product dictionary, Information resources in pharmacovigilance, Basic drug information resources Specialised resources for ADRs, Establishing pharmacovigilance programme, Establishing in a hospital, Establishment & operation of drug safety department in industry, Contract Research Organisations (CROs), Establishing a national programme.

Vaccine safety surveillance, Vaccine Pharmacovigilance, Vaccination failure, Adverse events following immunization, Pharmacovigilance methods, Passive surveillance – Spontaneous reports and case series, Stimulated reporting, Active surveillance – Sentinel sites, drug event monitoring and registries, Comparative observational studies – Cross sectional study, case control study and cohort study, Targeted clinical investigations, Communication in pharmacovigilance, Effective communication in Pharmacovigilance, Communication in Drug Safety Crisis management, Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media.

Safety data generation, Pre clinical phase, Clinical phase, Post approval phase (PMS), ICH Guidelines for Pharmacovigilance, Organization and objectives of ICH, Expedited reporting, Individual case safety reports, Periodic safety update reports, Post approval expedited reporting, Pharmacovigilance planning, Good clinical practice in pharmacovigilance studies, Pharmacogenomics of adverse drug reactions, Genetics related ADR with example focusing PK parameters. Drug safety evaluation in special population, Paediatrics, Pregnancy and lactation, Geriatrics, CIOMS, CIOMS Working Groups, CIOMS Form, CDSCO (India) and Pharmacovigilance, D&C Act and Schedule Y, Differences in Indian and global pharmacovigilance requirements.

Recommended Books (Latest edition):

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.

3. Mann's Pharmacovigilance: Elizabeth B. Andrews, Nicholas, Wiley Publishers.
4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
5. An Introduction to Pharmacovigilance: Patrick Waller, Wiley Publishers.
6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert, Jones & Bartlett Publishers.
7. Textbook of Pharmacoepidemiology edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy, Wiley Publishers.
8. A Textbook of Clinical Pharmacy Practice - Essential Concepts and Skills: G. Parthasarathi, Karin Nyfort Hansen, Milap C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal
11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna
12. <http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297>
13. <http://www.ich.org/>
14. <http://www.cioms.ch/>
15. <http://cdsco.nic.in/>
16. http://www.who.int/vaccine_safety/en/
17. http://www.ipc.gov.in/PvPI/pv_home.html

IV/IV B. Pharmacy Even Semester
20PY4243ET - QUALITY CONTROL AND STANDARDIZATION OF
HERBALS (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours: 4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	know WHO guidelines for quality control of herbal drugs	1,4	1,2
CO2	know Quality assurance in herbal drug industry	1,4	1,2
CO3	know the regulatory approval process and their registration in Indian and international markets	1,4	1,2
CO4	appreciate EU and ICH guidelines for quality control of herbal drugs	1,4	1,2

Basic tests for quality control of herbal drugs, Evaluation of commercial crude drugs, Quality assurance in herbal drug industry, WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines, EU and ICH guidelines for quality control of herbal drugs, Stability testing of herbal medicines, Preparation of documents for new drug application and export registration, Regulatory requirements for herbal medicines, Role of chemical and biological markers in standardization of herbal products.

Syllabus

Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use.

Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine. WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.

EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines. Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.

Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products.

Recommended Books: (Latest Editions)

1. Pharmacognosy by Trease and Evans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I, Carrier Pub., 2006.
4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.
10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

IV/IV B. Pharmacy Even Semester 20PY4244ET - COMPUTER AIDED DRUG DESIGN (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Design and discovery of lead molecules	1,4	1,2
CO2	The role of drug design in drug discovery process	1,4	1,2
CO3	The concept of QSAR and docking	1,4	1,2
CO4	Various strategies to develop new drug like molecules.	1,4	1,2

Introduction to Drug Discovery and Development, Analog Based Drug Design, Quantitative Structure Activity Relationship, Molecular Modeling and virtual screening techniques: Virtual Screening techniques, Molecular docking, Informatics & Methods in drug design, Molecular Modeling.

Syllabus

Introduction to Drug Discovery and Development: Stages of drug discovery and development. Lead discovery and Analog Based Drug Design: Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation. **Analog Based Drug Design:** Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

Quantitative Structure Activity Relationship (QSAR): SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Taft's steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

Molecular Modeling and virtual screening techniques: Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening, **Molecular docking:** Rigid docking, flexible docking, manual docking, Docking based screening. *De novo* drug design.

Informatics & Methods in drug design: Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases. **Molecular Modeling:** Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination.

Recommended Books (Latest Editions)

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Park Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
3. Delgado JN, Remers WA eds "Wilson & Gisvold's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, NY.
4. Foye WO "Principles of Medicinal chemistry 'Lea & Febiger.
5. Koro Ikovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley & Sons, New York.
7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
9. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

**IV/IV B. Pharmacy Even Semester
20PY4245ET - CELL AND MOLECULAR BIOLOGY (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Summarize cell and molecular biology history.	1,4	1,2
CO2	Summarize cellular functioning and composition.	1,4	1,2
CO3	Describe the chemical foundations of cell biology.	1,4	1,2
CO4	Summarize the DNA properties of cell biology.	1,4	1,2

Cell and Molecular Biology, DNA and the Flow of Molecular Information, Transcription and Translation, Proteins, Cellular Activities and Checkpoints, Science of Genetics

Syllabus

Cell and Molecular Biology: Definitions theory and basics and Applications. Cell and Molecular Biology: History and Summation. Properties of cells and cell membrane. Prokaryotic versus Eukaryotic. Cellular Reproduction. Chemical Foundations – an Introduction and Reactions (Types).

DNA and the Flow of Molecular Information. DNA Functioning, DNA and RNA, Types of RNA, Transcription and Translation.

Proteins: Defined and Amino Acids, Protein Structure, Regularities in Protein Pathways, Cellular Processes, Positive Control and significance of Protein Synthesis. Science of Genetics: Transgenics and Genomic Analysis, Cell Cycle analysis, Mitosis and Meiosis, Cellular Activities and Checkpoints. Cell Signals: Introduction, Receptors for Cell Signals, Signaling Pathways: Overview, Misregulation of Signaling Pathways, Protein-Kinases: Functioning.

Recommended Books (latest edition):

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.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.

6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Pepler: Microbial Technology.
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company
12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
13. RA Goldshy et. al., : Kuby Immunology.

**IV/IV B. Pharmacy Even Semester
20PY4246ET - COSMETIC SCIENCE (Theory)**

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Principles of formulation and building blocks of skin care products	1,4	1,2
CO2	Principles of formulation and building blocks of Hair care products	1,4	1,2
CO3	Role of herbs in cosmetics	1,4	1,2
CO4	Principles of Cosmetic Evaluation	1,4	1,2

Concept of cosmetics, principles, evaluation, classification, excipients used. Study of Principles of formulation of skincare products like different creams, antiperspirants, deodorants, hair care products, oral care products, sun protectors, analytical cosmetics.

Syllabus

Classification of cosmetic and cosmeceutical products. Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs. **Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application. **Skin:** Basic structure and function of skin. **Hair:** Basic structure of hair. Hair growth cycle. **Oral Cavity:** Common problem associated with teeth and gums.

Principles of formulation and building blocks of skin care products: Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals. **Antiperspirants & deodorants-** Actives & mechanism of action. Principles of formulation and building blocks of Hair care products: Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Paraphenylenediamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

Sun protection, Classification of Sunscreens and SPF. Role of herbs in cosmetics: Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove. **Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin-cream and toothpaste.

Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties. Soaps, and syndet bars. Evolution and skin benefits. Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor. Antiperspirants and Deodorants- Actives and mechanism of action.

References

1. Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.

2. Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.
3. Text book of cosmeticology by Sanju Nanda & Roop K. Khar, Tata Publishers

IV/IV B. Pharmacy Even Semester
20PY4247ET – EXPERIMENTAL PHARMACOLOGY (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Appreciate the applications of various commonly used laboratory animals	2,4	1,2
CO2	Appreciate and demonstrate the various screening methods used in preclinical research	2,4	1,2
CO3	Appreciate and demonstrate the importance of biostatistics and research methodology	2,4	1,2
CO4	Design and execute a research hypothesis independently	2,4	1,2

Syllabus

Laboratory Animals: Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.

Preclinical screening models: Introduction: Dose selection, calculation and conversions, preparation of drug solution /suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. **Study of screening animal models for** Diuretics, nootropics, anti-Parkinson's, antiasthmatics, **Preclinical screening models:** for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease

Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics. **Preclinical screening models:** for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslipidemic, anti-aggregatory, coagulants, and anticoagulants. Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.

Research methodology and Bio-statistics: Selection of research topic, review of literature, research hypothesis and study design, Pre-clinical data analysis and interpretation using Students 't' test, and One-way ANOVA. Graphical representation of data

Recommended Books (latest edition):

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh
2. Hand book of Experimental Pharmacology-S.K.Kulakarni
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G.
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard

IV/IV B. Pharmacy Even Semester
20PY4248ET - ADVANCED INSTRUMENTATION TECHNIQUES (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	understand the advanced instruments used and its applications in drug analysis	1,4	1,2
CO2	understand the chromatographic separation and analysis of drugs.	1,4	1,2
CO3	understand the calibration of various analytical instruments	1,4	1,2
CO4	know analysis of drugs using various analytical instruments.	1,4	1,2

Principles, theory, instrumentation, factors influencing their efficiency and applications on advanced instrumental analytical techniques like Nuclear Magnetic Resonance spectroscopy, Mass Spectrometry, Thermal Methods of Analysis, X-Ray Diffraction Methods, Radio immune assay, Extraction and Hyphenated techniques. It gives extensive study on Calibration and validation of analytical Instruments as per ICH and USFDA guidelines.

Syllabus

Nuclear Magnetic Resonance spectroscopy: Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications. **Mass Spectrometry-** Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications.

Thermal Methods of Analysis: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC). **X-Ray Diffraction Methods:** Origin of X-rays, basic aspects of crystals, X-ray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications. **Calibration and validation-**as per ICH and USFDA guidelines Calibration of following Instruments. Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC.

Radio immune assay: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay. **Extraction techniques:** General principle and procedure involved in the solid phase extraction and liquid-liquid extraction. **Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.**

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K.Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

IV/IV B. Pharmacy Even Semester

20PY4249ET – DIETARY SUPPLEMENTS AND NUTRACEUTICALS (Theory)

L-T-P/S: 3-1-0

Credits: 4

Contact Hours:4

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the need of supplements by the different group of people to maintain healthy life.	1,2	1,2
CO2	Understand the outcome of deficiencies in dietary supplements.	1,2	1,2
CO3	Appreciate the components in dietary supplements and the application.	1,2	1,2
CO4	Appreciate the regulatory and commercial aspects of dietary supplements including health claims.	1,2	1,2

Definitions of Functional foods, Nutraceuticals and Dietary supplements, Phytochemicals as nutraceuticals, Introduction to free radicals, Synthetic antioxidants

Syllabus

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. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds

Phytochemicals as nutraceuticals: Occurrence and characteristic features(chemical nature medicinal benefits) of following: Carotenoids- α and β -Carotene, Lycopene, Xanthophylls, leutin; Sulfides: Diallyl sulfides, Allyl trisulfide; Polyphenolics: Resveratrol; Flavonoids- Rutin, Naringin, Quercetin, Anthocyanidins, catechins, Flavones; Prebiotics / Probiotics.: Fructo oligosaccharides, Lactobacillum; Phyto estrogens : Isoflavones, daidzein, Geobustin, lignans; Tocopherols; Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids. Dietary fibres and complex carbohydrates as functional food ingredients..

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, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α - Lipoic acid, melatonin. Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. Functional foods for chronic disease prevention. 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.

References:

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and nutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPublication.
3. Advanced Nutritional Therapies by Cooper. K.A.,(1996).
4. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
5. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn., Avery Publishing Group, NY (1997).
6. G. Gibson and C.williams Editors 2000 *Functional foods* Woodhead Publ.Co.London.
7. Goldberg, I. *Functional Foods*. 1994. Chapman and Hall, New York.

8. 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.
9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
10. Shils, ME, Olson, JA, Shike, M. 1994 *Modern Nutrition in Health and Disease*. Eighth edition. Lea and Febiger

**IV/IV B. Pharmacy Even Semester
20PY4250PW – PROJECT WORK**

L-T-P/S: 0-0-12

Credits: 6

Contact Hours: 12