TECHNO INDIA UNIVERSITY
WESTBENGAL

B.PHARM SYLLABUS

SEMESTER IV

Pharmaceutical Organic Chemistry III–Theory (TIU-UBP-401T)
Credit points-4

Course Outcomes

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

CO1	**Demonstrate** and understand the concept of stereo isomerism.	K2
CO2	**Demonstrate** and understand the concept of geometrical isomerism.	K2
CO3	**Demonstrate** and classify hetero cyclic compounds and understand their structures.	K2
CO4	**Describe** synthesis, reactions and medicinal uses of hetero cyclic compounds.	K2
CO5	**Describe** and understand the different name reactions which are important in medicinal chemistry	K2

Course Content

UNIT-I

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 racemicmixture.
Asymmetric synthesis: partial and absolute

UNIT-II

Geometrical isomerism
Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems)
Methods ofdetermination 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

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

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

Reactions of synthetic 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 condensation

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

Credit points-4

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	K3
CO2	**Summarize** the drugs acting on Autonomic Nervous System	K2
CO3	**Classify** Cholinesterase inhibitors and Cholinesterase activator	K2
CO4	**Compare** Sedatives and Hypnotics; Antipsychotics and anticonvulsants Drugs	K4
CO5	**Demonstrate** general anaesthetics drugs, Narcotic and non-narcotic analgesics and Anti-inflammatory agents	K2

Course Content

UNIT- I

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

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

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, Isofluorphate, 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, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

UNIT- IV

Drugs acting on Central Nervous System

A. Sedatives and Hypnotics:

Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem

Barbiturtes: SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital

Miscelleneous:

Amides & imides: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol.

Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.

B. Antipsychotics

Phenothiazeines: SAR of Phenothiazeines-Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

Ring Analogues of Phenothiazeines: 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, Methabarbital.

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

Drugs acting on Central Nervous System

General anesthetics:

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

Ultra short acting barbitutrates: 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, Levallorphantartarate, Naloxone hydrochloride.

Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

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

Credit points-2

Course Outcomes:

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

CO1	**Describe** the method of preparation of organic compounds like drugs	K2
CO2	**Describe** the method of preparation of intermediates	K2
CO3	**Demonstrate** the assay methods of drugs	K2
CO4	**Evaluate** the partition coefficient of the drugs	K4
CO5	**Compare** preparation and assay for various categories of drugs	K4

Course Content

I. Preparation of drugs/ intermediates

1. 1 ,3-pyrazole
2. 1,3-oxazole
3. Benzimidazole
4. Benztriazole
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

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

Credit points-4

Course Outcomes

Upon completion of the course, the student shall be able

CO1	**Classify** colloidal dispersions which are used in pharmaceutical formulations	K2
CO2	**Identify** the concepts of rheology and solid deformations observed in pharmaceutical products	K3
CO3	**Discuss** coarse dispersions used as drug dosage forms.	K2
CO4	**Identify** the concepts of particle size, size distribution and surface area related to dosage forms.	K3
CO5	**Summarize** the stability issues and testing techniques for pharmaceutical formulations	K2

Course Content

UNIT-I

Colloidal dispersions:

Classification of dispersed systems & their generalcharacteristics, 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

Rheology:

Newtonian systems, law of flow, kinematic viscosity, effect of temperature,non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy informulation, determination of viscosity, capillary, falling Sphere, rotational viscometers

Deformation of solids:

Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus

UNIT-III

Coarse dispersion:

Suspension, interfacial properties of suspended particles, settling insuspensions, 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 emulsionformulation by HLB method.

UNIT IV

Micromeretics:

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

UNIT V

Drug stability:

Reaction kinetics: zero, pseudo-zero, first & second order, units of basicrate constants, determination of reaction order. Physical and chemical factors influencingthe 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

Physical Pharmaceutics II – Practical (TIU-UBP-407P)
Credit points-2

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.	K4
CO2	**Evaluate** the flow properties of different drug dosage forms.	K4

CO3	**Evaluate** the derived properties of different powder dosage forms.	K4
CO4	**Describe** the stability testing of drug products.	K2
CO5	**Demonstrate** rheology measurements	K2

Course Content

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

Pharmacology I – Theory (TIU-UBP-404T)
Credit points-4

Course Outcomes

Upon completion of the course, the student shall be able

CO1	**Demonstrate** concept of Pharmacology, Pharmacokinetics and Pharmacodynamics.	K2
CO2	**Explain** the drug interactions and toxicity related to drugs and adverse drug reactions.	K2
CO3	**Summarize** the pharmacology of drugs acting on peripheral nervous system	K2
CO4	**Describe** the pharmacology of drugs acting on central nervous system including sedatives, hypnotics, alcohols, anesthetics and anti-epileptics.	K2
CO5	**Demonstrate** the pharmacology of drugs acting on central nervous system including psychopharmacological agents. Stimulants, analgesics and drugs used in Parkinson's and alzheimers disease	K2

Course Content

UNIT-I

General Pharmacology

a. Introduction to Pharmacology- Definition, historical landmarks and scope ofpharmacology, nature and source of drugs, essential drugs concept and routes ofdrug administration, Agonists, antagonists (competitive and noncompetitive), sparereceptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.

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

UNIT-II

General Pharmacology

a. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactionssignal transduction mechanisms, G-protein–coupled receptors, ion channel receptor,transmembrane enzyme linked receptors, transmembrane JAK-STAT bindingreceptor and receptors that regulate transcription factors, dose responserelationship, therapeutic index, combined effects of drugs and factors modifyingdrug action.

b. Adverse drug reactions.

c. Drug interactions (pharmacokinetic and pharmacodynamic)

d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase,preclinical evaluation phase, clinical trial phase, phases of clinical trials andpharmacovigilance.

UNIT-III

Pharmacology of drugs acting on peripheral nervous system

a. Organization and function of ANS.

b. Neurohumoraltransmission,co-transmission and classification of neurotransmitters.

c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.

d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).

e. Local anesthetic agents.

f. Drugs used in myasthenia gravis and glaucoma

UNIT IV

Pharmacology of drugs acting on central nervous system

a. Neurohumoral transmission in the C.N.S. special emphasis on importance of variousneurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.

b. General anesthetics and pre-anesthetics.

c. Sedatives, hypnotics and centrally acting muscle relaxants.

d. Anti-epileptics

e. 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

Pharmacology of drugs acting on central nervous system

a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents,anti-manics and hallucinogens.

b. Drugs used in Parkinsons disease and Alzheimer's disease.

c. CNS stimulants and nootropics.

d. Opioid analgesics and antagonists

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

Pharmacology I –Practical (TIU-UBP-408P)
Credit points-2

Course Outcomes:

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

CO1	**Demonstrate** the instruments used in experimental pharmacology, anesthetics and euthanasia used for animal studies.	K2
CO2	**Identify** the different routes of drugs administration in mice/rats.	K3
CO3	**Explain**the common laboratory techniques like Blood withdrawal, serum and plasma separation,	K2
CO4	**Classify** the mechanisms of drug action by using different animal models.	K2
CO5	**Demonstrate** various pharmacological activity with animal models	K3

Course Content

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 byMES 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.

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

Credit points-4

Course Outcomes

Upon completion of the course, the student shall be able

CO1	Classify crude drug based on morphology, chemically, pharmacologically and taxonomically.	K2
CO2	Recognize the factors affecting medicinal plant cultivation, collection and commercial conservation.	K2
CO3	Summarize plant tissue culture and the testing techniques required for crude drug evaluation and interpreting the results.	K2
CO4	Compare between allopathic and traditional systems of medicine and **Demonstrate** secondary metabolites	K4
CO5	**Illustrate** study of plant products and primary metabolites	K3

Course Content

UNIT-I

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 serotaxonomical 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, leafconstants,camera lucida and diagrams of microscopic objects to scale with camera lucida.

UNIT-II

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
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
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
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

Pharmacognosy and Phytochemistry I—Practical (TIU-UBP-409P)
Credit points-2

Course Outcomes:

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

CO1	Demonstrate chemical tests for unorganized crude drugs and its analysis	K2
CO2	Evaluate the quality and purity of crude drugs	K4
CO3	Describe linear measurements for crude drug identification using microscopical techniques	K2

CO4	Develop quality control methods for standardisation of herbal drug	K3
CO5	Evaluate swelling characteristics	K4

Course Content

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