Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Scheme of Teaching and Examination

Bachelor of Pharmacy (B. Pharmacy)

III – Semester

S. No	Board of Study	Subject Code	Name of the course with PCI Code	Internal Assessment				End Semester Exams		Total Marks	Credit
				TA	Sessional Exams		Total	Marks	Duration		
					CT	Duration					
1.	Pharmacy	341351 (41)	Pharmaceutical Organic Chemistry – II – Theory (BP301T)	10	15	1 Hr	25	75	3 Hrs	100	4
2.	Pharmacy	341352 (41)	Physical Pharmaceutics – I – Theory (BP302T)	10	15	1 Hr	25	75	3 Hrs	100	4
3.	Pharmacy	341353 (41)	Pharmaceutical Microbiology – Theory (BP303T)	10	15	1 Hr	25	75	3 Hrs	100	4
4.	Pharmacy	341354 (41)	Pharmaceutical Engineering – Theory (BP304T)	10	15	1 Hr	25	75	3 Hrs	100	4
5.	Pharmacy	341361 (41)	Pharmaceutical Organic Chemistry – II – Practical (BP305P)	5	10	4 Hr	15	35	4 Hrs	50	2
6.	Pharmacy	341362 (41)	Physical Pharmaceutics – I – Practical (BP306P)	5	10	4 Hr	15	35	4 Hrs	50	2
7.	Pharmacy	341363 (41)	Pharmaceutical Microbiology – Practical (BP307P)	5	10	4 Hr	15	35	4 Hrs	50	2
8.	Pharmacy	341364 (41)	Pharmaceutical Engineering – Practical (BP308P)	5	10	4 Hr	15	35	4 Hrs	50	2
Total				**60**	**100**	**20**	**160**	**440**	**28Hrs**	**600**	**24**

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: B. Pharmacy 3rd semester **Branch: Pharmacy**
Subject: Pharmaceutical Organic Chemistry–II–Theory (BP301T) **Subject Code: 341351 (41)**
Total Theory Periods: 45 **Total Tutorial Periods: 15**
Total Marks in the End Semester: 75
Minimum of Class tests to be conducted:02

45 Hours

Scope: This subject deal with general methods of preparation and reactions of someorganic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes 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

1. write the structure, name and the type of isomerism of the organic compound
2. write the reaction, name the reaction and orientation of reactions
3. account for reactivity/stability of compounds,
4. prepare organic compounds

Course Content:

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 **10 Hours**

- **Benzene and its derivatives**
  - **A.** Analytical, synthetic and other evidence 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, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.
  - **C.** Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction
  - **D.** Structure and uses of DDT, Saccharin, BHC and Chloramine

- **Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitativetests, Structure and uses of phenol, cresols, resorcinol, naphthols
- **Aromatic Amines* -** Basicity of amines, effect of substituents on basicity,and synthetic uses of aryl diazonium salts

UNIT III **10 Hours**

- **Fats and Oils**

a. Fatty acids – 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.

UNIT IV **08 Hours**

- **Polynuclear hydrocarbons:**

a. Synthesis, reactions
b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

UNIT V **07 Hours**

- **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

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: B. Pharmacy 3rd semester **Branch: Pharmacy**
Subject: Physical Pharmaceutics – I – Theory (BP302T) **Subject Code: 341352 (41)**
Total Theory Periods: 45 **Total Tutorial Periods: 15**
Total Marks in the End Semester: 75
Minimum of Class tests to be conducted:02

45 Hours

Scope: The course deals with the various physical, physicochemical properties andprinciple 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 pharmaceuticals.

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 form
2. Know the principles of chemical kinetics & to use them in assigning expiry date for formulation
3. Demonstratetheuse of physicochemical properties inthe evaluation of dosage forms.
4. Appreciate physicochemical properties of drug molecules in formulation research and development

Course Content:

UNIT-I **10 Hours**

The solubility of drugs: Solubility expressions, mechanisms of solute-solventinteractions,ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, Dissolution & drug release, diffusion principles in biological systems. The solubility ofagas in liquids, thesolubility 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 Hours**

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 **10 Hours**

Micromeretics: Particle size and distribution, average particle size, number and weightdistribution, 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-IV **08 Hours**

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 Hours**

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.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: B. Pharmacy 3rd semester **Branch: Pharmacy**
Subject: Pharmaceutical Microbiology – Theory (BP303T) **Subject Code: 341353 (41)**
Total Theory Periods: 45 **Total Tutorial Periods: 15**
Total Marks in the End Semester: 75
Minimum of Class tests to be conducted: 02

45 Hours

Scope:

- In the broadest sense, thescope of microbiology is the study of all organisms that are invisible to the naked eye- that is the study of microorganisms.
- Microorganisms are necessary for the production of bread, cheese, beer, antibiotics, vaccines, vitamins, enzymes etc.
- Microbiology has an impact on medicine, agriculture, food science, ecology, genetics, biochemistry, immunology etc.

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

1. Understand methods of identification, cultivation and preservation of various microorganisms
2. Importance of sterilization in microbiology. and pharmaceutical industry
3. Learn sterility testing of pharmaceutical products.
4. Microbiological standardization of Pharmaceuticals.
5. Understand the cell culture technology and its applications in pharmaceutical industries.

Course content:

Unit I **10 Hours**

Introduction, history of microbiology, its branches, scope and its importance.
Introduction to Prokaryotes and Eukaryotes
Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count).
Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.

Unit II **10 Hours**

Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC).

Study of principle, procedure, merits, demerits and applications of thePhysical, chemical and mechanical method of sterilization.

Evaluation of the efficiency of sterilization methods.

Equipment's employed in large scale sterilization.

Sterility indicators.

Unit III **10 Hours**

Study of morphology, classification, reproduction/replication and cultivation of Fungi and Virus.

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 Hours**

Designing of aseptic area, laminar flow equipment; 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 and testing of antimicrobial activity of a new substance.
General aspects-environmental cleanliness.

Unit V **07Hours**

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.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: B. Pharmacy 3rd semester **Branch: Pharmacy**
Subject:Pharmaceutical Engineering – Theory (BP304T) **Subject Code: 341354 (41)**
Total Theory Periods: 45 **Total Tutorial Periods: 15**
Total Marks in the End Semester: 75
Minimum of Class tests to be conducted:02

45 Hours

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

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

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend thesignificance of plant lay out adesign for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

Course content:

UNIT-I **10 Hours**

- **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.
- **Mixing:** Objectives, applications & factors affecting mixing, Difference betweensolid 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 &Silver son Emulsifier,

UNIT-II **10 Hours**

- **Crystallization:** Objectives, applications, & theory of crystallization. Solubility curves, principles, construction, working, uses, merits and demerits of theAgitated

batch crystallizer, Swenson Walker Crystallizer, Krystal crystallizer, Vacuum crystallizer. Caking of crystals, factors affecting caking & prevention of caking.

- **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.
- **Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

UNIT- III **10 Hours**

- **Drying:** Objectives, applications & mechanism of thedrying 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.

- **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

UNIT-IV **08 Hours**

- **Filtration:** Objectives, applications, Theories & Factors influencing filtration,filter aids, filter medias. The 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 **07 Hours**

- **Plant location, industrial hazards and plant safety:** Plant Layout, utilitandservices, Mechanical hazards, Chemical hazards, Fire hazards, explosive hazards and their safety.

- **Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plantconstruction, Theories of corrosion, types of corrosion and their prevention. Ferrous and nonferrous metals, inorganic and organic non-metals.

- **Material handling systems:** Objectives & applications of Material handlingsystems, different types of conveyors such as belt, screw and pneumatic conveyors.

Recommended Books: (Latest Editions)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson-Latest edition.
3. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann.,Latest edition.
7. D. K. Tripathi, Industrial Pharmacy (A comprehensive Approach), PharmaMed Press, Hyderabad.
8. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
9. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: B. Pharmacy 3rd semester **Branch: Pharmacy**
Subject: Pharmaceutical Organic Chemistry–II–Practical (BP305P) **Subject Code: 341361 (41)**
Total Practical Periods: 04 Hours/week
Total Marks in the End Semester: 35

4 Hrs/week

I Experiments involving laboratory techniques

- Recrystallization
- Steam distillation

II Determination of following oil values (including standardization of reagents)

- Acid value
- Saponification value
- Iodine value

III **Preparation of compounds**

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

Recommended Books (Latest Editions)

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

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: B. Pharmacy 3rd semester **Branch: Pharmacy**
Subject: Physical Pharmaceutics – I – Practical (BP306P) **Subject Code: 341362 (41)**
Total Practical Periods:04 Hours/week
Total Marks in the End Semester: 35

4 Hrs./week

1. Determination the solubility of drug at room temperature
2. Determination of pKa value by Half Neutralization/ Henderson Hassel Balch equation.
3. Determination of Partition co- efficient of benzoic acid in benzene and water
4. Determination of Partition co- efficient of Iodine in CCl_4 and water
5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
6. Determination of particle size, particle size distribution using sieving method
7. Determination of particle size, particle size distribution using Microscopic method
8. Determination of bulk density, true density and porosity
9. Determine the angle of repose and influence of lubricant on angle of repose
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

Recommended Books: (Latest Editions)

1. Physical pharmacy by Alfred Martin
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea &Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical pharmaceutics by Ramasamy C and ManavalanR.
8. Laboratory manual of physical pharmaceutics, C.V.S. Subramanyam, J. Thimma settee

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: B. Pharmacy 3rd semester **Branch: Pharmacy**
Subject: Pharmaceutical Microbiology – Practical (BP307P) **Subject Code: 341363 (41)**
Total Practical Periods: 04 Hours/week
Total Marks in the End Semester: 35

4 Hrs./week

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

Recommended Books (Latest edition)

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

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: B. Pharmacy 3rd semester **Branch: Pharmacy**
Subject: Pharmaceutical Engineering – Practical (BP308P) **Subject Code: 341364 (41)**
Total Practical Periods:04 Hours/week
Total Marks in the End Semester: 35

4 Hours/week

I. Determination of radiation constant of brass, iron, unpainted and painted glass.
II. Steam distillation – To calculate the efficiency of steam distillation.
III. To determine the overall heat transfer coefficient by the heat exchanger.
IV. Construction of drying curves (for calcium carbonate and starch).
V. Determination of moisture content and loss on drying.
VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method.
VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
IX. 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.
X. Demonstration of acolloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such othermajor equipment.
XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity
XII. To study the effect of time on the Rate of Crystallization.
XIII. To calculate the uniformity Index for given sample by using Double Cone Blender.