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Amrutvahini Sheti & Shikshan Vikas Sanstha's

Amrutvahini College of Pharmacy, Sangamner

(An Autonomous College)

(As per UGC letter Ref.no. No.F. 2-10/2023(AC-Policy) dated 27th May 2025 and SPPU letter no. CA/ 716 dated 09/06/2025)

SYLLABUS FOR SECOND YEAR BACHELOR OF PHARMACY (S.Y.B.Pharm)

[Framed under Regulation 6, 7 & 8 of the Bachelor of Pharmacy (B. Pharm) course regulations 2014]

With Effect from Academic Year
2026-27
[Revision 0.0]

Amrutvahini Sheti & Shikshan Vikas Sanstha's

Amrutvahini College of Pharmacy, Sangamner

Nashik-Pune Highway, Ghulewadi, Amrutnagar,
Tal. Sangamner, Dist.-Ahilynagar, Pin Code:- 422608

Vision

Our College will be recognized as socially cautious centre of excellence in innovative education through its contribution in training, scholarly research in pharmacy profession and services to society

Mission

For translation of our vision into reality college is striving to:

M1: Provide value based student centric and sustained quality pharmaceutical education

M2: Foster advanced and innovative research that benefits pharmaceutical industry and community.

M3: Encourage and strengthen leadership, competitiveness, ethical reasoning and intellectual curiosity

Amrutvahini Sheti & Shikshan Vikas Sanstha's
AMRUTVAHINI COLLEGE OF PHARMACY, SANGAMNER
• Approved by Pharmacy Council of India (PCI), New Delhi • Approved by D.T.E., Mumbai & Govt. of Maharashtra
• Permanently Affiliated to Savitribai Phule Pune University • Recognised under section 2(f) and 12B UGC Act 1956
• University ID : PU/AN/Pharm/83, 2004; Puncode : CPHA016760 • DTE CODE : 5194 • A.I.S.H.E. Code : C-42026 • NAAC "A" Grade
An Autonomous College

Ref. AVCOP/ 64 /2026-27 Date: 02/05/2026

Syllabus for Second Year B.Pharm -2026-27:B.Pharm

The Bachelor of Pharmacy (B.Pharm) program syllabus of **Second Year B.Pharm Semester-III and Semester–IV** of academic year 2026-27 being offered at **Amrutvahini College of Pharmacy, Sangamner (An Autonomous College)** has been duly approved by the Academic Council of Amrutvahini Sheti & Shikshan Vikas Sanstha's, Amrutvahini College of Pharmacy, Sangamner (An Autonomous College).

Dr.M.J.Chavan
Chairman Academic Council & Principal
Chairman, Academic Council
Amrutvahini College of Pharmacy
(Autonomous), Sangamner-422608

Course of study for semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP301T	Pharmaceutical Organic Chemistry II – Theory	3	1	4
BP302T	Physical Pharmaceutics I – Theory	3	1	4
BP303T	Pharmaceutical Microbiology – Theory	3	1	4
BP304T	Pharmaceutical Engineering – Theory	3	1	4
BP305P	Pharmaceutical Organic Chemistry II – Practical	4	-	2
BP306P	Physical Pharmaceutics I – Practical	4	-	2
BP307P	Pharmaceutical Microbiology – Practical	4	-	2
BP 308P	Pharmaceutical Engineering –Practical	4	-	2
Total		**28**	**4**	**22**

BAD309T*	Democracy, Election and Governance-Theory*

*Add on course (Non Countable credit Course) as per UGC. The credits of which will be converted to grade and course is compulsory to get degree certificate

Program: B. Pharmacy **Class:** Second Year **Semester: III**

Pharmaceutical Organic Chemistry-II (Theory)

Course Code: BP301T **Credits:** 4 **Contact Hours:** 45 Hrs.

Scope : This course provides a comprehensive understanding of the chemistry, preparation, properties, and reactions of aromatic and heterocyclic organic compounds relevant to pharmaceutical sciences. It emphasizes reaction mechanisms, orientation and reactivity in organic transformations, and the chemistry of fats and oils, thereby establishing a strong foundation for medicinal chemistry, pharmaceutical synthesis, and drug development.

Objectives :

- Draw the structure; write 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 Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
CO-BP301T.1	Apply concepts of aromacity, structure, and electrophilic substitution reactions to analyze reactivity and orientation in benzene and its derivatives.
CO-BP301T.2	Evaluate the acidity/basicity and reactivity of phenols, aromatic amines, and acids, including their synthetic and pharmaceutical significance.
CO-BP301T.3	Analyze the chemical properties, reactions, and analytical parameters of fats and oils for quality assessment and industrial applications.
CO-BP301T.4	Explain the structure, stability, reactions, and medicinal importance of Polynuclear hydrocarbons and their derivatives.
CO-BP301T.5	Interpret the stability and reactivity of cycloalkanes using various strain theories and reaction mechanisms

Course Content:

Note- General methods of preparation (any 05) and reactions of compounds superscripted with asterisk (*) to be explained.

Unit	Topic	Hours
I	**Benzene and its derivatives**: A. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule B. Reactions of benzene- nitration, sulphonation, halogenation reactivity, Friedel crafts alkylation reactivity, limitations, Friedel crafts acylation. C. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction	**10**

II	• **Phenols*-** Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthol • **Aromatic Amines*-** Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts • **Aromatic Acids*-** Acidity, effect of substituents on acidity and important reactions of benzoic acid.	**10**

III	**Fats and Oils Fatty acids- Introduction: Definition, Classification, Nomenclature,** reactions. b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. c. Analytical constants– Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value– significance and principle involved in their determination.	**10**
IV	**Polynuclear hydrocarbons**- a. Definition, Stability b. Synthesis, reactions c. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	**08**
V	**Cyclo alkanes* —** Stabilities– Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strain less rings), reactions of cyclopropane and cyclobutane only	**07**

Recommended Books: (Latest Editions)

1. Morrison, R. T. & Boyd, R. D Textbook of Organic Chemistry, VI(ed.)ELBS, London, 1996 2. Pine, S. H, Organic Chemistry, V, Tata McGraw Hill, New Delhi, 2003
2. Finar, I. L., Organic Chemistry Vol. I, V(ed.), ELBS, Pearson Education, New Delhi, 2003
3. Joule and Mills, Heterocyclic Chemistry, IV (ed.), Blackwel Publishing House, Oxford, UK, 2004
4. Li, J. J., Name Reactions, III (ed.), Springer, Berlin, 2006
5. Furniss, B. S., Hannaford, A. J. Smith, P. W. G., and Tatchel, A. R., "Vogel"s Textbook of Practical Organic Chemistry", V (ed.), Pearson, London, 1994
6. Finar, I. L., Organic Chemistry Vol. I, V (ed.), ELBS, Pearson Education, New Delhi, 2003
7. Mann, F. G. and Saunders, B. C., Practical Organic Chemistry, IV(ed.), Pearson, UK, 2009
8. Advanced General Organic Chemistry-A Modern Approach by Sachin Kumar Ghosh, 3/Ed. 2009, New Central Book Agency (P) Ltd

Program: B. Pharmacy **Class:** Second Year **Semester: III**

Physical Pharmaceutics - I

Course Code: BP302T **Credits:** 4 **Contact Hours:** L 45 (3 Hr/wk), T 15 (1 Hr/wk)

Scope : The course deals with the various physical and physicochemical properties, and principals 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 completion of this course the student shall be able:

- Knowledge of various physicochemical properties of drug molecules in the designing the dosage forms.
- Know the different states of matter, properties and behavior of each state
- Understand surface and interfacial tension concepts.
- Understand types and mechanisms of complex formation.
- Understand and apply pH, buffer systems, and isotonicity principles in pharmaceutical formulations.

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP302T.1	Apply principles of drug solubility, solution behavior, phase equilibria, and distribution law in pharmaceutical systems.
BP302T.2	Explain states of matter, phase transitions, crystal properties, polymorphism, and physicochemical characteristics of drug molecules.
BP302T.3	Analyse surface and interfacial phenomena, including surface tension, adsorption, and applications of surfactants in drug formulation
BP302T.4	Explain complexation, protein binding, and their role in drug action, stability, and pharmaceutical applications.
BP302T.5	Apply concepts of pH, buffers, and isotonicity in the preparation and evaluation of pharmaceutical solutions.

Course Content:

Unit	Topic	Hours
I	**Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Introduction to BCS Classification. Solubility of gas in liquids, solubility of liquids in liquids, Solubility of Solids in liquids (Binary solutions, ideal solutions), real solutions, Raoult's law, and its deviation. Partially miscible liquids (Phase equilibria, Phase rule, One, two and three component systems), Critical solution temperature and applications). Distribution of solutes between immiscible solvents: Distribution law, its limitations and applications.	**10**
II	**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, Liquefaction of gases, aerosols– inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, Crystalline solids, polymorphism, Solvates, amorphous Solids, Cocrystals. **Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications.	**09**
III	**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, Cloud point and Krafft point, HLB Scale, solubilization, detergency, adsorption at solid interface.	**09**
IV	**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.	**09**
V	**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, Isotonicity.	**08**

References:

1. Carter SJ, editor. Cooper and Gunn's Tutorial Pharmacy. 6th ed. New Delhi: CBS Publishers & Distributors Pvt. Ltd.; 2005.
2. Jain K, Khar RK, Ahmad FJ. Textbook of Physical Pharmacy. 1st ed. New Delhi: Elsevier India Pvt. Ltd.; 2016.
3. Lieberman HA, Lachman L, Schwartz JB, editors. Pharmaceutical Dosage Forms: Tablets. 2nd ed. Vol. 1–3. New York: Marcel Dekker Inc.; 1989–1990.
4. Lieberman HA, Rieger MM, Banker GS, editors. Pharmaceutical Dosage Forms: Disperse Systems. 2nd ed. Vol. 1–3. New York: Marcel Dekker Inc.; 1988–1998.

5. Parrott EL, Saski W. Experimental Pharmaceutics. 4th ed. Minneapolis: Burgess Publishing Company; 1977.
6. Sinko PJ, editor. Martin's Physical Pharmacy and Pharmaceutical Sciences. 8th ed. Philadelphia: Wolters Kluwer; 2023.
7. Subrahmanyam CVS. Physical Pharmaceutics-I: The Molecular Approach. 2nd ed. New Delhi: Vallabh Prakashan; 2022.

Program: B. Pharmacy **Class: Second** Year **Semester: III**

Pharmaceutical Microbiology

Course Code: BP303T **Credits:** 4 **Contact Hours:** L 45 (3 Hr/wk), T 15 (1 Hr/wk)

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 of various microorganisms
- To understand the importance and implementation of sterilization in pharmaceutical 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 Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP303T.1	Explain basic microbiology concepts, microscopy, and identification of microorganisms.
BP303T.2	Describe the growth requirements, cultivation methods, and reproduction processes of microorganisms.
BP303T.3	Apply the principles and methods of sterilization and disinfection for effective control of microorganisms.
BP303T.4	Outline aseptic techniques, sterility testing, and microbiological assays.
BP303T.5	Analyze microbial spoilage, preservation methods, and animal cell culture.

Course Content:

Unit	Topic	Hours
I	**Basics of microbiology** Introduction & history: Introduction, history of microbiology (Contribution of Louis Pasteur & Robert Koch), its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes. Microscopy: Types, Study of phase contrast microscopy, dark field microscopy and electron microscopy. Morphology of microorganisms: Study of ultra-structure and morphological classification of bacteria, Study of morphology, classification of Fungi and Virus. Identification of bacteria: Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC).	**9**
II	**Growth and cultivation:** Nutritional requirements, culture media, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure	**9**

	cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Reproduction/Replication and cultivation of fungi and virus.	
III	**Sterilization and Disinfection** Sterilization: Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipment employed in large scale sterilization. Sterility indicators. D- value, Z- value and its significance. Disinfectants and Antiseptics: Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & bacteriostatic.	**9**
IV	**Pharmaceutical Microbiology Application** Aseptic techniques: Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Sterility testing: Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP. Microbiological Assay: Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.	**9**
V	**Microbial spoilage and animal cells culture** Microbial spoilage: Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. (Microbial limit test and regulatory requirements).Preservation of pharmaceutical products: Preservatives, evaluation of microbial stability of formulations (Preservative efficacy test).Preservation of pharmaceutical products using antimicrobial agents, Animal cells culture: 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	**9**

References:

1. Ananthanarayan R, Paniker CKJ. Textbook of Microbiology. 10th ed. Chennai: Orient Longman; 2013.
2. Bergey DH, Holt JG. Bergey's Manual of Systematic Bacteriology. 1st ed. Baltimore: Williams & Wilkins; 1984.
3. Cooper, Gunn. Tutorial Pharmacy. 6th ed. New Delhi: CBS Publishers & Distributors; 1986.
4. Harris M. Pharmaceutical Microbiology. London: Bailliere Tindall; 1989.
5. Hugo WB, Russell AD. Pharmaceutical Microbiology. 7th ed. Oxford, London: Blackwell Scientific Publications; 2004.
6. Jain NK. Pharmaceutical Microbiology. 1st ed. New Delhi: Vallabh Prakashan; 1998.
7. Kokare CR. Pharmaceutical Microbiology: Principles and Applications. 16th ed. Pune: Nirali Prakashan; 2020.
8. Pelczar MJ, Chan ECS, Krieg NR. Microbiology. 5th ed. New Delhi: Tata McGraw-Hill Publishing Company; 1993.
9. Prescott SC, Dunn CG. Industrial Microbiology. 4th ed. New Delhi: CBS Publishers

& Distributors; 2010.

10. Probisher H, Hinsdill RD, et al. Fundamentals of Microbiology. 9th ed. Tokyo: Japan Scientific Societies Press; 1995.
11. Tortora GJ, Funke BR, Case CL. Microbiology: An Introduction. 12th ed. Pearson Education; 2010.

Program: B. Pharmacy **Class:** Second Year **Semester: III**

Pharmaceutical Engineering

Course Code : BP304T **Credits: 4** **Contact Hours:** L 45 (3 Hr/wk), T 15 (1 Hr/wk)

Scope : This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

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

- To know various unit operations used in Pharmaceutical industries.
- To understand the material handling techniques.
- To perform various processes involved in pharmaceutical manufacturing process.
- To appreciate and comprehend significance of plant lay out design for optimum use of resources.
- To appreciate the various preventive methods used for corrosion control in pharmaceutical industries.

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP304T.1	Explain the principles and applications of fluid flow, size reduction, and size separation, including the working; and summarise industrial use of related pharmaceutical equipment.
BP304T.2	Apply the concepts of heat transfer, evaporation, and distillation for the selection and operation of pharmaceutical processing equipment
BP304T.3	Analyze the principles of drying and mixing and select suitable equipment for processing pharmaceutical solids, liquids, and semisolids.
BP304T.4	Examine filtration and centrifugation processes of unit operations in the pharmaceutical industry
BP304T.5	Demonstrate the material selection for pharmaceutical plant with emphasis on corrosion prevention and material handling systems.

Course Content:

Unit	Topic	Hours
I	**Flow of fluids:** Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturi meter, Pitot tube and Rotameter. **Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, Roller mill, ball mill, fluid energy mill, Colloidal mill, Edge runner mill & end runner mill. Introduction to Mills used in pharmaceutical unit operation. **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	**10**
II	**Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. **Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator. **Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation	**10**
III	**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.	**9**
IV	**Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter &Cartridge filter, membrane filters and Seidtz filter. **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, non-perforated basket	**9**

	centrifuge, semi continuous centrifuge & super centrifuge.	
V	**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 their prevention. Ferrous and nonferrous metals, inorganic and organic nonmetals, basic of material handling systems.	**7**

References:

1. Badger WL, Banchero JT. Introduction to Chemical Engineering. New York: McGraw-Hill; 2016.
2. Carter SJ. Cooper and Gunn's Tutorial Pharmacy. New Delhi: CBS Publishers & Distributors; 2008.
3. Lachman L, Lieberman HA, Kanig JL. The Theory and Practice of Industrial Pharmacy. Mumbai: Varghese Publishing House; 2022.
4. Martin A. Remington: The Science and Practice of Pharmacy. Philadelphia: Lippincott Williams & Wilkins; 2000.
5. McCabe WL, Smith JC, Harriott P. Unit Operations of Chemical Engineering. New York: McGraw-Hill; 2001.
6. Simpson NJK. Solid-Phase Extraction: Principles, Techniques, and Applications. New York: Marcel Dekker; 2018.
7. Subrahmanyam CVS, et al. Pharmaceutical Engineering: Principles and Practices. New Delhi: Vallabh Prakashan; 2008.

Program: B. Pharmacy **Class:** Second Year **Semester: III**

Pharmaceutical Organic Chemistry-II (Practical)

Course Code: BP305P **Credits:** 2 **Contact Hours:** 04 Hrs./Week (Practical)

Scope : This course focuses on practical skills in analyzing oils and fats and preparing organic compounds through classical reactions. It provides hands-on experience in separation techniques, functional group transformations, and reaction mechanisms, bridging theoretical knowledge with laboratory practice

Objectives : To develop accurate laboratory skills in analysis and synthesis of organic compounds.

- To understand reaction mechanisms and functional group behavior in organic chemistry.
- To learn reagent standardization, quantitative analysis, and mixture separation techniques.
- To apply experimental knowledge to real-world chemical and industrial processes safely and effectively.

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP305P.1	Apply laboratory safety measures and appropriate waste management practices to ensure safe handling, storage, and disposal of chemicals during pharmaceutical laboratory experiments.
BP305P.2	Analyze oil samples by determining acid, iodine, and saponification values
BP305P.3	Apply separation techniques to isolate components from a binary mixture
BP305P.4	Perform and create organic compounds using various chemical reactions

Course Content: **Total 60 Hrs. (04 hrs./ week)**

Unit	Topic
I	Introduction and demonstration on Waste disposal and Laboratory safety
II	Determination of value of oil samples (Including standardization of reagent) - Acid Value, Saponification Value
III	Experiments Involving separation of Binary mixture

IV	**Synthesis of compounds and Recrystallization, TLC and Melting point after each synthesis** • Benzanilide /phenyl benzoate /acetanilide from aniline/phenol/ aniline • y benzoylation/acylation reaction • 2, 4, 6-Tribromoaniline/ para-bromo acetanilide from aniline using green synthesis • p-bromo Acetanilide by halogenation (Bromination) reaction using green synthesis • Acetanilide by acetylation reaction using aniline and zinc acetate • 5-Nitrosalicylic /meta-dinitrobenzene from salicylic acid/ nitrobenzene by nitration reaction Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl Salicylate by hydrolysis reaction. • 1-Phenylazo-2-naphthol from aniline by diazotization and Coupling reactions/ p-Iodobenzoic acid from P amino benzoic acid by replacement reaction. • Benzil from benzoin by oxidation reaction • Dibenzal acetone from benzaldehyde by Claisen-Schmidt reaction

Recommended Books: (Latest Editions)

1. Mann, F. G. and Saunders, B. C., Practical Organic Chemistry, IV(ed.), Pearson, UK, 2009

2. Vogel's Text Book of Practical Organic Chemistry- Brian Furniss, Antony Hannaford, Peter Smith, Austrin (Eds), 5th edition, ELBS Publication, Singapore, 1997.

3. A Guidebook to Mechanism in Organic Chemistry by Peter Sykes Longman Scientific and Technical, Sixth Edition, 1985.

4. Advanced Organic Chemistry by Francis A. Carey, Part A: Structure and Mechanism, Springer, 2007.

5. Writing Reaction Mechanisms in Organic Chemistry by Audrey Miller, Second Edition, Elsevier Science & Technology Books, 1999.

6. Organic Reactions by Werner E. Bachmann, Volume I, John Wiley and Sons. INC,1942, 7. Advanced Organic Chemistry Reaction Mechanisms by Reinhard Bruckner, Elsevier, 2002

Program : B. Pharmacy **Class:** Second Year **Semester : III**

Physical Pharmaceutics I – Practical

Course Code : BP306P **Credits : 2** **Contact Hours:** P 60 (4 Hr/wk)

Scope : This practical course provides hands-on training in physicochemical principles of drugs such as solubility, partition coefficient, surface tension, adsorption, and complexation. It helps students understand their applications in drug formulation, stability, and bioavailability.

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

- Operate different pharmaceutical laboratory instruments used in determining various physical properties solubility, partition coefficient and pKa value.
- Understand and measure surface and interfacial phenomena such as surface tension and adsorption.
- student develop skills in experimental techniques related to physical pharmaceutics-l

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP306P.1	Analyze various physicochemical properties such as solubility and partition coefficient.
BP306P.2	Study the principle of critical solution temperature & effect of addition of electrolyte on CST of phenol-water system.
BP306P.3	Elaborate principles and measurements of surface tension, critical micelle Concentration, Freundlich and Langmuir constants and HLB value of given surfactant.
BP306P.4	To predict stability constant and donor acceptor ratio of given compound.
BP306P.5	To evaluate physicochemical properties of drugs refractive index, pKa and Cloud point and Kraft point

Course Content:

1. Determination the solubility of drug (Oxalic acid/ Salicylic acid/ Sodium Chloride) at room temperature by titrimetric or gravimetric method.
2. Evaluation of effect of pH on solubility of drug.
3. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
4. Determination of Partition co- efficient of benzoic acid in benzene and water.
5. Determination of Partition co- efficient of Iodine or suitable substance n-octanol/n-hexane and water.
6. Determination of CST using phenol water system / triethylamaine water system.
7. Determination of % composition of NaCl in a solution using phenol-water system by CST method.

8. Determination of Refractive index of given sample (Water/ Ethanol/ Acetone/ Vegetable oil/ Glycerine solution).
9. Determine surface tension of given liquids (Water/ Toluene/ Glycerine solution)
10. by drop count and drop weight method
11. Determination of HLB number of a surfactant (GMS) by saponification method.
12. Determination of Freundlich and Langmuir constants using activated charcoal.
13. Determination of critical micellar concentration of surfactants (SLS).
14. Determination of Cloud point and Kraft point of given surfactant (Tween 80/ SLS).
15. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method.
16. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method.

References:

1. Carter SJ, editor. Cooper and Gunn's Tutorial Pharmacy. 6th ed. New Delhi: CBS Publishers & Distributors Pvt. Ltd.; 2005.
2. Derle DV. Essentials of Physical Pharmacy. 2nd ed. Hyderabad: PharmaMed Press; 2008.
3. Jain K, Khar RK, Ahmad FJ. Textbook of Physical Pharmacy. 1st ed. New Delhi: Elsevier India Pvt. Ltd.; 2016.
4. Lieberman HA, Lachman L, Schwartz JB, editors. Pharmaceutical Dosage Forms: Tablets. 2nd ed. Vol. 1–3. New York: Marcel Dekker Inc.; 1989–1990.
5. Lieberman HA, Rieger MM, Banker GS, editors. Pharmaceutical Dosage Forms: Disperse Systems. 2nd ed. Vol. 1–3. New York: Marcel Dekker Inc.; 1988–1998.
6. More HN, Hajare AA. Physical Pharmaceutics Practical Handbook. 1st ed. Nashik: Career Publications; 2018.
7. Parrott EL, Saski W. Experimental Pharmaceutics. 4th ed. Minneapolis: Burgess Publishing Company; 1977.
8. Sinko PJ, editor. Martin's Physical Pharmacy and Pharmaceutical Sciences. 8th ed. Philadelphia: Wolters Kluwer; 2023.
9. Subrahmanyam CVS. Physical Pharmaceutics-I: Practical Handbook. 1st ed. New Delhi: Vallabh Prakashan; 2022.
10. Subrahmanyam CVS. Physical Pharmaceutics-I: The Molecular Approach. 2nd ed. New Delhi: Vallabh Prakashan; 2022.

Program: B. Pharmacy **Class:** second Year **Semester: III**

Pharmaceutical Microbiology - Practical

Course Code : BP307P **Credits : 2** **Contact Hours:** P 60 (4 Hr/wk)

Scope : This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Objectives :

- To know various unit operations used in Pharmaceutical industries.
- To understand the material handling techniques.
- To perform various processes involved in pharmaceutical manufacturing process.
- To carry out various test to prevent environmental pollution.
- To appreciate and comprehend significance of plant lay out design for optimum use of resources.
- To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP307P.1	Describe microbiology lab equipment and perform bacterial motility test by hanging drop method.
BP307P.2	Perform staining techniques and biochemical tests for identification of microorganisms.
BP307P.3	Demonstrate sterilization methods and Perform media preparation, sub culturing, and isolation of pure microbial cultures.
BP307P.4	Explain and perform sterility testing, microbiological assay of antibiotics, MIC determination and bacteriological analysis of water using standard techniques.

Course Content:

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. To study motility of bacteria by hanging drop method.
3. To study bacterial morphology by simple staining technique.
4. To study bacterial morphology by gram staining technique.
5. To study the given bacterial culture by acid fast staining technique.
6. To perform biochemical test (IMViC) for identification of microorganism.
7. To carry out sterilization of glassware, preparation & sterilization of nutrient media (Nutrient broth).

8. To prepare sterile nutrient agar stab, slant and plates.
9. To study sub culturing of Bacteria or Fungi.
10. To isolate the pure cultures of microorganisms by using streak plate method
11. To isolate the pure cultures of microorganisms by pour plate method.
12. To perform sterility test (Injection/Ophthalmic solution) by direct inoculation method as per IP.
13. Microbiological assay of antibiotics by cup plate method or other method.
14. To determine Minimum Inhibitory Concentration (MIC) of given antibiotic sample.
15. Bacteriological analysis of water by most probable number technique.
16. Evaluation of disinfectant by disc diffusion method.

References:

1. Aneja KR. Experiments in Microbiology, Plant Pathology and Biotechnology. 4th ed. New Delhi: New Age International Publishers; 2003.
2. Bodhankar S. Practical Book of Pharmaceutical Microbiology. 1st ed. Pritam Publications; 2024.
3. Gujar KN, Bhatnagar S. Pharmaceutical Microbiology (Practicals). 1st ed. Mumbai: Himalaya Publishing House; 2018.
4. Kokare CR. Pharmaceutical Microbiology with Practicals. 2nd ed. Pune: Nirali Prakashan; 2019.
5. Mahajan K, Mendhekar SY, Mehta HD. Practical Handbook of Pharmaceutical Microbiology. 1st ed. Pritam Publications; 2024.
6. Mahore JG, et al. A Practical Book of Pharmaceutical Microbiology. 1st ed. Pune: Nirali Prakashan; 2022.
7. Sharma K. Practical Manual of Pharmaceutical Microbiology. 1st ed. New Delhi: R. Narain Publishers & Distributors; 2022.

Program: B. Pharmacy **Class:** Second Year **Semester :III**

Pharmaceutical Engineering - Practical

Course Code :BP308P **Credits : 2** **Contact Hours:** P 60 (4 Hr/wk)

Scope : This practical course provides hands-on training in pharmaceutical engineering unit operations such as heat transfer, mass transfer, size reduction, drying, and filtration. It also helps students understand the working principles and applications of pharmaceutical machinery used in manufacturing.

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

- Understand the principles of heat transfer and mass transfer operations used in pharmaceutical processes.
- Perform experiments to determine moisture content, humidity, drying behavior, and efficiency of unit operations
- Analyze particle size reduction and size distribution of pharmaceutical powders.
- Understand the construction, working, and applications of major pharmaceutical equipment used in industry.

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP308P.1	Apply the principles of size reduction and perform size analysis by sieving to determine particle size distribution.
BP308P.2	Analyze heat transfer mechanisms and evaporation/distillation processes influencing pharmaceutical unit operations.
BP308P.3	Evaluate drying processes, moisture analysis, and mixing efficiency using pharmaceutical equipment.
BP308P.4	Assess filtration, centrifugation, and crystallization processes for efficient solid-liquid separation and crystal formation in pharmaceutical systems.

Course Content:

1. To evaluate size distribution of tablet granulations using electromagnetic sieve shaker and to construct size frequency curves including arithmetic and logarithmic probability plots.
2. To Study the size reduction process using ball mill.
3. Determination of radiation constant of brass, iron, unpainted and painted glass.
4. To determine the overall heat transfer coefficient by heat exchanger.
5. To evaluate the factors affecting the rate of evaporation (surface area, concentration, temperature, and viscosity).
6. To study the process of steam distillation and calculate the efficiency of the distillation process.

7. To construct drying curves (for calcium carbonate/ starch/ Lactose).
8. Determination of moisture content and loss on drying.
9. Determination of humidity of air– i) From wet and dry bulb temperatures; ii) Dew point method.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer, Spray dryer, dehumidifier and such other major equipment.
11. Description of Construction working and application of Pharmaceutical Machinery such as Double cone blender, Planetary Mixer, and Propellers.
12. To calculate the blend uniformity Index for given sample by using Double Cone Blender.
13. To evaluate the factors affecting the Rate of Filtration (Surface area, Concentration and Thickness/ viscosity)
14. To determine effect of centrifugal force on separation of solids from liquids.
15. To study the effect of time on the Rate of Crystallization.

References:

1. Carter SJ. Cooper and Gunn's Tutorial Pharmacy. New Delhi: CBS Publishers & Distributors; 2008.
2. Lachman L, Lieberman HA, Kanig JL. The Theory and Practice of Industrial Pharmacy. Mumbai: Varghese Publishing House; 2022.
3. Martin A. Remington: The Science and Practice of Pharmacy. Philadelphia: Lippincott Williams & Wilkins; 2000.
4. Subrahmanyam CV, Thimmasetty J, Sarasija S, Kusumadevi V. Pharmaceutical Engineering. Delhi: Efficient Offset Printers; 2004.

Program : B. Pharmacy **Class:** Second Year **Semester : III**

Democracy, Election and Governance (Theory)

Course Code :BAD309T **Credits :** 2 **Contact Hours:** 30 Hrs TH

Objectives : To introduce the students meaning of democracy and the role of the governance
To help them understand the various approaches to the study of democracy and governance

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
1	Explain the **fundamental principles of democracy, the Constitution of India, and different models of democracy**
2	Describe the concept, evolution, and significance of decentralization and Panchayati Raj institutions in India.
3	Analyze the 73rd and 74th Constitutional Amendments and the challenges of caste, gender, class, and ethnicity in democratic governance.

Course Content:

Modules	Topics	Hours
I	**Democracy- Foundation and Dimensions** a. Constitution of India b. Evolution of Democracy- Different Models c. Dimensions of Democracy- Social, Economic, and Political	**10**
II	**Decentralization** a. Indian tradition of decentralization b. History of Panchayat Raj institution in the lost independence period c. 73rd and 74th amendments d. Challenges of caste, gender, class, democracy and ethnicity	**10**
III	**Governance** a. Meaning and concepts b. Government and governance c. Inclusion and exclusion	**12**

Reference Books

1. Banerjee-Dube, I. (2014). A history of modern India. Cambridge University Press.
2. Basu, D. D. (1982). Introduction to the Constitution of India. Delhi: Prentice Hall of India.
3. Bhargava, R. (2008). Political theory: An introduction. Chennai: Pearson Education India.
4. Bhargava, R., &Vanaik, A. (2010).Understanding Contemporary India: Critical Perspective. New Delhi: Orient Blackswan.
5. Chandhoke, N., &Proyadardhi,P. (Ed.). (2009).Contemporary India: Economy, Society, Politics. Chennai: Pearson Education India.
6. Chandra, B. (1999). Essays on contemporary India. New Delhi: Har-Anand Publications Pvt Ltd.

Course of study for semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP401T	Pharmaceutical Organic Chemistry III– Theory	3	1	4
BP402T	Medicinal Chemistry I – Theory	3	1	4
BP403T	Physical Pharmaceutics II – Theory	3	1	4
BP404T	Pharmacology I – Theory	3	1	4
BP405T	Pharmacognosy and Phytochemistry I– Theory	3	1	4
BP406P	Medicinal Chemistry I – Practical	4	-	2
BP407P	Physical Pharmaceutics II – Practical	4		2
BP408P	Pharmacology I – Practical	4	-	2
BP409P	Pharmacognosy and Phytochemistry I – Practical	4	-	2
	Total	**31**	**5**	**28**

Program : B. Pharmacy **Class:** Second Year **Semester : IV**

Pharmaceutical Organic Chemistry- III (Theory)

Course Code : BP401T **Credits :** 4 **Contact Hours:** 45 Hrs.

Scope : This course 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 : To Understand the Chemistry, medicinal uses and other applications of heterocycles

- To Explain the stereo chemical aspects of organic compounds and stereo chemical reactions
- To Explain Know name reactions of synthetic importance and its applications

Course Outcome (CO):
Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP401T.1	Explain the fundamental concepts of stereoisomerism, stereochemistry of reactions, racemic modification, and asymmetric synthesis
BP401T.2	Differentiate and analyse various types of isomerism including geometrical isomerism, conformational isomerism (in n-butane and cyclohexane), and atropisomerism and Apply the principles of stereochemistry to distinguish between stereo-selective and stereospecific reactions with suitable examples
BP401T.3	Know and describe the nomenclature, classification, basic chemistry, synthesis and uses of important heterocyclic compounds with five & six membered rings & fused and bridged heterocyclic compounds
BP401T.4	Understand and Examine the chemistry, reactions, synthesis, uses of some important heterocyclic compounds
BP401T.5	Know and Utilize knowledge of heterocyclic reactions to propose synthetic pathways and predict products for target compounds.

Course Content:

Unit	Topic	Hours
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 racemic mixture, Asymmetric synthesis: partial and absolute	**09**
II	**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	**09**

III	**Nomenclature and classification of heterocyclic compounds in to classes:** Oxygen containing five & six membered rings, Nitrogen containing five & six membered rings, sulphur containing five & six member rings; Oxygen & nitrogen containing five & six membered rings, oxygen & sulphur containing five & six membered rings, and sulphur and nitrogen containing five & six membered rings; Fused and Bridged Heterocyclic Compounds Chemistry, Synthesis, reactions and medicinal uses of pyrrole, furan and thiophene Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene	**10**
IV	Synthesis, reactions and medicinal uses of following compounds and their derivatives- Pyrazole, Imidazole, Oxazole, Thiazole, Pyridine, Quinoline, Isoquinoline, Acridine and Indole, Basicity of pyridine Synthesis and medicinal uses of Pyrimidine, Purine, Azepines and their derivatives	**10**
V	Reactions of synthetic importance Metal hydride reduction (NaBH4 and LiAlH4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation	**07**

Recommended Books: (Latest Editions)

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. A text book of organic chemistry- Arun Bahl, B.S. Bahl.
3. Heterocyclic Chemistry by Raj K. Bansal
4. Organic Chemistry by Morrison and Boyd
5. Heterocyclic Chemistry by T.L. Gilchrist
6. Advanced General Organic Chemistry-A Modern Approach by Sachin Kumar Ghosh
7. Joule and Mills, Heterocyclic Chemistry, IV (ed.), Blackwell Publishing House, Oxford, UK,
8. Li, J. J., Name Reactions, III (ed.), Springer, Berlin, 2006
9. Stereochemistry of Organic Compound Principles and Applications by Nasipuri, Revised Edition, New Age International Publishers.
10. Stereochemistry Conformation and Mechanism by P.S. Kalsi

Program: B. Pharmacy **Class:** Second Year **Semester: IV**

Medicinal Chemistry- I (Theory)

Course Code: BP402T **Credits:** 4 **Contact Hours:** 45 Hrs.

Scope : This course 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 :

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

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
CO-BP402T.1	Describe and correlate the historical development of Medicinal Chemistry with physiological properties of drugs, and explain the relationship between chemical structure, biological action, and drug metabolism
CO-BP402T.2	Differentiate adrenergic agonists and antagonists, illustrate their mechanism of action, and examine structure activity relationships with reference to therapeutic uses.
CO-BP402T.3	Distinguish cholinergic agonists and antagonists, outline their mechanism of action, and assess structure activity relationships in relation to clinical applications and safety.
CO-BP402T.4	Classify drugs acting on the Central Nervous System, explain their mechanism of actions, and analyze structure activity relationships with respect to therapeutic indications.
CO-BP402T.5	Compare narcotic and non-narcotic analgesics and anti-inflammatory agents, discuss their mechanism of action, and appraise structure activity relationships in relation to efficacy and safety.

Course Content:

Unit	Topic	Hours
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	**06**

	II reactions. Factors affecting drug metabolism including stereo chemical aspects. **Introduction to SAR and QSAR**	
Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship, therapeutic relevance and Adverse effect of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)		
II	**Drugs acting on Autonomic Nervous System** **A. Drugs acting on Adrenergic System** Adrenergic Neurotransmitters-Biosynthesis and catabolism of catecholamines. 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. **Sympatholytic agents:** **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	**10**
III	**B. Drugs acting on Cholinergic System** 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. **Parasympatholytic 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, Benztropinemesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamideiodide, Ethopropazine hydrochloride.	**10**

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 Drugs 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. **Flurobuterophenones:** Haloperidol, Droperidol, Risperidone. **Beta amino ketones:**Molindone hydrochloride. **Benzamides:** Sulpiride. **C.** Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action Barbiturates: Phenobarbitone, Methabarbital. Hydantoins: Phenytoin*, Mephenytoin, Ethotoin Oxazolidinediones: Trimethadione, Paramethadione Succinimides, Phensuximide, Methsuximide, Ethosuximide* Urea and monoacylureas: Phenacemide, Carbamazepine* Benzodiazepines: Clonazepam Miscellaneous: Primidone, Valproic acid , Gabapentin, Felbamate **D.** General anesthetics: Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. Ultra short acting barbitutrates: Methohexital sodium*, Thiamylal sodium, Thiopental sodium. Dissociative anesthetics: Ketamine hydrochloride.*	**12**
V	Analgesics, anti-inflammatory and antipyretic drugs A. Narcotic Analgesics **a.** Narcotic Agonists: Opioid receptors, 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. **b.** Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride. B. Non-Narcotic analgesics, anti-inflammatory and antipyretic drugs Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.	**07**

Recommended Books: (Latest Editions)

1. John Marlowe Beale, Wilson and Giswold‟s Organic medicinal and Pharmaceutical Chemistry. 11th E/d,
2. Thomas L. Lemke, David A. Williams, Victoria F. Roche, Foye‟s Principles of Medicinal Chemistry.
3. Burger‟s Medicinal Chemistry, Vol I to IV, 6th E/d, M. E. Wolff. John Wiley & Sons, New York. 1997.
4. Smith and Williams, Introduction to principles of drug design, CRC Press; 4 editions.
5. John E. Hoover, Remington‟s Pharmaceutical Sciences, Mack Publishing Company; 13th edition

(1965)
6. Organic Chemistry by I.L. Finar, Vol. II, Longmans Green & Co., 3rd E/d.
7. Daniel Lednicer, Lester A. Mitscher, The Organic Chemistry of Drug Synthesis, John Wiley & Sons, Inc, Vol. 1-5.
8. Indian Pharmacopoeia.
9. Text book of practical organic chemistry- A. I. Vogel
10. An Introduction to Medicinal chemistry, Graham Patrick

Program : B. Pharmacy **Class:** Second Year **Semester** : **IV**

Physical Pharmaceutics- II

Course Code : BP403T **Credits :** 4 **Contact Hours:** L 45 (3 Hr/wk), T 15 (1 Hr/wk)

Scope : The course deals with the various physical 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 completion of this course the student should be able to:

- To understand the behaviour and characteristics of colloidal systems.
- To learn the importance of rheology in formulation, manufacturing, and product performance.
- To understand the formulation and stability of suspensions and emulsions.
- To learn methods for particle size analysis and measurement.
- To understand reaction kinetics and accelerated stability guidelines.

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP403T.1	Analyze flow behavior and viscosity of pharmaceutical systems and deformation of solids.
BP403T.2	Apply formulation concepts in the preparation of suspensions and emulsions and analyze their stability.
BP403T.3	Assess particle size, surface properties, and powder flow characteristics.
BP403T.4	Apply principles of reaction kinetics to estimate drug stability and shelf-life.
BP403T.5	Classify and analyze colloidal systems based on their properties and stability.

Course Content:

Unit	Topic	Hours
I	**a. Rheology:** Fundamental and importance of rheology**,** concept of viscosity, 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 **b. Deformation of solids:** Plastic and elastic deformation, Heckel equation, Heckel plot, Stress, Strain, Elastic Modulus.	**9**
II	**Coarse dispersions:** Suspension, interfacial properties of suspended particles, Stoke's law, settling in suspensions, sedimentation volume, formulation of flocculated and deflocculated suspensions, application of suspension. 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 (rHLB Calculations), Application of emulsion.	**9**
III	**Micromeretics:** Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for	**9**

	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. importance of flow properties and determination of flow properties (Angle of repose, carr's index, Hausner ratio), application of micromeritics.	
IV	**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 of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention, application of chemical kinetics.	**9**
V	**Colloidal dispersions:** Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids, Preparation of colloids, Purification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action and, gold number, stability and instability of colloids. application of colloids.	**9**

References:

1. Carter SJ, editor. Cooper and Gunn's Tutorial Pharmacy. 6th ed. New Delhi: CBS Publishers & Distributors Pvt. Ltd.; 2005.
2. Jain K, Khar RK, Ahmad FJ. Textbook of Physical Pharmacy. 1st ed. New Delhi: Elsevier India Pvt. Ltd.; 2016.
3. Lieberman HA, Lachman L, Schwartz JB, editors. Pharmaceutical Dosage Forms: Tablets. 2nd ed. Vol. 1–3. New York: Marcel Dekker Inc.; 1989–1990.
4. Lieberman HA, Rieger MM, Banker GS, editors. Pharmaceutical Dosage Forms: Disperse Systems. 2nd ed. Vol. 1–3. New York: Marcel Dekker Inc.; 1988–1998.
5. Parrott EL, Saski W. Experimental Pharmaceutics. 4th ed. Minneapolis: Burgess Publishing Company; 1977.
6. Sinko PJ, editor. Martin's Physical Pharmacy and Pharmaceutical Sciences. 8th ed. Philadelphia: Wolters Kluwer; 2023.
7. Subrahmanyam CVS. Physical Pharmaceutics-II: The Molecular Approach. 2nd ed. New Delhi: Vallabh Prakashan; 2022.

Program: B. Pharmacy **Class:** Second Year **Semester: IV**

Pharmacology - I

Course Code: BP404T **Credits:** 4 **Contact Hours:** 60Hrs (45TH&15 TU)

Scope **:** The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs, mechanism of action, physiological and biochemical effects (Pharmacodynamics) as well as absorption, distribution, metabolism and excretion (Pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and route of administration of different classes of drugs.

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

- Understand the pharmacological actions of different categories of drugs.
- Explain the mechanism of action at organ system, subcellular & macromolecular levels
- Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
- Observe the effects of drugs on animal by simulated experiments.
- Appreciate correlation of pharmacology with other bio medical sciences.

Course Outcome (CO):
Upon completion of the course student shall be able to

CO number	Course Outcome(CO)Statement
BP404T.1	Describe the important concepts in Pharmacology
BP404T.2	Summarize the basic concepts in Pharmacokinetics and predict the ADME of drugs.
BP404T.3	Explain and apply the basic concepts of Pharmacodynamics, New drug discovery & development process.
BP404T.4	Break down the Pharmacology of drugs acting on Peripheral nervous system
BP404T.5	Analyse the Pharmacology of drugs acting on Central Nervous system

Course Content:

Unit	Topics	Hours
I	**Introduction to Pharmacology** ▪ Definition, Historical landmarks and scope of pharmacology ▪ Nature & source of drugs and Essential drugs concept ▪ Routes of drug administration. ▪ Dose response relationship & Therapeutic index, ▪ Agonists, Antagonists (competitive and non-competitive), ▪ Combined effects of drugs. ▪ Factors modifying drug action.	**4**
II	**Pharmacokinetics** ▪ Membrane transport, Absorption, Distribution, Metabolism and Excretion of drugs. ▪ Enzyme induction, Enzyme inhibition, Introduction to kinetics of elimination	**4**
III	**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 receptors ▪ Introduction to transmembrane enzyme linked receptors e.g. JAK-STAT, tyrosine kinase, and Insulin receptors. ▪ Intracellular receptors (Nuclear receptors) e.g. Steroid, Thyroid and Vitamin D receptors. ▪ Spare receptors e.g. Beta-adrenergic and Insulin receptors. **Adverse drug reactions:** ▪ Addiction, Tolerance, Dependence, Tachyphylaxis, Idiosyncrasy, Allergy (explain with suitable examples) **Drug interactions:** ▪ Pharmacokinetic drug interactions. ▪ Pharmacodynamic drug interactions. **Drug discovery and clinical evaluation of new drugs:** ▪ Introduction to drug discovery ▪ Preclinical evaluation and Clinical trials. ▪ Introduction to Pharmacovigilance	**12**
IV	**Pharmacology of drugs acting on Peripheral Nervous System** ▪ Introduction to Autonomic Nervous System ▪ Parasympathomimetics & Parasympatholytics ▪ Sympathomimetics and Sympatholytics. ▪ Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). ▪ Local anaesthetic agents. ▪ Drugs used in myasthenia gravis and glaucoma**.**	**10**

V	**Pharmacology of drugs acting on Central Nervous System** ▪ Neurohumoral transmission in the C.N.S. ▪ Special emphasis to be given on importance of various neurotransmitters like with GABA, Glutamate, Glycine, Serotonin, Dopamine, Acetylcholine, Nor Adrenaline, etc. ▪ General anaesthetics and pre-anaesthetics ▪ Sedatives & Hypnotics ▪ Centrally acting muscle relaxants ▪ Anti-epileptics ▪ Alcohol and Disulfiram **Psychopharmacological agents:** ▪ Antipsychotics, Antidepressants, Anti-anxiety agents, anti-manics and Hallucinogens ▪ Drugs used in Parkinson's disease and Alzheimer's disease ▪ CNS stimulants and Nootropics ▪ Opioid analgesics and antagonists ▪ Addiction, abuse, tolerance and dependence	**8** **7**

Reference Books

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology; Churchil 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. Barar, F.S.K., Essentials of Pharmacotherapeutics; S. Chand and Company, New Delhi.
10. Das, M. M. and Dutta S. K. : R. Ghosh's Modern Concepts on pharmacology and Therapeutics, (HILTON and Co. Calcutta)
11. Satoskar, R.S. and Bhandarkar S.D. Pharmacology and Pharmacotherapeutics (Popular Prakashan, Bombay).
12. Harrison's Principle and Practice of Medicine, 18th Edition, Churchill, Livingston, London.
13. Roger and Walker. Clinical Pharmacy and Therapeutics, Churchill, Livingston, London.
14. Dipiro Joseph L. A Pathophysiological Approach, Elsevier.
15. Davidson's Principle of Internal Medicine, McGraw-Hill companies.
16. Chatterjee, C.C., Human Physiology. Medical Allied Agency, Kolkata.
17. Ganong, W.F., Review of Medical Physiology. Prentice-Hall International, London.

Program: **B. Pharmacy** Class: **Second Year** Semester: **IV**

PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)

Course Code: **BP405T** Credits: **4** Contact Hours: **45 Hours (Theory)**

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

1. to know the techniques in the cultivation and production of crude drugs
2. to know the crude drugs, their uses and chemical nature
3. know the evaluation techniques for the herbal drugs
4. to carry out the microscopic and morphological evaluation of crude drugs

Course Outcome (CO):
Upon completion of course student will able to:

CO number	Course Outcome (CO) statement
BP405T.1	Students will understand the fundamentals of Pharmacognosy and quality control evaluation tests for natural origin drug.
BP405T.2	Students will gain the knowledge of techniques for cultivation and processing of crude drugs
BP405T.3	Students will know the techniques of plant tissue culture
BP405T.4	Students will understand the description, morphology and anatomy of plant organs and study of its metabolites.
BP405T.5	Students will gain the knowledge of plant products with its source, chemical nature and its applications.

Unit	Topic	Hours
I	**Introduction to Pharmacognosy:** (a) Introduction to Traditional System of Medicine (AYUSH) (b) Definition, history, scope and development of Pharmacognosy (c) Sources of Drugs – Plants, Animals, Marine & Tissue culture (d) 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,	**10**

	microscopic, physical, chemical and biological methods and properties. • Phytochemical analysis by Qualitative & Quantitative phytochemical parameters such as determination of total phenolic content • **WHO guidelines for WHO guidelines for Good Agricultural and Collection Practices (GACP)** ***(The above Quantitative Microscopy included in PRACTICAL SYLLABUS and it is suitable to understand by students practically instead of theory hours)***	
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** **WHO guidelines for Good Agricultural and Collection Practices (GACP)**	**10**
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	**7**
IV	~~(~~*Students practically also know the plant morphology and anatomy of above parts. It will be better to understand practically. Students already learned this topic in 12th standard in Botany. So it may inculcate in Practical Syllabus in this same COURSE in same SEMESTER)* **Introduction to (instead of this Plant metabolites):** (*Topic name is required* Introduction to Plant metabolite OR Introduction to Primary and Secondary metabolites) • Introduction to Plant metabolites • Comparative account on Primary and Secondary metabolites • Definition, classification, properties, identification tests, therapeutic uses and commercial utility of Carbohydrates, Proteins, Lipids • Definition, classification, properties and test for identification (identification tests, therapeutic uses and commercial utility of) of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins	**8**
V	Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs **Natural Products:**	**10**

	• Plant Fibers - Cotton, Jute, Hemp • Animal Fibers – Silk, Wool • 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):** General methods of extraction of lipids. Castor oil, Chaulmoogra oil, Shark liver oil and Cod liver oil, Wool Fat, Bees Wax **Marine Drugs:** Novel medicinal agents from marine sources a) Cardiovascular agents and b) Anti cancer agents	

Program: B. Pharmacy **Class:** Second Year **Semester: IV**

Medicinal Chemistry- I (Practical)

Course Code : BP406P **Credits :** 2 **Contact Hours:** 04 Hrs./ Week (Practical)

Scope : The course provides practical training in recrystallization, TLC-based reaction monitoring, and Pharmacopoeial assays (I.P.) for selected drugs, along with the determination of partition coefficient. It integrates organic synthesis with pharmaceutical analysis, preparing students for industrial and research applications**.**

Objectives :

- To develop practical skills in the synthesis of medicinally important compounds and drug intermediates.
- To understand and perform purification techniques such as recrystallization.
- To apply Thin Layer Chromatography (TLC) for monitoring reactions and assessing purity.
- To perform Pharmacopoeial assays (I.P.) for quantitative determination of drugs.
- To determine and interpret the partition coefficient of drugs and understand its significance in drug action.

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP406P.1	Synthesize various heterocyclic compounds and pharmaceutical intermediates using appropriate laboratory techniques.
BP406P.2	Perform purification (recrystallization) and evaluate compound purity using TLC methods.
BP406P.3	Carry out quantitative analysis of drugs as per Indian Pharmacopoeia (I.P.) standards.
BP406P.4	Determine the partition coefficient of drugs and correlate it with drug absorption, distribution, and pharmacokinetic behavior.

Course Content: **Total 60 Hrs. (04 hrs./ week)**

Unit	Topic
I	**Synthesis of following medicinally important compounds/ drug intermediates with recrystallization of compound and monitoring reactions with TLC and functional group determination by I. R. Spectroscopy (Any 08)** 1. 1, 2- pyrazole 2. 1,3-oxazole 3. Benzimidazole 4. Benztriazole 5. 2,3- diphenyl quinoxaline 6. Benzocaine/ Aspirin/ Methyl Salicylate 7. Phenytoin 8. Phenothiazine 9. 2-phenyl indole
II	**Assay of drugs (As per I.P.)** 1. **Chlorpromazine** 2. **Phenobarbitone** 3. **Atropine** 4. **Ibuprofen** 5. **Furosemide**
III	**Determination of Partition coefficient for (any two drugs)**

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.

Program : B. Pharmacy **Class:** Second Year **Semester : IV**

Physical Pharmaceutics- II - Practical

Course Code : BP407P **Credits : 2** **Contact Hours:** P 60 (4 Hr/wk)

Scope : The course deals with the various physical 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 completion of this course the student should be able to:

- To learn about stability of colloidal dispersions**.**
- To know flow behavior of liquids.
- Understand applications of coarse dispersions in pharmaceuticals.
- Understand different methods of particle size analysis and powder flow properties.
- To study first, and second order reactions accelerated stability testing.

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP407P.1	Analyse rheological behaviour of liquids and semisolids using Ostwald and Brookfield viscometers.
BP407P.2	Formulate and evaluate coarse dispersions including suspensions and emulsions using appropriate stabilizers and formulation approaches.
BP407P.3	Assess micromeritic properties of powders including particle size distribution, density, porosity, and flow characteristics using standard experimental methods.
BP407P.4	Determine reaction kinetics and evaluate stability of pharmaceutical preparations under accelerated storage conditions to predict drug stability behavior.

Course Content:

1. Determination of viscosity of liquid (Water/ toluene/ ethanol) using Ostwald's viscometer.
2. To determine effect of temperature on viscosity using Ostwald's viscometer. (e.g. sucrose syrup)
3. To determine unknown concentration by viscosity method using Ostwald's viscometer.
4. Determination of viscosity of semisolid by using Brookfield viscometer.
5. Determination sedimentation volume with effect of different suspending agent (Acacia, tragacanth, bentonite, sodium alginate).
6. Determination sedimentation volume with effect of different concentration of single suspending agent (Acacia/ tragacanth/ bentonite/ sodium alginate/ sodium CMC).
7. Determination of effect of salts on stability of hydrophobic sols.
8. Determination of particle size, particle size distribution using sieving method.
9. Determination of particle size, particle size distribution using Microscopic method.

10. Determination of bulk density, true density, Hausner ratio, Compressibility index.
11. Determination of porosity of given sample.
12. Determine the angle of repose and influence of lubricant (Talc/ magnesium stearate) on angle of repose.
13. Determination of reaction rate constant first order.
14. Determination of reaction rate constant second order.
15. To demonstrate stability study on accelerated storage condition.

References:

1. Carter SJ, editor. Cooper and Gunn's Tutorial Pharmacy. 6th ed. New Delhi: CBS Publishers & Distributors Pvt. Ltd.; 2005.
2. Derle DV. Essentials of Physical Pharmacy. 2nd ed. Hyderabad: PharmaMed Press; 2008.
3. Jain K, Khar RK, Ahmad FJ. Textbook of Physical Pharmacy. 1st ed. New Delhi: Elsevier India Pvt. Ltd.; 2016.
4. Lieberman HA, Lachman L, Schwartz JB, editors. Pharmaceutical Dosage Forms: Tablets. 2nd ed. Vol. 1–3. New York: Marcel Dekker Inc.; 1989–1990.
5. Lieberman HA, Rieger MM, Banker GS, editors. Pharmaceutical Dosage Forms: Disperse Systems. 2nd ed. Vol. 1–3. New York: Marcel Dekker Inc.; 1988–1998.
6. More HN, Hajare AA. Physical Pharmaceutics Practical Handbook. 3rd ed. Nashik: Career Publications; 2024.
7. Parrott EL, Saski W. Experimental Pharmaceutics. 4th ed. Minneapolis: Burgess Publishing Company; 1977.
8. Sinko PJ, editor. Martin's Physical Pharmacy and Pharmaceutical Sciences. 8th ed. Philadelphia: Wolters Kluwer; 2023.
9. Subrahmanyam CVS. Physical Pharmaceutics-I Practical Handbook. 1st ed. New Delhi: Vallabh Prakashan; 2022.
10. Subrahmanyam CVS. Physical Pharmaceutics-II: The Molecular Approach. 2nd ed. New Delhi: Vallabh Prakashan; 2022.

Program: **B. Pharmacy** Class: **Second Year** Semester: **IV**

PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)

Course Code: **BP409P** Credits: **4** Contact Hours: **4 Hours/Week (Practical)**

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:	Upon completion of the course, the student shall be able • to know the techniques in the plant material identification by study of morphological features • to know the techniques of determination of quantitative microscopic parameters for study of crude drugs • to know the physico-chemical evaluation techniques for the herbal drugs • to carry out the screening of herbal drugs by physical stands and chemical test for identification of crude drugs

Course Outcome (CO):
Upon completion of course student will able to:

CO number	Course Outcome (CO) statement
BP 409P.1	Demonstrate skill of plant material identification by study of various parts of plant, its description and preparation of herbarium
BP 409P.2	Demonstrate skill of plant material sectioning, staining, mounting & understand techniques of study of microscopic features
BP 409P.3	Students learned the techniques of determination of quantitative microscopic features by drawing microscopical diagrams & be able to know the micrometry technique.
BP 409P.4	Student understand skill to analyze and evaluate crude drug material by conducting various physico-chemical parameters
BP 409P.5	Student understand Identify crude drugs using physical characteristics & chemical tests.

Course content:

Practical	Topic	Hours
1	Demonstrate skill of plant material identification by study of various parts of plant, its description and preparation of herbarium	4
2	Demonstrate skill of plant material sectioning, staining, mounting & understand techniques of study of microscopic features	4
3	Determination of stomatal number and index	4
4	Determination of vein islet number	4
5	Determination of vein islet termination number	4
6	Determination of paliside ratio.	4

7	Determination of size of starch grains by eye piece micrometer	4
8	Determination of size of calcium oxalate crystals by eye piece micrometer	4
9	Determination of Fiber length and width	4
10	Determination of number of starch grains by Lycopodium spore method	4
11	Determination of swelling index	4
12	Determination of foaming index	4
13	Determination of Ash value	4
14	Determination of Extractive values of crude drugs	4
15	Determination of moisture content of crude drug	4
16	Determination of total crude fiber content	4
17	Analysis of crude drugs by chemical tests: (i) Tragaccanth (ii) Acacia (iii) Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil	4

Note:

1. ***Practical 1 and 2 are demonstrations***
2. ***Practical 3 to 17 (Total 15 practical for understanding practical techniques)***

Reference Book:

Title	Author	Publisher
Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis	J.B. Harborne	Chapman & Hall, Landon
Quality Control of Herbal Drugs	Pulok K. Mukherjee	Business Horizons Pharmaceutical Publisher

Program : B. Pharmacy **Class:** Second Year **Semester :IV**

Pharmacology I

Course Code : BP408P **Credits :** 2 **Contact Hours:** 4 Hrs/Week (Practical)

Course Outcome (CO):

Upon completion of course student will able to

CO number	Course Outcome (CO) statement
BP 408P.1	Explain the basic concepts of experimental pharmacology
BP 408P.2	Apply the CCSEA guidelines for ethical treatment of the experimental animals
BP 408P.3	Comprehend basic techniques used in the experimental pharmacology
BP 408P.4	Perform various pharmacology experiments by using experimental pharmacology software

Course Content:

Sr. No.	List of Experiments
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 CCSEA guidelines.
5.	Common laboratory techniques. Blood withdrawal, serum and plasma separation, anaesthetics 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 pentobarbitone sleeping time in mice (righting reflex).
8.	Study of effect of drugs on ciliary motility of frog oesophagus.
9.	Study of effect of drugs on rabbit eye.
10.	Study of skeletal muscle relaxants using rota-rod apparatus.
11.	Study of locomotor activity of drugs on using actophotometer.
12.	Study of 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 anaesthetics by different methods.
16.	Demonstration of PK/PD studies using open source simulation software (Pk-Sim and MoBi6).

*****Relevant and latest research articles for each simulation practical must be discussed and assigned to the students.

Recommended Books (Latest Editions)

1. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
2. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.
3. Burn JH. Practical Pharmacology Blackwell Scientific, Oxford London.
4. Jaju BP. Pharmacology: A Practice Exercise Book, Jaypee Brothers, New Delhi. Sheth UK, Dadkar NK and Kamat UG. selected topics in experimental pharmacology, (Kothari Book Depot, Mumbai)
5. Perry W.L.M. Pharmacological Experiments on Isolated Preparation, E&S Livingstone,London.
6. Goyal R. K., Practicals in Pharmacology, B. S. Shah Prakashan, Ahemadabad.