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

| Course Code | Name of the Course | No.of hours | Tutorial | Credit points |
|---|---|---|---|---|
| TIU-UBP-301T | Pharmaceutical Organic Chemistry II -Theory | 3 | 1 | 4 |
| TIU-UBP-302T | Physical Pharmaceutics I-Theory | 3 | 1 | 4 |
| TIU-UBP-303T | Pharmaceutical Microbiology -Theory | 3 | 1 | 4 |
| TIU-UBP-304T | Pharmaceutical Engineering-Theory | 3 | 1 | 4 |
| TIU-UBP-305P | Pharmaceutical Organic Chemistry II- Practical | 4 | - | 2 |
| TIU-UBP-306P | Physical Pharmaceutics I -Practical | 4 | - | 2 |
| TIU-UBP-307P | Pharmaceutical Microbiology– Practical | 4 | - | 2 |
| TIU-UBP-308P | Pharmaceutical Engineering– Practical | 4 | - | 2 |
| | Total | **28** | **4** | **24** |

**B.PHARM SYLLABUS**

**SEMESTER – III**

**Pharmaceutical Organic Chemistry II –Theory**
**Contact hours: 45 hr**

**Course Objectives**

1. To understand the basic structure of Benzene, Polyneuclear hydrocarbons, Cycloalkanes, aromatic amines, acids, fats and oils.
2. To know the mechanism of action of the different chemical reaction of organic compounds, their resonance hybridization and their orientation reactions
3. To gain knowledge of the basic preparation, physicochemical properties, use and preparation of different organic compounds.

**Course Outcomes**

Upon completion of the course, the student shall be able
CO1. **Write** the structure, name and the type of isomerism of the organic compound
CO2. **Write** the reaction, name the reaction and orientation of reactions
CO3. **Understand** the resonance hybridization of different organic compounds.
CO4. **Account** for reactivity/stability of compounds,
CO5. **Preparation** chemical reaction and use of different organic compounds

**Course Content** **45 Hours**

**UNIT I** **10 Hours**

**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, halogenationreactivity, 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

**UNIT II** **10 Hours**

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

**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 – Bae yer'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

**Reference 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& Arun Bahl.
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.

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

| Mapping between COs and POs | | |
|---|---|---|
| | **Course Outcomes (COs)** | **Mapped Program Outcomes** |
| **CO1** | **Write** the structure, name and the type of isomerism of the organic compound | PO1, PO11, PO12, PS01 |
| **CO2** | **Write** the reaction, name the reaction and orientation of reactions | PO1, PO5, PO11, PO12 PEO2, |
| **CO3** | **Understand** the resonance hybridization of different organic compounds. | PO1,PO3,PO5, PO8, PO11, PO12, PEO1,PEO2 |

| | | |
|---|---|---|
| **CO4** | **Account** for reactivity/stability of compounds, | PO1,PO11,PO12,PEO1 |
| **CO5** | **Preparation** chemical reaction and use of different organic compounds | PO1,PO5,PO11, PO12,PEO1,PEO2 |

| | | Pharmaceutical Knowledge | Problem solving | Conduct, analyze and interpret data | Ability to design and formulating a process | Ability to understand mechanism | Demonstrate skills in problem solving | Professional and ethical responsibilities | Communication to present a technical report | Impact on society and responsibilities | Leadership qualities | Self educating and Life-long Learning | Preparation for competitive examinations | Building a theoretical knowledge base along with necessary practical skills | To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy | Training students to achieve expertise |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PEO1** | **PEO2** | **PEO3** |
| TIU-UBP-301T | PHARMACEUTICAL ORGANIC CHEMISTRY – II Theory | 3 | - | 2 | - | 3 | - | - | 2 | - | - | 3 | 3 | 3 | 3 | 2 |

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

## Pharmaceutical Organic Chemistry II- Practical (TIU-UBP-305P)
## Contact hours: 4hrs/wk

### Course Objectives

1.To know the systematic qualitative analysis of unknown organic compounds
2.To prepare solid derivatives of organic compounds.
3.To understand the molecular models.

### Course Outcomes:

After successful completion of this course, students will be able to:
CO1. **Demonstrate** the systematic qualitative analysis of unknown organic compounds
CO2.**Evaluate** the Functional group and melting point of organic compounds
CO3. **Understand** the suitable solid derivatives from organic compounds
CO4.**Demonstrate** the molecular models

**Course Content** **4**
**Hours/Week**

1. Systematic qualitative analysis of unknown organic compounds like

   a. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.
   b. Detection of elements like Nitrogen, Sulphur and Halogen byLassaigne's test
   c. Solubility test
   d. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
   e. Melting point/Boiling point of organic compounds
   f. Identification of the unknown compound from the literature using melting point/ boiling point.
   g. Preparation of the derivatives and confirmation of the unknown compound bymelting point/ boiling point.
   h. Minimum 5 unknown organic compounds to be analysed systematically.

2. Preparation of suitable solid derivatives from organic compounds
3. Construction of molecular models

**Recommended Books (Latest Editions)**

1. Organic Chemistry byMorrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl& Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry byMann 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.
9. Reaction and reaction mechanism by Ahluwaliah/Chatwal.

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

| **Mapping between COs and POs** | | |
|---|---|---|
| | **Course Outcomes (COs)** | **Mapped Program Outcomes** |
| **CO1** | **Demonstrate** the systematic qualitative analysis of unknown organic compounds | PO1,PO3,PO12,PEO1 |
| **CO2** | **Evaluate** the Functional group and melting point of organic compounds | PO1, PO3, PO12,PEO1,PEO2, PEO3 |

| | | |
|---|---|---|
| **CO3** | **Understand** the suitable solid derivatives from organic compounds | PO1,PO12 |
| **CO4** | **Demonstrate** the molecular models | PO1,PO4,PO5,PO12, PEO1,PEO2, PEO3 |

| | | Pharmaceutical Knowledge | Problem solving | Conduct, analyze and interpret data | Ability to design and formulating a process | Ability to understand mechanism | Demonstrate skills in problem solving | Professional and ethical responsibilities | Communication to present a technical report | Impact on society and responsibilities | Leadership qualities | Self educating and Life-long Learning | Preparation for competitive examinations | Building a theoretical knowledge base along with necessary practical skills | To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy | Training students to achieve expertise |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PEO1** | **PEO2** | **PEO3** |
| TIU-UBP-305P | Pharmaceutical Organic Chemistry II–Practical | 3 | - | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | 2 | 2 |

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

**Physical Pharmaceutics I-Theory (TIU-UBP-302T)**
**Contact hours: 45 hrs**

## Course Objectives

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

3.To demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
4. To understand various chemical and physical properties of different drug molecules.

**Course Outcomes**

Upon completion of the course, the student shall be able

CO-1.**Demonstrate** the various physicochemical properties of drug molecules in the designing of the formulation.
CO-2.**Identify** the different states of matter and their properties.
CO-3.**Discuss** the different surface and interfacial properties related to pharmaceutical formulations..
CO-4.**Identify** the role of pH and buffers in pharmaceutical formulations.
CO-5.**Discuss** the role of protein binding and complexation in pharmaceutical formulations.

**Course Content** **45 Hours**

**Unit- I**
**10h**

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

**Unit- II**
**10h**

Describes of Matter and properties of matter:Describe of matter, changes in the Describe of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy Describes, solid- crystalline, amorphous &polymorphism.Physicochemical properties of drug molecules: Refractive index, optical rotation,dielectric constant, dipole moment, dissociation constant, determinations and applications.

**Unit- III** **09h**

Surface and interfacial phenomenon: Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilization, detergency, adsorption at solid interface.

**Unit- IV**
**08h**

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**
**08h**

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.

**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
9.Physical Pharmaceutics by C.V.S. Subramanyam
10.Test book of Physical Phramacy, by Gaurav Jain &Roop K. Khar

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

| **Mapping between COs and Pos** | | |
|---|---|---|
| | **Course Outcomes (COs)** | **Mapped Program Outcomes** |
| **CO1** | **Recognize** the various physicochemical properties of drug molecules in the designing formulation Know the thermodynamic principles to use them to study stability of dosage form and demonstrate knowledge of pharmaceutical science & basic science. | PO1, PO4, PO5, PEO2,PO12 |
| **CO2** | **Identify** various use of physicochemical properties in evaluation of dosage forms. | PO1, PEO2 |

| | | |
|---|---|---|
| **CO3** | **Demonstrate** and apply different formulate and solve the problems associated with pharmaceutical industries. | PO1, PO4, PO6, PO11 |
| **CO4** | **Recognize** and design formulation & synthetic processes relevant to pharmaceutical industries as well as interpret the role of physicochemical properties of drug molecules in formulation research and development. | PO1,PO2,PO3, PO6, PEO1, PEO2, PEO3 |

| | | Pharmaceutical Knowledge | Problem solving | Conduct, analyze and interpret data | Ability to design and formulating a process | Ability to understand mechanism | Demonstrate skills in problem solving | Professional and ethical responsibilities | Communication to present a technical report | Impact on society and responsibilities | Leadership qualities | Self educating and Life-long Learning | Preparation for competitive examinations | Building a theoretical knowledge base along with necessary practical skills | To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy | Training students to achieve expertise |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PEO1** | **PEO2** | **PEO3** |
| TIU-UBP-302T | Physical Pharmaceutics-I- Theory | 3 | 3 | 2 | 3 | 2 | 3 | - | - | - | - | 3 | 2 | 3 | 3 | 2 |

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

## Physical Pharmaceutics I –Practical (TIU-UBP-306P)

### Contact hours: 4hrs/wk

**Course Objectives:-**

1.To understand physical pharmacy and able to design as per pharmaceutical industry
2.To know the principles and acquire basic knowledge about identifying the basic properties and the ADME of dosage form
3.To demonstrate various kinds of solubilization, absorption technique in lab scale as well as industry scale.

**Course Outcomes:**

After successful completion of this course, students will be able to:
CO1. **Demonstrate** the role of various physicochemical properties related to pharmaceutical formulation design.
CO2. **Identify** the role of pKa and surface tension in design of pharmaceutical formulation.
CO3. **Evaluate** the effect of partition coefficient andstability constant related to pharmaceutical formulation design.
CO4. **Explain** suitable graphical plots for presentation of results.

**Course Content** **4 Hours/Week**

1.Determination the solubility of drug at room temperature
2.Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
3.Determination of Partition co- efficient of benzoic acid in benzene and water
4.Determination of Partition co- efficient of Iodine in CCl4 and water
5.Determination of % composition of NaCl in a solution using phenol-water system by CST method
6.Determination of surface tension of given liquids by drop count and drop weight method
7.Determination of HLB number of a surfactant by saponification method
8.Determination of Freundlich and Langmuir constants using activated char coal
9.Determination of critical micellar concentration of surfactants
10.Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
11.Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex bypH titration method

**Reference 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
9.Physical Pharmaceutics by C.V.S. Subramanyam
10.Test book of Physical Phramacy, by Gaurav Jain &Roop K. Khar

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

| Mapping between COs and Pos | | |
|---|---|---|
| | **Course Outcomes (COs)** | **Mapped Program Outcomes** |
| **CO1** | **Demonstrate** various formulation Describeed in the pharmaceutical industry | PO1,PEO1, PEO2, PEO3 |
| **CO2** | **Identify** various use of physicochemical properties in evaluation of dosage forms. | PO1,PO5, PEO1, PEO2, PEO3 |
| **CO3** | **Evaluate** the effect of various factors related to different physicochemical properties of drugs | PO1, PO3, PEO1, PEO2, PEO3 |
| **CO4** | **Explain** suitable graphical plots for presentation of results | PO1, PO3, PEO1,PEO2, PEO3 |

| | | Pharmaceutical Knowledge | Problem solving | Conduct, analyze and interpret data | Ability to design and formulating a process | Ability to understand mechanism | Demonstrate skills in problem solving | Professional and ethical responsibilities | Communication to present a technical report | Impact on society and responsibilities | Leadership qualities | Self educating and Life-long Learning | Preparation for competitive examinations | Building a theoretical knowledge base along with necessary practical skills | To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy | Training students to achieve expertise |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PEO1** | **PEO2** | **PEO3** |
| TIU-UBP-306P | Physical Pharmaceutics I - Practical | 3 | 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 3 | 2 | 3 |

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

## Pharmaceutical Microbiology –Theory (TIU-UBP-303T)
## Contact hours: 45 hrs

**Course Objectives**

1. To understand the methods of identification, cultivation and preservation of various microorganisms
2. To have an idea about the importance and implementation of sterilization in pharmaceuticalprocessing and industry.

3. To know sterility testing of pharmaceutical products.
4. To learn microbiological standardization of Pharmaceuticals.
5. To gain knowledge about the cell culture technology and its applications in pharmaceutical industries.

**Course Outcomes**

Upon completion of the course, the student shall be able

CO1.**Summarize** the various nutritional requirements, physical parameters required for the growth and preservation of bacterial culture, together with bacterial count.

CO2.**Classify** the different sterilization techniques along with their merits, demerits and efficiency.

CO3.**Differentiate** between antiseptics and disinfectants.

CO4.**Demonstrate** the types of microorganisms, disinfectants as well as principles and methods of different microbiological assay.

CO5.**Identify** sources and types of microbial contaminants, assessment of microbial contamination and spoilage and method for prevention of pharmaceutical contamination.

| **Course Content** | **45 Hours** |
|---|---|

**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 physical, chemical gaseous,radiation and mechanical method of sterilization.
Evaluation of the efficiency of sterilization methods.
Equipments employed in large scale sterilization.
Sterility indicators.

**Unit III** **10 Hours**

Study of morphology, classification, reproduction/replication and

cultivation of Fungi and Viruses.
Classification and mode of action of disinfectants
Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions
Evaluation of bactericidal & Bacteriostatic.
Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

**Unit IV** **08 Hours**

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

**Unit V** **07 Hours**

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.

**Reference Books**

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.KJain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

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

| **Mapping between COs and Pos** |
|---|

| | Course Outcomes (COs) | Mapped Program Outcomes |
|---|---|---|
| **CO1** | **Summarize** the various nutritional requirements, physical parameters required for the growth and preservation of bacterial culture, together with bacterial count. | PO1, PO3, PO12, PEO1 |
| **CO2** | **Classify** the different sterilization techniques along with their merits, demerits and efficiency. | PO1, PO5, PO11, PO12, PEO1, PEO2 |
| **CO3** | **Compare** between antiseptics and disinfectants. | PO1,PO11, PO12,PEO2 |
| **CO4** | **Demonstrate** the principles and methods of different microbiological assay. | PO1,PO12,PEO1, PEO3 |
| **CO5** | **Identify**sources and types of microbial contaminants,assessment of microbial contamination and spoilage and method for prevention of pharmaceutical contamination. | PO1,PO12,PEO1,PEO2 |

| | | Pharmaceutical Knowledge | Problem solving | Conduct, analyze and interpret data | Ability to design and formulating a process | Ability to understand mechanism | Demonstrate skills in problem solving | Professional and ethical responsibilities | Communication to present a technical report | Impact on society and responsibilities | Leadership qualities | Self educating and Life-long Learning | Preparation for competitive examinations | Building a theoretical knowledge base along with necessary practical skills | To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy | Training students to achieve expertise |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PEO1** | **PEO2** | **PEO3** |
| TIU-UBP-303T | Pharmaceutical Microbiology - Theory | 3 | - | 2 | - | 2 | - | - | - | - | - | 2 | 3 | 3 | 2 | 2 |

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

## Pharmaceutical Microbiology– Practical (TIU-UBP-307P)
## Contact hours: 4hrs/wk

### Course Objectives

1. To know the fundamentals of sterilization and its industrial utility.
2. To administer the knowledge and techniques required for sub culturing of microbes.
3. To understand the concept of microbiological assay.

### Course Outcomes:

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

CO1.**Operate** the various sterilizing equipments.
CO2.**Prepare** the sub-cultures of bacteria and fungus.
CO3.**Describe** the various staining techniques.
CO4.**Describe** the microbiological assay and bacteriological analysis of various pharmaceutical products.

**Course Content** **4 Hrs/week**

1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
2. Sterilization of glassware, 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.

**Reference Books**

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.KJain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

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

| Mapping between COs and POs | | |
|---|---|---|
| | **Course Outcomes (COs)** | **Mapped Program Outcomes** |
| **CO1** | **Operate** the various sterilizing equipments. | PO1, PO4, PO11, PO12, PEO1, PEO2, |

| | | |
|---|---|---|
| | | PEO3 |
| **CO2** | **Prepare** the subcultures of bacteria and fungus. | PO1, PO4, PO12, PEO1, PEO2, PEO3 |
| **CO3** | **Describe** the various staining techniques. | PO1, PO5, PO12, PEO1,PEO2, PEO3 |
| **CO4** | **Describe** the microbiological assay and bacteriological analysis of various pharmaceutical products. | PO1, PO2, PO5, PO12, PEO1, PEO2, PEO3 |

| | | Pharmaceutical Knowledge | Problem solving | Conduct, analyze and interpret data | Ability to design and formulating a process | Ability to understand mechanism | Demonstrate skills in problem solving | Professional and ethical responsibilities | Communication to present a technical report | Impact on society and responsibilities | Leadership qualities | Self educating and Life-long Learning | Preparation for competitive examinations | Building a theoretical knowledge base along with necessary practical skills | To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy | Training students to achieve expertise |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PEO1** | **PEO2** | **PEO3** |
| TIU-UBP-307P | Pharmaceutical Microbiology - Practical | 3 | 2 | - | 2 | 2 | - | - | - | - | - | 2 | 3 | 3 | 3 | 3 |

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

## Pharmaceutical Engineering-Theory (TIU-UBP-304T)

**Contact hours: 45 hrs**

**Course Objectives**

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To carry out various test to prevent environmental pollution.
4. To appreciate and comprehend significance of plant lay out design for optimumuse of resources.
5. To appreciate the various preventive methods used for corrosion control inPharmaceutical industries.

**Course Outcomes**

Upon completion of the course, the student shall be able

CO1. **Recognize** the importance of the various unit operations used in pharmaceutical Industries like filtration, centrifugation, mixing, size separation, size reduction, flow of fluids, heat transfer, distillation, evaporation, drying, etc

CO2. **Identify** the various the various preventive methods used for hazards and corrosion control in Pharmaceutical Industries.

CO3. **Demonstrate** the applications of laws in the various unit operations for optimization of the process.

CO4. **Interpret** the results for problem solving in various unit operations.

CO5. **Classify** the equipments according to their mechanism of operation and identify their use for production of various pharmaceuticals.

**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.

**UNIT-II** **12 Hours**

**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

**UNIT-III** **08 Hours**

**Drying:** Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction,

working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

**Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles&Silverson Emulsifier.

**UNIT IV** **08 Hours**

**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 centrifuge, semi continuous centrifuge & super centrifuge.

**UNIT V** **07 Hours**

Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

**Reference Books** (Latest Editions)

1. Introduction to chemical engineering . Walter L Badger & Julius Banchero, Latest edition
2. Unit operation of chemical engineering .Mcabe Smith, Latest edition,
3. Pharmaceutical Engineering principles and practices .C.V.S.Subrahmanyam et al., Latest edition
4. Physical Pharmacy-Martin et al., Latest edition
5. Bentleys Pharmaceutics.Davis, Latest edition
6.Physical Pharmaceutics.Shotton, Latest edition
7.Remington Practice of Pharmacy.Martin, Latest edition
8.Cooper and Gunn.s Tutorial Pharmacy, S.J. Carter., Latest edition
9.Theory and practice of Industrial Pharmacy by Lachman., Latest edition
10.Refrigeration and Air conditioning by L. Ballaney., Latest edition.
11."Coulson and Richardson's Chemical Engineering", Vol. I, 3rd Edition, Butterworth Heinemann Publishers, 2004. Coulson, J.M., and Richardson, J.F.
12. Pharmaceutical Engineering, K. Sambhamurthy, New Age International publishers

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

| Mapping between COs and POs | | |
|---|---|---|
| | **Course Outcomes (COs)** | **Mapped Program Outcomes** |
| **CO1** | **Recognize** the importance of the various unit operations used in pharmaceutical Industries like filtration, centrifugation, mixing, size separation, size reduction, flow of fluids, heat transfer, distillation, evaporation, drying, etc | PO1, PO12, PEO1, PEO2 |
| **CO2** | **Identify** the various the various preventive methods used for hazards and corrosion control in Pharmaceutical Industries. | PO1, PEO2 |
| **CO3** | **Demonstrate** the applications of laws in the various unit operations for optimization of the process. | PO1, PO4, PO11, PO12,PEO1,PEO2, PEO3 |
| **CO4** | **Interpret** the results for problem solving in various unit operations. | PO1,PO2,PO3, PO6, PEO1, PEO2, PEO3 |
| **CO5** | **Classify** the equipments according to their mechanism of operation and identify their use for production of various pharmaceuticals. | PO1,PO5,PO11, PO12,PEO1,PEO2 |

| | | Pharmaceutical Knowledge | Problem solving | Conduct, analyze and interpret data | Ability to design and formulating a process | Ability to understand mechanism | Demonstrate skills in problem solving | Professional and ethical responsibilities | Communication to present a technical report | Impact on society and responsibilities | Leadership qualities | Self educating and Life-long Learning | Preparation for competitive examinations | Building a theoretical knowledge base along with necessary practical skills | To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy | Training students to achieve expertise |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PEO1** | **PEO2** | **PEO3** |
| TIU-UBP-304T | Pharmaceutical Engineering-Theory | 3 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 2 |

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

**Pharmaceutical Engineering– Practical (TIU-UBP-308P)**

**Contact hours: 4hrs/wk**

**Course Objectives**

1.ToDescribe various processes involved in pharmaceutical manufacturing process.
2.To interpret the results with the help of suitable calculations
3.To apply the knowledge in problem solving in manufacturing.

**Course Outcomes:**

After successful completion of this course, students will be able to:
CO1. **Demonstrate** various unit operations Describeed in the pharmaceutical industry
CO2. **Relate** various laws and related equations governing the various unit operations
CO3. **Evaluate** the effect of various factors on the unit operations.
CO4. **Use** suitable graphical plots for presentation of results

**Course Content** **4**

**Hours/Experiment**

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation – To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier
8. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic andlogarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
11. Factors affecting rate of filtration and evaporation (surface area, concentration and thickness/viscosity)
12. To study the effect of time on the Rate of Crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone Blender.

**Reference Books** (Latest Editions)

1.Introduction to chemical engineering . Walter L Badger & Julius Banchero, Latest edition
2. Unit operation of chemical engineering .Mcabe Smith, Latest edition,
3. Pharmaceutical Engineering principles and practices .C.V.S.Subrahmanyam et al., Latest edition
4. Physical Pharmacy-Martin et al., Latest edition
5. Bentleys Pharmaceutics.Davis, Latest edition
6.Physical Pharmaceutics.Shotton, Latest edition

7.Remington Practice of Pharmacy.Martin, Latest edition
8.Cooper and Gunn.s Tutorial Pharmacy, S.J. Carter., Latest edition
9.Theory and practice of Industrial Pharmacy by Lachman., Latest edition
10.Refrigeration and Air conditioning by L. Ballaney., Latest edition.
11."Coulson and Richardson's Chemical Engineering", Vol. I, 3rd Edition, Butterworth Heinemann Publishers, 2004. Coulson, J.M., and Richardson, J.F.
12. Pharmaceutical Engineering, K. Sambhamurthy, New Age International publishers

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

| Mapping between COs and POs | | |
|---|---|---|
| | **Course Outcomes (COs)** | **Mapped Program Outcomes** |
| **CO1** | **Demonstrate** various unit operations Describeed in the pharmaceutical industry | PO1,PEO1, PEO2, PEO3 |
| **CO2** | **Relate** various laws and related equations governing the various unit operations | PO1,PO5, PEO1, PEO2, PEO3 |
| **CO3** | **Evaluate** the effect of various factors on the unit operations. | PO1, PO3, PEO1, PEO2, PEO3 |
| **CO4** | **Use** suitable graphical plots for presentation of results | PO1, PO3, PEO1,PEO2, PEO3 |

| | | Pharmaceutical Knowledge | Problem solving | Conduct, analyze and interpret data | Ability to design and formulating a process | Ability to understand mechanism | Demonstrate skills in problem solving | Professional and ethical responsibilities | Communication to present a technical report | Impact on society and responsibilities | Leadership qualities | Self educating and Life-long Learning | Preparation for competitive examinations | Building a theoretical knowledge base along with necessary practical skills | To build a strong foundation as per the requirements of pharmaceutical Industries, Community and Hospital Pharmacy | Training students to achieve expertise |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PEO1** | **PEO2** | **PEO3** |
| TIU-UBP-308P | Pharmaceutical Engineering - Practical | 3 | 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 3 | 2 | 3 |

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