B. PHARM. II YEAR
SEMESTER – III

II B.PHARM. SCHEME

SEMESTER – III

S. No.	Sub. Code	Subject	L	T	P	Th. Credit	Tu. Credit	Pr. Credit	Total Credit	Maximum Marks				
										TH	CW	SW	Pr.	Total
1.	PY2Y015	Pharmaceutical Organic Chemistry II	3	1	4	3	1	2	6	75	25	15	35	150
2.	PY2Y014	Physical Pharmaceutics-I	3	1	4	3	1	2	6	75	25	15	35	150
3.	PY2Y013	Pharmaceutical Microbiology	3	1	4	3	1	2	6	75	25	15	35	150
4.	PY2Y012	Pharmaceutical Engineering	3	1	4	3	1	2	6	75	25	15	35	150
Total			**12**	**4**	**16**	**12**	**4**	**8**	**24**	**300**	**100**	**60**	**140**	**600**

PY2Y015: PHARMACEUTICAL ORGANIC CHEMISTRY-II

L	T	P	Th. Credit	Tut. Credit	Pr. Credit	Total Credits	Maximum Marks				
							TH	CW	SW	Pr.	Total
3	1	4	3	1	2	6	75	25	15	35	**150**

Scope: This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

Objectives: Upon completion of the course the student shall be able to

- Write the structure, name and the type of isomerism of the organic compound
- Write the reaction, name the reaction and orientation of reactions
- Account for reactivity/stability of compounds,
- Prepare organic compounds

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Understand the structures and basic fundamentals of aromaticity.
CO-2: Summarise and elaborate the reactivity/stability of organic compounds.
CO-3: Outline the methods of preparation, uses and reaction of organic compounds,
CO-4: Articulate the need of writing structure, type of reactions, reactivity; identify conformational isomerism and stability of organic compounds in relation to development of drug.
CO-5: Prepare and standardize various reagents for determination of aromatic compounds.

THEORY **DURATION (LECTURES)**

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained.

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

UNIT-1 **10**

Benzene and its derivatives

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

UNIT-II **10**

(a) Phenols*

Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols

(b) Aromatic Amines*

Basicity of amines, effect of substituents on basicity and synthetic uses of aryl diazonium salts

(c) Aromatic Acids*

Acidity, effects of substituents on acidity and important reaction of benzoic acid

UNIT-III **10**

Fats and Oils

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

UNIT-IV **08**

Polynuclear hydrocarbons

i. Synthesis and reactions

ii. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

UNIT-V **07**

Cyclo alkanes*

Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only

PRACTICALS: Minimum 15 experiments based on following:

I Experiments involving laboratory techniques
1. Recrystallization
2. Steam distillation

II Determination of following oil values (including standardization of reagents)
1. Acid value
2. Saponification value
3. Iodine value

III **Preparation of compounds**
1. Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction.
2. 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/ Acetanilide by halogenation (Bromination) reaction.
3. 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.
4. Benzoic acid from Benzyl chloride by oxidation reaction.
5. Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
6. 1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions.
7. Benzil from Benzoin by oxidation reaction.
8. Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction
9. Cinnammic acid from Benzaldehyde by Perkin reaction
10. *P*-Iodo benzoic acid from *P*-amino benzoic acid

BOOKS & REFERENCES RECOMMENDED

Text books:

1. Carey A. F., and Giuliano M. R., Organic Chemistry (2011): 8th Edition. McGraw-Hill Companies, Inc.
2. Finar I. L., Organic Chemistry (2011) vol. 1,Organic Chemistry: 6th Edition. Longman.
3. Finar I. L., Organic Chemistry (2011) vol.2, Organic Chemistry: 6th Edition. Longman.
4. Robert T. Morrison and Robert N. Boyd (2008) Organic Chemistry: 7th Edition. Printice Hall

Reference books:

1. Bahl B. S., Bahl A., " Text Book of Organic Chemistry" 22nd edition (2016) S. Chand publication
2. Soni P. L., "Text Book of Organic Chemistry: A modern Approach" 18th edition (1985) S. Chand publication.
3. Pavia D. L., Lampman G. M., Kriz G. S., Vyvyan J. A., " Introduction to spectroscopy" 5th edition, 2015, cengage learning, USA.
4. Cleyden J., Greeves N., Warren S., and Wothers P., (2001) organic chemistry: 1st Edition. Oxford university press.
5. Mann, G. F., and Saunders, C. B., (1960) Practical Organic Chemistry: 4th Edition. Longman
6. Vogel, I. A., (1956) A Text Book of Practical Organic Chemistry Including Qualitative Organic Analysis: 3rd Edition. Longman
7. Visnoi N. K., " Advanced Practical Organic Chemistry" 3rd edition (2009) Vikas Publishing House

Internet references:

1. http://www.internetchemistry.com/chemistry/organic_chemistry.htm

PY2Y014: PHYSICAL PHARMACEUTICS-I

L	T	P	Th. Credit	Tut. Credit	Pr. Credit	Total Credits	Maximum Marks				
							TH	CW	SW	Pr.	Total
3	1	4	3	1	2	6	75	25	15	35	150

Scope: The course deals with the various physica and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Define and relate various physicochemical properties of drug molecules in the designing the dosage forms.

CO-2: Learn and explain the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.

CO-3: Demonstrate use of surface and interfacial phenomenon in the formulation development and evaluation of dosage forms.

CO-4: Relate the physicochemical properties of the drug molecules with its therapeutic effect, protein binding and complexation.

CO-5: Express the solubility and electrochemical behaviour of liquid in pharmaceutical and biological system.

THEORY **DURATION (LECTURES)**

UNIT-I **10**

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, Dissolution & drug release, diffusion principles in biological systems.

Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions, azeotropic mixtures, fractional distillation. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications.

UNIT-II **10**

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.

UNIT-III **08**

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.

UNIT-IV **08**

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.

UNIT-V **07**

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.

Practical: Minimum 15 experiments based on following:

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.

BOOKS & REFERENCES RECOMMENDED:

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 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 ManavalanR.
8. LaboratoryManual 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

PY2Y013: PHARMACEUTICAL MICROBIOLOGY

L	T	P	Th. Cr.	Tu. Cr.	Pr. Cr.	Total Credit	Maximum Marks				
							TH	CW	SW	Pr.	Total
3	1	4	3	1	2	6	75	25	15	35	150

Scope:
Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.

Objectives: Upon completion of the subject student shall be able to;

- Understand methods of identification, cultivation and preservation ofvarious microorganisms
- To understand the importance and implementation of sterilization inpharmaceutical processing and industry
- Learn sterility testing of pharmaceutical products.
- Carried out microbiological standardization of Pharmaceuticals.
- Understand the cell culture technology and its applications in pharmaceutical industries.

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Learn and understand the methods of identification, cultivation and preservation of various microorganisms.
CO-2: Demonstrate the techniques of sterilization in pharmaceutical processing and industry.
CO-3: Explain and apply the methods for sterility testing of pharmaceutical products.
CO-4: Implement the techniques for microbiological standardization of Pharmaceuticals.
CO-5: Describe the cell culture technology and its applications in pharmaceutical industries.

THEORY **DURATION (LECTURE)**

UNIT I **10**

Introduction, history of microbiology, its branches, scope and itsimportance.
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 methodsfor pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count).
Study of different types of phase contrast microscopy, dark fieldmicroscopy and electron microscopy.

UNIT II **10**

Identification of bacteria using staining techniques (simple, Gram's &Acidfast staining) and biochemical tests (IMViC).
Study of principle, procedure, merits, demerits and applications of physical,chemical gaseous, radiation and mechanical method of sterilization.
Evaluation of the efficiency of sterilization methods.
Equipments employed in large scale sterilization.
Sterility indicators.

UNIT III **10**

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.

UNIT IV **08**

Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.
Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids.
Assessment of a new antibiotic.

UNIT V **07**

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.
Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.
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.

PRACTICALS: Minimum 15 experiments based on the following

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 and other accessories.
3. Preparation and sterilization of different types of media.
4. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
5. Simple Staining method
6. Differential Staining methods- (Grams staining/Acid fast staining/Capsule Staining)
7. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
8. Microbiological assay of antibiotics by cup plate method and other methods
9. Motility determination by Hanging drop method.
10. Sterility testing of pharmaceuticals.
11. Bacteriological analysis of water
12. Biochemical test (IMViV test).
13. Evaluation of antiseptic and disinfectants.
14. Designing of aseptic area as per GMP
15. Revision Practical class

BOOKS & REFERENCES RECOMMENDED:

Text books:

1. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill Education.
2. Ananthnarayan: Text Book of Microbiology, Orient-Longman, Chennai
3. Edward: Fundamentals of Microbiology.
4. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
5. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly Company
6. Benteley's Textbook of Pharmaceutics, Elsevier books Pvt. Ltd.

Reference books:

1. Tortora, Microbiology: An Introduction, Ninth edition, 2008, Pearson Education
2. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
3. Prescott and Dunn. Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
4. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill Education.
5. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
6. Rose: Industrial Microbiology, Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. Aulton's Pharmaceutics; The Design and Manufacture of Medicines, Elsevier books Pvt. Ltd
10. I.P., B.P., U.S.P. - latest editions.

Internet Reference:

1. http://www.pharmamicroresources.com
2. http://www.microbiologyonline.org

PY2Y012: PHARMACEUTICAL ENGINEERING

L	T	P	Th. Cr.	Tut. Cr.	Pr. Cr.	Total Credit	Maximum Marks				
							TH	CW	SW	Pr.	Total
3	1	4	3	1	2	6	75	25	15	35	**150**

Scope:
The course is designed to impart fundamental knowledge of unit operations used in the pharmaceutical industry. Upon completion of the course the student shall be able:

- To understand the engineering principles involved in the processing of drugs and pharmaceutical products.
- To develop understanding about the basic principles of process engineering.
- To impart knowledge on operations of various equipments and machineries.
- To develop concept of unit operations.

Objectives:
Upon completion of the course the student should be able to

- Develop strong background in basics of the pharmaceutical processing.
- Develop understanding the concepts of unit operations in pharmaceutical process.
- Understand the various techniques involved in the presure mesurments and process of fluid flow.
- Develop understanding of suitable equipment to be used for different types raw materials and size separation.
- Understand the applications of particle size in pharmaceuticals.
- Develop understanding on heat transfer against different materials, equipment involved in drying and evaporation.
- Understand filtration process, use of filter aid for complex suspensions.
- Handling and effective separation of desired constituent by using centrifugation.
- Understand the preventive methods used for corrosion control in pharmaceutical industries.
- Understand the role of distillation in purification of multi component system.

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Recognize the concepts of unit operations in pharmaceutical process.

CO-2: To identify the principles involved in working of pharmaceutical machineries.

CO-3: Apply his knowledge in selecting appropriate equipment for unit operations.

CO-4: Develop his engineering concepts in finding solutions of pharmaceutical process.

CO-5: Evaluate the critical manufacturing process and provide improvement with better solutions.

THEORY **DURATION (LECTURE)**

UNIT I **10**

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.

UNIT II **10**

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, triple effect evaporator& Economy of multiple effect evaporator.

UNIT III **08**

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,

UNIT IV **08**

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter media. 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.

UNIT V **09**

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.

Distillation: Objectives, applications & types of distillation. principles, construction, working, uses, merits and demerits of (lab scale and industrial scale) Simple distillation, preparation of purified water and water for injection BP by distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

PRACTICALS: Minimum 15 experiments based on the following

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, dehumidifier.
8. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size 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. Effect of filter aid on rate of filtration.
13. To study the effect of time on the Rate of Crystallization.
14. To prepare Mier's super solubility curve for the given samples.
15. To calculate the uniformity Index for given sample by using Double Cone Blender.
16. To observe the electrochemical changes in an iron nail when it corrodes and to investigate methods to protect it.

BOOKS & REFERENCES RECOMMENDED

Text books:

1. Walter L. Badgre and T. Banchero, Introduction to chemical Engineering, McGraw-Hill, 1955.
2. Kaning J. K. (Editor), S. J. Carter, Tutorial Pharmacy, CBS Publishers & distributers, 1986, Indian Edition. 6th Ed.
3. Hickey A. J., and Ganderton D., Pharmaceutical Process Engineering, Marcel Dekker, 2001.
4. Subrahmanyam C.V.S. et al, Pharmaceutical engineering principles and practices, Latest edition.
5. Paradkar A. R., Introduction to pharmaceutical engineering, latest edition.

References books:

1. Parry H. (Editor), Chemical Engineering Hand Book, McGraw-Hill,1997, 7th Ed.
2. Leon Lachman and H. R. Libberman, The Theory and Practice of Industrial Pharmacy, CBS Publishers & Distributors, Special Indian Edition, 2009.
3. Max S. Peters, Elementary Chemical Engineering, Tata McGraw-Hill, 2009 2nd Ed.
4. Ganderton C., Unit Processes Pharmacy, William Heinemann medical book ltd, 1968.
5. Browns G., Unit Operations, Wiley and Sons, 1955.
6. Warren L. Maccabe, Juliano C. Smith.Unit Operations of Chemical Engineering.

B. PHARM. II YEAR
SEMESTER -IV

II B. PHARM SCHEME

SEMESTER - IV

S. No.	Sub. Code	Subject	L	T	P	Th. Credit	Tu. Credit	Pr. Credit	Total Credit	Maximum Marks				
										TH	CW	SW	Pr.	Total
1.	PY 2Y 629	Pharmaceutical Organic Chemistry III	3	1	-	3	1	-	4	75	25	-	-	100
2.	PY 2Y 627	Medicinal Chemistry I	3	1	4	3	1	2	6	75	25	15	35	150
3.	PY 2Y 620	Physical Pharmaceutics II	3	1	4	3	1	2	6	75	25	15	35	150
4.	PY 2Y 628	Pharmacology I	3	1	4	3	1	2	6	75	25	15	35	150
5.	PY 2Y 621	Pharmacognosy and Phytochemistry-I	3	1	4	3	1	2	6	75	25	15	35	150
Total			**15**	**5**	**16**	**15**	**5**	**8**	**28**	**375**	**125**	**60**	**140**	**700**

PY2Y629: PHARMACEUTICAL ORGANIC CHEMISTRY-III

L	T	P	Th. Credit	Tut. Credit	Pr. Credit	Total Credits	Maximum Marks				
							TH	CW	SW	Pr.	Total
3	1	-	3	1	-	4	75	25	-	-	100

Scope: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

Objectives: At the end of the course, the student shall be able to

- Understand the methods of preparation and properties of organic compounds
- Explain the stereo chemical aspects of organic compounds and stereo chemical reactions
- Know the medicinal uses and other applications of organic compounds

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Learn about the properties of organic/ heterocyclic compounds and reagents and their methods of preparation.

CO-2: Explain the importance of stereochemistry of organic compounds and stereo-chemical reactions

CO-3: Sketch the structure/ isomeric structure, explain synthesis and medicinal uses of different heterocycles/ organic compounds

CO-4: Perform the chemical test & evaluation test for organic compounds and reagents.

CO-5: Articulate the importance of synthetic chemistry, reactions mechanisms and reagents in relation to drug synthesis.

THEORY **DURATION (LECTURE)**

Note: To emphasize on definition, types, mechanisms, examples, uses/applications

UNIT-I **10**

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 **10**

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.

UNIT-III **10**

Heterocyclic compounds:

Nomenclature and classification, Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene - Relative aromaticity, reactivity and Basicity of Pyrrole, Furan and Thiophene

UNIT-IV **08**

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**

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

BOOKS & REFERENCES RECOMMENDED

Text books:

1. Carey A. F., and Giuliano M. R., Organic Chemistry (2011): 8th Edition. McGraw-Hill Companies, Inc.
2. Finar I. L., Organic Chemistry (2011) vol. 1,: 6th Edition. Longman.
3. Finar I. L., Organic Chemistry (2011) vol.2, Organic Chemistry: 6th Edition. Longman.
4. Robert T. Morrison and Robert N. Boyd (2008) Organic Chemistry: 7th Edition. Printice Hall
5. Gilchrist T. L., Heterocyclic Chemistry, 2 nd Ed.,
6. Joules J. A., Mills K., and Smith G. F., Heterocyclic Chemistry, 3 rd Ed., (QD 400 J8)

Reference books:

8. Bahl B. S., Bahl A., " Text Book of Organic Chemistry" 22nd edition (2016) S. Chand publication
9. Bansal R. K., "Hetrocyclic Chemistry" 5th edition (2015) New edge International Private Ltd.
10. Cleyden J., Greeves N., Warren S., and Wothers P., (2001) organic chemistry: 1st Edition. Oxford university press.
11. Mann, G. F., and Saunders, C. B., (1960) Practical Organic Chemistry: 4th Edition. Longman
12. Vogel, I. A., (1956) A Text Book of Practical Organic Chemistry Including Qualitative Organic Analysis: 3rd Edition. Longman

Internet references:

1. http://www.internetchemistry.com/chemistry/organic_chemistry.htm

PY2Y627: MEDICINAL CHEMISTRY – I

L	T	P	Th. Credit	Tut. Credit	Pr. Credit	Total Credits	Maximum Marks				
							TH	CW	SW	Pr.	Total
3	1	4	3	1	2	6	75	25	15	35	**150**

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to

- Understand the chemistry of drugs with respect to their pharmacological activity
- Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
- Know the Structural Activity Relationship (SAR) of different class of drugs
- Write the chemical synthesis of some drugs.

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Recognize the need for medicinal chemistry principles in understanding the impact of drug discovery on human health.

CO-2: Draw and relate the chemical structure of drugs and their pharmacological properties

CO-3: Understand the therapeutic value ofdrugs, drug metabolism and drug adverse effect in relation to professional pharmacy practice.

CO-4: Systematically outline the Structural Activity Relationship (SAR) of different class of drugs.

CO-5: Sketch and explain the chemical synthesis of drugs which is very important learning for a medicinal chemist.

THEORY **DURATION (LECTURE)**

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

UNIT-I **10**

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**

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**

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 **08**

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.

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 **07**

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, 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.

PRACTICALS: Minimum 15 experiments based on following:

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 drugs

BOOKS & REFERENCES RECOMMENDED:

Text books:

1. Block J. H., Beale J. M., "Wilson and Gisvold's Textbook of organic medicinal and pharmaceutical chemistry", 11th edition, 2004, Lippincott Williams and Wilkins-A Wolters Kluwer Company.
2. Lemke T. L., Williams D. A., "Foye's principles of medicinal chemistry", 6th edition, 2008, Lippincott Williams and Wilkins-A Wolters Kluwer Company.

Reference books:

1. Wolff M. E., "Burger's medicinal chemistry and drug discovery" 5th edition, 1995, Wiley-Interscience, New York.
2. Finar I. L., Organic Chemistry (2011) vol.2, Organic Chemistry: 6th Edition. Longman.
3. Vogel, I. A., (1956) A Text Book of Practical Organic Chemistry Including Qualitative Organic Analysis: 3rd Edition. Longman
4. The Science and Practice of Pharmacy by Remington, 21th edition, 2005, Lipincott, William and Wilkins.
5. Indian Pharmacopoeia, The Indian Pharmacopoeia Commission, Govt. of India. Ministry of Health and Family Welfare, Ghaziabad. 5th edition, 2007
6. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1to 5.
7. Smith H. J., Williams H., "Introduction to Principles of drug design" 4th edition (2005) CRC Press.

PY2Y620: PHYSICAL PHARMACEUTICS-II

L	T	P	Th. Cr.	Tu. Cr.	Pr. Cr.	Total Credit	Maximum Marks				
							TH	CW	SW	Pr.	Total
3	1	4	3	1	2	6	75	25	15	35	150

Scope:

- To develop understanding about fundamental principles of physical pharmacy.
- To impart knowledge of scientific principles behind chemical kinetics, interfacial phenomenon, micromeritics, rheology, diffusion & dissolution and their pharmaceutical applications.

Objectives: On completion of this subject, students would be able to

- Understand basic concept of interfacial phenomena, colloids, rheology and micromeritics and their pharmaceutical application.
- Impart the knowledge of basic principles and theories of emulsions, suspensions and semi-solids with their pharmaceutical applications.
- Understand various physicochemical properties of drug molecules in the designing the dosage forms
- Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
- Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Explain the basic concept of interfacial phenomena, colloids, rheology and micromeritics and their pharmaceutical application.

CO-2: Understand the knowledge of basic principles and theories of emulsions, suspensions and semi-solids with their pharmaceutical applications.

CO-3: Relate the various pharmaceutical characteristics of drug and formulation for designing of dosage forms

CO-4: Apply the principles of chemical kinetics and to use them for stability testing and determination of expiry date of the formulations

CO-5: Perform different pharmaceutical experiment related to drug and dosage forms.

THEORY TOPICS **DURATION (LECTURE)**

UNIT I **07**

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**

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**

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 **08**

Micromeretics: 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**

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

PRACTICALS:

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
12. Determination of reaction rate constant zero order
13. To determine the surface tension of given liquid with the help of the Stalagmometer.
14. To find out the critical micellar concentration of tween 80 by using Stalagmometer
15. To determine the viscosity of a given liquid with respect to water, by ostwald viscometer

BOOKS & REFERENCES RECOMMENDED

Text books:

1. Patrick J. Sinko, Martin's Physical Pharmacy and Pharmaceutical Sciences, Sixth Edition, 2011, Lippincott Williams & Wilkins.
2. Rawlins, E.A., Bentley's Text Book of Pharmaceutics, Eighth Edition, 2010, Elsevier/BSP Books Pvt. Ltd.
3. Joseph, K. H. Ma, Hadzija, B., Basic Physical Pharmacy, 2012, Jones & Bartlette.
4. Physical Pharmacy by Alfred Martin, Sixth edition.
5. Experimental pharmaceutics by Eugene, Parott.
6. Tutorial pharmacy by Cooper and Gunn..
7. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
8. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
9. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
10. Physical Pharmaceutics by Ramasamy C, and Manavalan R.

Reference books:

1. Lloyd, V. A., Remington's The science & Practice of pharmacy, 22nd Edition, 2012, Pharmaceutical Press.
2. Alexander T. F., David A., Physicochemical Principles of Pharmacy, Fifth Edition, 2011, Pharmaceutical Press.

Internet references:

1. http://www.micromeritics.com/
2. http://nptel.ac.in/

PY2Y628: PHARMACOLOGY-I

L	T	P	Th. Cr.	Tu. Cr.	Pr. Cr.	Total Credit	Maximum marks				
							TH	C	SW	Pr	Tot
3	1	4	3	1	2	6	75	25	15	35	150

Scope:

- To understand pharmacology of drugs with basics of drug action and effect consequences (desirable and undesirable) in the course of disease treatment.
- To have general understanding of drugs used in therapeutics.
- To learn basics of drug's mechanism of action, physiological and biochemical effects (Pharmacodynamics).

Objectives:

After completion of course, student should be able to:

- Understand scientific principles of drug action and various mechanisms by which drugs can medicate their pharmacological and other effects.
- Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
- Apply the basic pharmacological knowledge in the prevention & treatment of various diseases.
- Understand the principle of pharmacokinetic that underlay absorption, distribution, metabolism and excretion of drugs thereby assess drugs behaviour and effectiveness.
- Understand the legal requirements of animal housing and ethical handling of animals.
- Understand the procedure for new drug development.
- Observe the effect of drugs on animals by simulated experiments.

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Enlist the pharmacokinetic parameters to moniter drugs kinetics/effectiveness in the living system.

CO-2: Describe the pharmacodynamic aspects of various mechanisms involved in receptor & ligand (Agonist, antagonist), drug interaction, adverse drug reaction and steps involved in drug discovery process.

CO-3: Explain the mechanism of action, interaction and adverse effects of drugs used in treatment of peripheral nervous system and central nervous system disorders.

CO-4: Develop the basic practical skills of animal handling and experimentation.

CO-5: Define the terminologies like drug addiction, drug abuse, tolerance and dependence

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THEORY TOPICS **DURATION (LECTURES)**

UNIT I **10**

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 non competitive), 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**

General Pharmacology

a. 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.
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 and pharmacovigilance.

UNIT III **10**

Pharmacology of drugs acting on peripheral nervous system

a. Organization and function of ANS.
b. Neurohumoral transmission, 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 **8**

Pharmacology of drugs acting on central nervous system

a. Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters 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.

UNIT V **7**

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.

PRACTICALS: Minimum 15 experiments based on the following:

1. To study commonly used instruments in experimental pharmacology.
2. To study common laboratory animals.
3. To study maintenance of laboratory animals as per CPCSEA guidelines.
4. To study common laboratory techniques like Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
5. To study different routes of drugs administration in mice/rats.
6. To study the effect of hepatic microsomal enzyme inducers on phenobarbitone sleeping time in mice.

7. To study the effect of drugs on ciliary motility of frog oesophagus.
8. To study the effect of drugs on rabbit eye.
9. To study effects of skeletal muscle relaxants using rota-rod apparatus.
10. To study effect of drugs on locomotor activity using actophotometer.
11. To study anticonvulsant effect of drugs by MES and PTZ method.
12. To study stereotype and anti-catatonic activity of drugs on rats/mice.
13. To study anxiolytic activity of drugs using rats/mice.
14. To study local anesthetics by different methods

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

BOOKS AND REFERENCES RECOMMENDED:

Text books:

1 Tripathi, K. D. Essentials of Medicinal Pharmacology, 7th edition 2013, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
2 Satostkar, R.S., Rege, N.N., Bhandarkar, S.D. Pharmacology and Pharmacotherapeutics. Revised 23rd edition 2013, Popular Prakashan Pvt. Ltd., Mumbai,
3 Rang, H.P., Dale, M.M., Ritter, J.M., Flower, R.J., Henderson, G. Rang and Dale's Pharmacology. 8th edition 2015, Elsevier India.
4 Ghosh, M. N. Fundamentals of Experimental Pharmacology. 2nd edition 1984, Scientific Book Agency, Calcutta.
5 Kulkarni, S.K., Hand Book of Experimental Pharmacology, 3rd Edition, 1999, Vallabh Prakashan.
6 Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher.

Reference books:

1. Brunton, L., Chabner, B.A., Knollman, B. Goodman and Gillman's the Pharmacological Basis of Therapeutics. 12th edition 2011, McGraw Hill Education.
2. Katzung B. G., Trevor A.J. Basic and Clinical Pharmacology.13th edition 2015, McGraw-Hill Medical
3. Vogel, H. G. Drug Discovery and Evaluation. 2nd edition 2002, Springer Publication, Berlin.
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. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,

Software:

1 Ex-Pharm, Raveendran R. Department of pharmacology, JIPMER, Pandicherry, India, 2009.

Website:

1. http://www.indphar.org

Mobile Application:

1 Pharmacology by Apple Medical Group 2014.

PY2Y621: PHARMACOGNOSY & PHYTOCHEMISTRY-I

L	T	P	Th. Cr.	Tu. Cr.	Pr. Cr.	Total Credit	Maximum Marks				
							TH	CW	SW	Pr.	Total
3	1	4	3	1	2	6	75	25	15	35	150

Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Objectives:
After completion of course, student shall be able to:

- Know the techniques in the cultivation and production of crude drug.
- Know the crude drugs, their uses and chemical nature.
- Know the evaluation techniques for the herbal drugs.
- Carry out the microscopic and morphological evaluation of crude drug.

Course Outcomes: Upon completion of the course, student shall be able to:

CO-1: Understand scope of pharmacognosy with their pharmaceutical significance.
CO-2: Explain the sources, uses, chemical nature, characteristic features and evaluation techniques of herbal drugs.
CO-3: Illustrate different techniques of cultivation, collection, storage and conservation of herbal drugs.
CO-4: Apply different techniques of plant tissue culture in relation to their pharmaceutical applications.
CO-5: Relate importance of crude drugs in ayurvedic and alternative system of medicine

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THEORY **DURATION (LECTURES)**

UNIT I **10**

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

UNIT II **10**

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 **7**

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**

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 **8**

General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and 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.

PRACTICALS: Minimum 15 experiments based on the following:

1. Analysis of crude drugs by chemical tests: (i)Tragaccanth (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 paliside 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.
11. Morphology of crude drugs.
12. Microscopy of crude drugs.
13. Powder microscopy of crude drugs.

BOOKS & REFERENCES RECOMMENDED

Text books

1. Kokate C.K., Purohit A.P., Gokhale S.B., Pharmacognosy, 44th edition, 2009, Published by Nirali Prakashan, New Delhi.
2. Wallis TE. Textbook of Pharmacognosy. 5th edition, 1985, CBS Publishers and Distributors, New Delhi.
4. Kokate C. K., Practical Pharmacognosy, 4th edition, 2006, Vallabh Prakashan, New Delhi. Mohammad Ali. Pharmacognosy and Phytochemistry, 1st edition, 2008, CBS Publishers & Distribution, New Delhi.
5. Ansari S.H.,Essentials of Pharmacognosy, 2nd edition, 2007, Birla publications, New Delhi.
6. Khandelwal K.R., Practical Pharmacognosy, Techniques and Experiments, 17th edition, 2007, published by Nirali Prakashan. New Delhi.
7. Iyengar M.A., Nayak S.G.K., Anatomy of Crude Drugs, 2016.

Reference books

1. Evans, W. C. "Trease and Evans Pharmacognosy", 16th edition, 2009, WB Saunders& Co, London.
2. Tyler VE., Brady LR and Robbers JE., Pharmacognosy, 9th edition, 1988, Lea and Febiger, Philadelphia.
3. Choudhary R.D., Herbal drug industry, 1st edition, 1996, Eastern Publisher, New Delhi.
4. Mukherjee P. K., Quality Control of Herbal drugs. An Approach to Evaluation of Botanicals, 2002, Business Horizons.
5. Vyas S.P., Dixit V.K., Pharmaceutical Biotechnology, 1st edition, reprint2007, CBS Publishers & Distribution, New Delhi.