



4-Year Bachelor of Pharmacy (B.Pharm) Curriculum and Syllabus
Course Structure
Fourth Semester

Course Code	Name of the course	No.of hours	Tutorial	Credit points
TIU-UBP-401T	Pharmaceutical Organic Chemistry III–Theory	3	1	4
TIU-UBP-402T	Medicinal Chemistry I –Theory	3	1	4
TIU-UBP-403T	Physical Pharmaceutics II– Theory	3	1	4
TIU-UBP-404T	Pharmacology I–Theory	3	1	4
TIU-UBP-405T	Pharmacognosy and Phytochemistry I–Theory	3	1	4
TIU-UBP-406P	Medicinal Chemistry I– Practical	4	-	2
TIU-UBP-407P	Physical Pharmaceutics II– Practical	4	-	2
TIU-UBP-408P	Pharmacology I– Practical	4	-	2
TIU-UBP-409P	Pharmacognosy and Phytochemistry I– Practical	4	-	2
Total		31	5	28



B.PHARM SYLLABUS

SEMESTER – IV

Pharmaceutical Organic Chemistry III–Theory (TIU-UBP-401T)

Contact hours: 45 hrs

Course Objectives

1. To understand the methods of preparation and properties of organic compounds
2. To explain the stereo chemical aspects of organic compounds and stereo chemical reactions
3. To know the medicinal uses and other applications of organic compounds

Course Outcomes

Upon completion of the course, the student shall be able to

CO1. **Demonstrate** and understand the concept of stereo isomerism.

CO2. **Demonstrate** and understand the concept of geometrical isomerism.

CO3. **Demonstrate** and classify hetero cyclic compounds and understand their structures.

CO4. **Describe** synthesis, reactions and medicinal uses of hetero cyclic compounds.

CO5. **Describe** and understand the different name reactions which are important in medicinal chemistry

Course Content

45 Hours

UNIT-I

10 Hours

Stereo isomerism

Optical isomerism–Optical activity, enantiomerism, diastereoisomerism, 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

UNIT-II

10Hours

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.



Stereo specific and stereo selective reactions

UNIT-III

10 Hours

Hetero cyclic 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

UNIT-IV

08 Hours

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

UNIT-V

07 Hours

Reactionsofsynthetic importance

Metal hydride reduction (NaBH_4 and LiAlH_4), Clemmensen reduction, Birch reduction, WolffKishner reduction.

Oppenauer-oxidation and Dakin reaction.

Beckmanns rearrangement and Schmidt rearrangement.

Claisen-Schmidt condensatio

Reference 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

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Demonstrate and understand the concept of stereo isomerism.	PO1, PO2, PO3, PO11, PO12, PEO1, PEO2,
CO2	Demonstrate and understand the concept of geometrical isomerism.	PO1, PO2, PO3, PO11, PO12, PEO1, PEO2,
CO3	Demonstrate and classify hetero cyclic compounds and understand their structures.	PO1, PO2, PO3, PO11, PO12, PEO1, PEO2,



CO4	Describe synthesis, reactions and medicinal uses of hetero cyclic compounds.	PO1, PO2, PO3, PO4, PO5, PO11, PO12, PEO1, PEO2, PEO3,
CO5	Describe and understand the different name reactions which are important in medicinal chemistry	PO1, PO2, PO3, PO4, PO5, PO11, PO12, PEO1, PEO2, PEO3,

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-401T	Pharmaceutical Organic Chemistry III-Theory	3	3	3	2	2	-	-	-	-	-	3	3	3	2	2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Medicinal Chemistry I –Theory (TIU-UBP-402T)

Contact hours: 45hrs

Course Objectives

1. To understand the chemistry of drugs with respect to their pharmacological activity
2. To gain knowledge about the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. To know the Structural Activity Relationship (SAR) of different class of drugs
4. To understand the chemical synthesis of some drugs

Course Outcomes

Upon completion of the course, the student shall be able

CO1. **Identify** Drug metabolism pathway and physicochemical properties in relation to biological action of drugs

CO2. **Summarize** the drugs acting on Autonomic Nervous System

CO3. **Classify** Cholinesterase inhibitors and Cholinesterase activator

CO4. **Compare** Sedatives and Hypnotics; Antipsychotics and anticonvulsants Drugs



CO5. **Demonstrate** general anaesthetic drugs, Narcotic and non-narcotic analgesics and Anti-inflammatory agents

Course Content **45 Hours**

UNIT- I **10 Hours**

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.

UNIT- II **10 Hours**

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: Hydroxyamphetamine, 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.

UNIT-III **10 Hours**

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 chloride, Tacrine hydrochloride, Ambenonium chloride, Isoflurophate, Echothiophate iodide, Parathione, Malathion.

Cholinesterase reactivator: Pralidoxime chloride.

Cholinergic Blocking agents: SAR of cholinolytic agents

Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*.



Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Bzotropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

UNIT- IV

08 Hours

Drugs acting on Central Nervous System

A. Sedatives and 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.

B. 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.

Fluro buterophenones: Haloperidol, Droperidol, Risperidone.

Beta amino ketones: Molindone hydrochloride.

Benzamides: Sulpieride.

C. Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action

Barbiturates: Phenobarbitone, Methobarbital.

Hydantoins: Phenytoin*, Mephenytoin, Ethotoin

Oxazolidine diones: Trimethadione, Paramethadione

Succinimides: Phensuximide, Methsuximide, Ethosuximide*

Urea and monoacylureas: Phenacemide, Carbamazepine*

Benzodiazepines: Clonazepam

Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate

UNIT – V

07 Hours

Drugs acting on Central Nervous System

General anesthetics:

Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.

Ultra short acting barbiturates: Methohexital sodium*, Thiamylal 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, Anilerdine 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, Zomepirac, 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.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Identify Drug metabolism pathway and physicochemical properties in relation to biological action of drugs	PO1, PO3, PO5, PO12
CO2	Summarize the drugs acting on Autonomic Nervous System	PO1, PO12, PEO2
CO3	Classify Cholinesterase inhibitors and Cholinesterase activator	PO1, PO2, PO5, PO11, PO12, PEO1,
CO4	Compare Sedatives and Hypnotics; Antipsychotics and anticonvulsants Drugs	PO1, PO3, PO11, PO12, PEO1
CO5	Demonstrate general anaesthetics drugs, Narcotic and non-narcotic analgesics and Anti-inflammatory agents	PO1, PO5, PO11, PO12, PEO1, PEO2



Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-402T	Medicinal Chemistry I – Theory	3	-	2	-	3	-	-	-	-	-	3	3	3	2	-

1=weakly mapped

2= moderately mapped

3=strongly mapped

Medicinal Chemistry I– Practical (TIU-UBP-406P)

Contact hour: 4 hrs/wk

Course Objectives

1. To administer the knowledge and techniques required for method of preparation for the organic compounds.
2. To understand the method of assay techniques of different drug
3. To administer the knowledge determination of partition coefficient of drugs

Course Outcomes:

After successful completion of this course, students will be able to:

CO1. **Describe** the method of preparation of organic compounds

CO2. **Demonstrate** and Describe the assay methods of drugs

CO3. **Evaluate** the partition coefficient of the drugs

Course Content

4 Hours/Week

I. Preparation of drugs/ intermediates



1. 1,3-pyrazole
2. 1,3-oxazole
3. Benzimidazole
4. Benzotriazole
5. 2,3- diphenyl quinoxaline
6. Benzocaine
7. Phenytoin
8. Phenothiazine
9. Barbiturate

II. Assay of drugs

1. Chlorpromazine
2. Phenobarbitone
3. Atropine
4. Ibuprofen
5. Aspirin
6. Furosemide

III. Determination of Partition coefficient for any two drug

Reference 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

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Describe the method of preparation of organic compounds	PO1, PO2, PO3, PO8, PO11, PO12, PEO1, PEO2, PEO3
CO2	Demonstrate and Describe the assay methods of drugs	PO1, PO2, PO3, PO4, PO8, PO11, PO12, PEO1, PEO2, PEO3
CO3	Evaluate the partition coefficient of the drugs	PO1, PO3, PO4, PO8 PO11, PO12, PEO1, PEO2



Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-406P	Medicinal Chemistry I- Practical	3	2	2	2	-	-	-	3	-	-	3	3	3	3	2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Physical Pharmaceutics II– Theory (TIU-UBP-403T)

Contact hours: 45 hours

Course Objectives

- 1.To know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
- 2.To demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms
- 3.To understand various physicochemical properties of drug molecules in the designing the dosage forms.

Course Outcomes

Upon completion of the course, the student shall be able

- CO1. **Classify** colloidal solutions which are being in used as pharmaceutical formulations.
- CO2. **Identify** the concepts of particle size, size distribution and surface area related to dosage forms.
- CO3. **Explain** the flow properties and deformations observed in pharmaceutical products.
- CO4. **Discuss** coarse dispersions used as drug dosage forms.
- CO5. **Summarize** the stability issues and testing techniques for pharmaceutical formulations.

Course Content

45 Hours



UNIT-I

7 Hours

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.

UNIT-II

10

Hours

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

UNIT-III

10

Hours

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.

UNIT IV

10

Hours

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.

UNIT V

10 Hours

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



Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-403T	PHYSICAL PHARMACEUTICS II - Theory	3	3	3	-	-	-	-	-	-	-	3	3	3	3	2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Physical Pharmaceutics II – Practical (TIU-UBP-407P)

Contact hours- 4 hr/wk

Course Objectives

- 1.To know the fundamentals of particle size analysis of pharmaceutical products.
2. To interpret the derived properties of powders and rheological properties of pharmaceutical formulations.
3. To understand the concept of stability related to dosage forms.

Course Outcomes:

After successful completion of this course, students will be able to:

- CO1. **Interpret** the particle size and particle size distribution of pharmaceutical products.
CO2. **Evaluate** the flow properties of different drug dosage forms.
CO3. **Evaluate** the derived properties of different powder dosage forms.
CO4. **Describe** the stability testing of drug products.

Course Content

4 hr/ Experiment

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

Reference Books (Latest Editions)

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

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Interpret the particle size and particle size distribution of pharmaceutical products.	PO1,PO2, PO3,PO6,PO12,PEO1
CO2	Evaluate the flow properties of different drug dosage forms.	PO2,PO12,PO3,PO5,PEO1,PEO2
CO3	Evaluate the derived properties of different powder dosage forms.	PO1,PO4,PO6,PO12, PEO3
CO4	Describe the stability testing of drug products.	PO1,PO2, PO4,PO6,PEO2, PEO3

		Pharmaceutical Knowledge	Problem solving	Conduct, analyze and interpret data	Ability to design and formulating a process	Ability to understand mechanism	Demonstrate skills in problem solving	Professional and ethical responsibilities	Communication to present a technical report	Impact on society and responsibilities	Leadership qualities	Self educating and Life-long Learning	Preparation for competitive examinations	Building a theoretical knowledge base along with necessary practical skills	To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital	Training students to achieve expertise
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3



TIU-UBP-407P	Physical Pharmaceutics- II -Practical	3	3	2	2	2	3	-	-	-	-	-	2	3	2	2
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1=weakly mapped

2= moderately mapped

3=strongly mapped

Pharmacology I – Theory (TIU-UBP-404T)

Contact hours: 45 hrs

Course Objectives

1. To understand the pharmacological actions of different categories of drugs.
2. To explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
3. To apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
4. To observe the effect of drugs on animals by simulated experiments.
5. To appreciate correlation of pharmacology with other bio medical sciences.

Course Outcomes

Upon completion of the course, the student shall be able

CO1. **Demonstrate** Pharmacology, Pharmacokinetics and Pharmacodynamics.

CO2. **Explain** the drug interactions and toxicity related to drugs and adverse drug reactions.

CO3. **Summarize** the different phases of drug discovery process.

CO4. **Distinguish** the drug action between peripheral nervous system and central nervous system.

CO5. **Demonstrate** different kind of receptors and their interactions with drug molecules.

Course Content

45 Hours

UNIT-I

08 Hours

General Pharmacology

- a. 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.
- b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination.



UNIT-II

12 Hours

General Pharmacology

- Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interaction 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.

UNIT-III

10 Hours

Pharmacology of drugs acting on peripheral nervous system

- Organization and function of ANS.
- Neurohumoral transmission, co-transmission and classification of neurotransmitters.
- Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.
- Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).
- Local anesthetic agents.
- Drugs used in myasthenia gravis and glaucoma

UNIT IV

08 Hours

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

Introduction to secondary metabolites

Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

UNIT V

07 Hours

Pharmacology of drugs acting on central nervous system

- 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.



Reference 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. VallabhPrakashan

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Demonstrate Pharmacology, Pharmacokinetics and Pharmacodynamics.	PO1, PO5
CO2	Explain the drug interactions and toxicity related to drugs and adverse drug reactions.	PO1, PO2, PO3, PO5, PEO1
CO3	Summarize the different phases of drug discovery process.	PO1, PEO2
CO4	Distinguish the drug action between peripheral nervous system and central nervous system.	PO1, PO5, PO11, PO12, PEO3
CO5	Demonstrate different kind of receptors and their interactions with drug molecules.	PO1, PO5, PO11, PO12



Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-404T	Pharmacology-I Theory	3	2	2	-	3	-	-	-	-	-	3	3	3	3	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

Pharmacology I –Practical (TIU-UBP-408P)

Contact hours: 4 hr/week

Course Objectives

1. To know the fundamentals of experimental pharmacology and the commonly used instruments in experimental pharmacology.
2. To administer the knowledge and techniques required for blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
3. To understand the concept of mechanism of drug action by using different animal models.

Course Outcomes:

After successful completion of this course, students will be able to:

CO1. **Demonstrate** the instruments used in experimental pharmacology.

CO2. **Identify** the different routes of drugs administration in mice/rats.

CO3. **Explain** the common laboratory techniques like Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.

CO4. **Classify** the mechanisms of drug action by using different animal models.



Course Content

4Hrs/Week

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.

Reference 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 McGraw-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,

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)



Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Demonstrate the instruments used in experimental pharmacology, anesthetics and euthanasia used for animal studies.	PO1, PO2, PO5, PEO1
CO2	Identify the different routes of drugs administration in mice/rats.	PO1, PO4, PO12, PEO1, PEO3
CO3	Explain the common laboratory techniques like Blood withdrawal, serum and plasma separation,	PO1, PO7, PEO1, PEO3
CO4	Classify the mechanisms of drug action by using different animal models.	PO1, PO3, PO5, PO12, PEO1, PEO3

Course Code	Course Title	Pharmaceutical Knowledge PO1	Problem solving PO2	Conduct, analyze and interpret data PO3	Ability to design and formulating a process PO4	Ability to understand mechanism PO5	Demonstrate skills in problem solving PO6	Professional and ethical responsibilities PO7	Communication to present a technical report PO8	Impact on society and responsibilities PO9	Leadership qualities PO10	Self educating and Life-long Learning PO11	Preparation for competitive examinations PO12	Building a theoretical knowledge base along with necessary practical skills PEO1	To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital PEO2	Training students to achieve expertise PEO3
TIU-UBP-408P	Pharmacology I- Practical	3	2	2	2	2	-	2	-	-	-	-	2	3	2	2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Pharmacognosy and Phytochemistry I—Theory (TIU-UBP-405T)

Contact hour :45 hrs

Course Objectives



1. To know the fundamentals about pharmacognosy and phytochemistry, its industrial applicability and future scope.
2. To administer the knowledge and techniques required for cultivation, collection, production and preservation of medicinal plants.
3. To understand the concept of quality control of drugs of natural origin crude drugs, their evaluation techniques and methodologies to be adopted.
4. To have an overall idea about the various systems of medicines practiced worldwide.
5. To gain knowledge about the various therapeutically valuable phytochemicals present in plants and mineral sources.

Course Outcomes

Upon completion of the course, the student shall be able

CO1. **Classify** crude drug based on morphology, chemically, pharmacologically and taxonomically.

CO2. **Recognize** the factors affecting medicinal plant cultivation, collection and commercial conservation.

CO3. **Summarize** the testing techniques required for crude drug evaluation and interpreting the results.

CO4. **Compare** between allopathic and traditional systems of medicine.

CO5. **Demonstrate** secondary metabolites, their therapeutic uses and to Describe chemical tests to identify the phytochemicals.

Course Content

UNIT-I

10 Hours

Introduction to Pharmacognosy:

- (a) Definition, history, scope and development of Pharmacognosy
- (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture
- (c) 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.

UNIT-II

10 Hours

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



UNIT-III

07 Hours

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

UNIT IV

10 Hours

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

UNIT V

08 Hours

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

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



Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Classify crude drug based on morphology, chemically, pharmacologically and taxonomically.	PO1, PO12
CO2	Recognize the factors controlling medicinal plant cultivation, collection and commercial conservation.	PO1, PO2, PEO2
CO3	Summarize the testing techniques required for crude drug evaluation and interpreting the results.	PO1, PO2, PO3, PO11, PO12, PEO1, PEO2, PEO3
CO4	Compare between allopathic and traditional systems of medicine.	PO1, PO11, PO12, PEO1
CO5	Demonstrate secondary metabolites, their therapeutic uses and to Describe chemical tests to identify the phytochemicals.	PO1, PO3, PO11, PO12, PEO1, PEO2, PEO3

Course Code	Course Title	Pharmaceutical Knowledge	Problem solving	Conduct, analyze and interpret data	Ability to design and formulating a process	Ability to understand mechanism	Demonstrate skills in problem solving	Professional and ethical responsibilities	Communication to present a technical report	Impact on society and responsibilities	Leadership qualities	Self educating and Life-long Learning	Preparation for competitive examinations	Building a theoretical knowledge base along with necessary practical skills	To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital	Training students to achieve expertise
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO1	PEO2	PEO3
TIU-UBP-405T	Pharmacognosy and Phytochemistry I - Theory	3	2	2	-	-	-	-	-	-	-	3	3	3	3	2

1=weakly mapped

2= moderately mapped

3=strongly mapped

Pharmacognosy and Phytochemistry I—Practical (TIU-UBP-409P)

Contact hours: 4 hrs/wk

Course Objectives



1. To know the fundamentals of crude drug analysis obtained from natural sources and its industrial utility.
2. To administer the knowledge and techniques required for evaluation of herbal drugs.
3. To understand the concept of quantitative microscopy and its application in QC testing.

Course Outcomes:

After successful completion of this course, students will be able to:

- CO1. **Demonstrate** chemical tests for crude drugs
CO2. **Evaluate** the quality and purity of crude drugs
CO3. **Describe** linear measurements for crude drug identification
CO4. **Develop** quality control methods for standardisation of herbal drug

Course Content Hours/Week

4

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

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

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)



Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Demonstrate chemical tests for unorganized crude drugs and its analysis	PO1,PO3,PO6,PEO1
CO2	Evaluate the quality and purity of crude drugs	PO1,PO12,PEO1,PEO2, PEO3
CO3	Describe linear measurements for crude drug identification using microscopical techniques	PO1,PO2,PO3,PO6,PO12
CO4	Develop quality control methods for standardisation of herbal drug	PO1,PO4,PO5,PO12, PEO1,PEO2, PEO3

Course Code	Course Title	Program Outcomes (POs)												Program Educational Objectives (PEOs)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PEO 1	PEO2	PEO 3
TIU-UBP-409P	Pharmacognosy and Phytochemistry I- Practical	3	2	2	2	2	2	-	-	-	-	-	2	3	2	2

1=weakly mapped

2= moderately mapped

3=strongly mapped