

(R15201) PHARMACEUTICAL UNIT OPERATIONS- I

**Objective:** The student shall be exposed to various aspects of handling of fluids, application of filtration, centrifugation, crystallization and humidification in pharmaceutical industry.

**UNIT I**

**a. Fluid Flow:** Types of flow, Reynold's number, viscosity, concept of boundary layer, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure.

**b. Dehumidification and Humidity control**

Basic concepts and definition, wet bulb and adiabatic saturation temperature. Psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipments for dehumidification operations.

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**UNIT II**

**Filtration and Centrifugation:** Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, etc. Factors affecting filtration, mathematical problems of filtration, optimum-cleaning cycle in batch filters.

Principles of centrifugation, industrial centrifugal filters, centrifugal filters, and centrifugal sedimenters.

**UNIT III**

**Crystalization:** Characteristics of crystals like; purity, size, shape, geometry, habit, forms, size and factors affecting it. Solubility curves and calculation of yields. Supersaturation theory and its limitations. Nucleation mechanisms, crystal growth. Study of various types of crystallizers such as Swenson walker crystalizer, vacuum crystalizer, crystal crystalizer. Caking of crystals and its prevention. Numerical problems on yields.

**UNIT IV**

**Distillation:** Raoult's law, phase diagrams, volatility, simple steam and flash distillations, principles of rectification, Azeotropic and extractive distillation.

**UNIT V**

**Industrial hazards and safety precautions:** Mechanical, Chemical, Electrical, fire and dust hazards. Industrial dermatitis, accident records etc.

**Outcomes:** Student will understand the concepts of fluid flow, parameter of filtration, centrifugation, crystallization and humidification. They also understand the safety factors and possess a sound knowledge on the above aspects.

**TEXT BOOKS**

1. S.J. Carter, Cooper and Gunn's Tutorial Pharmacy 6<sup>th</sup> ed CBS publisher, Delhi.
2. C.V.S. Subramanayam, Pharmaceutical Unit Operation, Vallabh Prakashan
3. Prof. K. Samba Murthy, Pharmaceutical Engineering.
4. Badzer & Banchemo, Introduction to Chemical Engineering.

**REFERENCES**

1. Perry's Handbook of Chemical Engineering.
2. Unit Operations by Mc Cabe & Smith.
3. Mc Cabe & Smith, Elements of Chemical Engineering.
4. Lippincott Williams and Wilkins: Remington Pharmaceutical Sciences.
5. EA Rawlins, Bentley's Text Book of Pharmaceutics, 8<sup>th</sup> edition, ELBS
6. Essentials of pharmaceutical engineering by D.V.Derle

## (R15202) PHARMACEUTICAL ORGANIC CHEMISTRY - II

**Objective:** The chemistry of highly complicated organic compounds like polynuclear hydrocarbons and heterocyclic compounds are discussed along with their stereochemical aspects

**Note:** Definition, nomenclature, structure, aromaticity, reactivity, acidity-basicity and characteristic reactions of the following heterocyclic compounds of Unit I and II  
Few Examples of Drugs which contain the cited ring system.

**UNIT I**

**Five membered and six membered ring systems with one hetero atom:** Furan, pyrrole, thiophene and pyridine.

**Fused ring systems with one hetero atom:** Indole, quinoline, iso-quinoline, and acridine.

**UNIT II**

**Five membered and six membered ring systems with two heteroatoms:** Pyrazole, imidazole, oxazole, isoxazole, thiazole, pyrazine, pyrimidine and pyridazine.

**Fused ring systems with two heteroatoms:** Benzimidazole and phenothiazine, Cinnoline, Quinazoline and Quinoxaline.

**UNIT III**

**Stereochemistry of Carbon compounds:** Optical rotation, plane polarized light, optical activity, chirality, notations (assignment of configuration), relative configuration (Fischer DL configuration), absolute configuration (R & S), sequence rules (with examples), enantiomers, meso compounds, racemic mixture, resolution.

**Stereochemistry of alkenes:** Concept of E & Z configurations. Elements of symmetry.

**UNIT IV**

**a) Polynuclear aromatic hydrocarbons:** Nomenclature, structure and aromatic character of naphthalene, anthracene, phenanthrene and naphthacene resonance structures, electron density and reactivity. Electrophilic substitution, oxidation and reduction reactions.

**b) Purine derivatives (xanthine bases):** Chemical structures of uric acid and methylated xanthines (caffeine, theophylline and theobromine) of physiological/ pharmaceutical significance. c) Definitions of nucleic Acids, nucleotides, nucleosides, A brief account on structure of DNA & RNA.

**UNIT V**

**A study of the mechanism and application in synthesis of the following named reactions:**

- Beckmann rearrangement
- Birch reduction
- Mannich reaction
- Michael addition reaction
- Wittig reaction
- Lossen rearrangement
- Curtius rearrangement
- Schmidt reaction

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**Outcome:** As the structural and stereochemical aspects and chemistry of organic compounds are discussed, it would help the students to have a good command over structural composition of organic compounds to evaluate and analyze the chemistry of these compounds

**TEXT BOOKS**

- R Morrison and R. Boyd, organic chemistry, Pub by Printice Hall of India, New Delhi.
- I L Finar, Organic Chemistry, Vol. I. & II, 6<sup>th</sup> Pearson education
- Reagents & reaction by O.P Agarwal
- Organic reactions, Stereo chemistry & mechanizam by PS Kalsi

**REFERENCES**

- Jerry March, Advanced Organic Chemistry 4<sup>th</sup> Ed.
- Cram & Hammond. Organic Chemistry.
- A.I. Vogel, A textbook of practical organic chemistry
- Solomons, Organic Chemistry
- Eliel, Stereochemistry of Organic compounds.
- Arun Bahl & S.S Bahl, Advanced Organic Chemistry

(R15203) STATISTICAL METHODS AND COMPUTER APPLICATIONS

Section - A: Bio-statistics

**Objective:** The objective of the course, centered around various techniques, collection of data and its treatment; Probability and distribution, correlation, regression and statistical inferences, besides computer application.

UNIT I

- i. **Data collection and treatment:** Data Collection and organization, diagrammatic representation of data( bar, pie, 2-D and 3-D diagrams), standard deviation and standard error of means, co-efficient of variation, Correlation and regression analysis.
- ii. **Probability and Distributions:** Bayer's theorem, probability theorem, elements of binomial and poison distribution, normal distribution curve and properties.

UNIT II

**Statistical inference:** Common parametric and non-parametric tests (t-test, F-test,  $X^2$ -test employed in testing of significance in biological/pharmaceutical experiments and elements of ANOVA (One way and two way).

UNIT III

**Design of experiments:** Basic concepts of CRD, RBD and Latin square designs.

**Sampling and Quality Control:** Concept of random sampling, statistical QC charts. Applications of statistical concepts in pharmaceutical sciences.

Section - B: Computer Applications

UNIT IV

**MS-Excel:** Basics, spreadsheets, data types, formulas, formatting, charts, graphs. Calculation of statistical parameters using excel.

**MS-Power Point:** Power point Basics, views, slide controls, applied design, page setup, templates, back ground control, colour screens, transitions, and animations, working with texts, and working with graphics.

UNIT V

**Database Management:** Concepts and Objectives of database management systems, advantages of the database management systems and examples of DBMS packages (like DBASE III) Introduction to structured Query language (SQL): over view of SQL, Reserved words, SQL Commands. **Computer Applications** in pharmaceutical and clinical studies,

**Outcome:** At the end of the course the expected outcomes are thorough knowledge of statistical techniques and application of computer in pharmacy

TEXT BOOKS

1. Sanford Boltan, Pharmaceutical statistics, Practical and clinical applications
2. Pranab Kumar Banarjee, Introduction to Biostatistics
3. Khan and Khanum, Fundamentals of Biostatistics
4. Text book of STATISTICAL Methods and computer applications by Dr. A. Ramakrishna Prasad.
5. Ron Mansfield, Working In Microsoft Office.
6. Ivan Bayross, SQL, PL/SQL the Programming Language of oracle.

REFERENCE

1. Roger E. Kirk, Statistics an introduction, Thomson Wadsworth [www.jntupharmaupdates.com](http://www.jntupharmaupdates.com)
2. Walter T. Ambrosius, Topics in Biostatistics, Humana Press
3. Philip Rowe, Essential Statistics for the Pharmaceutical Sciences, Wiley
4. Dona E. Knath, The Art Of Computer Programming by Pearson Education (Singapore) Pvt. Ltd Delhi, 110 092.
5. Remez Elmasi, Shankar. B. Navathe, Fundamentals Of Database System, Pearson Education (Singapore) Pvt. Ltd Delhi, 110 092.
6. Collins, Dictionary Of Computers and IT by Ian Sinclair, Harper Collins Publishers Glasgow, UK.
7. Y. Raja Raman, Computer Programming in C.
8. Introduction to Biostatistics by Dr. Pranab Kumar Banarjee
9. Introduction to Biostatistics and research methods by P.S.S. Sundar Rao and J. Richard.
10. Experimental statistics by Dr. K.Balaji: S. Chand Publication

(R15204) PHYSICAL PHARMACY – I

**Objective:** The student shall know important physical properties of drug molecules, phase value & its importance. Different law of thermodynamics, electrolyte and non-electrolyte solutions, importance of  $p^H$  and drug research.

**UNIT I**

**Physical properties of Drug Molecules:** Dielectric constant induced polarization, dipole moment, refractive index and molar refraction and optical rotatory dispersion.

**UNIT II**

**a. Phase equilibria and the phase rule:-** System containing single component, System containing two component, two component system containing solid and liquid phases, three component systems

**b. Thermodynamics:** The first law of thermodynamics. The second law of thermodynamics. The third law of thermodynamics, Free energy functions and applications.

**UNIT III**

**a. Solutions of Electrolytes:** Properties of solutions of electrolytes. The Arrhenius theory of electrolyte dissociation. The modern theory of strong electrolytes and other coefficients for expressing colligative properties.

**b. Solutions of Non electrolytes:** Concentration expressions, ideal and real solutions, colligative properties, molecular weight determinations.

**UNIT IV**

**Ionic equilibria:** Modern theories of acids, bases and salts, Sorensen's pH scale, species concentration as a function of pH, calculation of pH and acidity constants.

**UNIT V**

**Buffers and buffered isotonic systems:** The buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions, methods of adjusting tonicity and pH (relevant numerical problems).

**Outcomes:** Student will know about physical properties of molecules, three laws of thermodynamics, properties of electrolytes and non electrolytes,  $p^H$  and buffers. They also understand the importance of these studies in the physical pharmaceutics & Formulation development.

**TEXT BOOKS**

1. Patrick J. Sinko, Martin's Physical Pharmacy and Pharmaceutical Sciences Fifth Edition.
1. C.V.S.Subramanyam, Essentials of Physical Pharmacy, Vallabh Prakashan.
2. B.S Bahl, Arun Bahl and G.D Tuli, Essentials of Physical Chemistry.
3. Derle D.V., Essentials of Physical Pharmacy

**REFERENCES**

1. Pharmacopoeias, (I.P., B.P., U.S.P. and European.)
2. Martindale, The Extra Pharmacopoeia; latest edition, the Royal Pharmaceutical Society.
3. Lippincott Williams and Wilkins, Remington Pharmaceutical Sciences.
4. Robin. J. Haiwan, Hand Book of Pharmacy & Health Care ED, The Pharma Press UK.
5. Physical Pharmaceutics by Surydevara Vidhyadhara

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(R15205) ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY

**Objectives:** This course is designed to impart a fundamental knowledge on the structure and functions of the human body. Since a medicament, which is produced by pharmacist, is used to correct the deviations in human body, it enhances the understanding of how the drugs act on the various body systems in correcting the disease state of the organs

**UNIT I**

**Central Nervous System:** Functions of different parts of brain and spinal cord. Neurochemical transmission in the central nervous system, reflex action, electroencephalogram, cranial nerves and their functions. epilepsy, psychosis, depression, mania, Parkinsonism, Alzheimer's disease.

**Autonomic Nervous System:** Physiology and functions of autonomic nervous system. Mechanism of neurohumoral transmission in the A.N.S.

**UNIT II**

**Respiratory System:** Anatomy of respiratory organs. Functions of respiration, mechanism and regulation of respiration, respiratory volumes and vital capacity. Asthma, tuberculosis.

**Urinary System:** Various parts, structures and functions of the kidney and urinary tract. Physiology of urine formation and acid base balance, urinary tract infections. acute and chronic renal failure.

**UNIT III** [www.jntupharmaupdates.com](http://www.jntupharmaupdates.com)

**Endocrine System:** Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenals, pancreas, testes and ovary, their hormones and functions. Diabetes, Hyperthyroidism, and Hypothyroidism.

**UNIT IV**

**Reproductive Systems:** Male and Female reproductive systems and their hormones, physiology of menstruation, coitus and fertilization. Sex differentiation, spermatogenesis & oogenesis. Pregnancy its maintenance and parturition.

**UNIT V**

**Basic Principles of Cell Injury , Adaptation & process of inflammation:** Causes of cellular injury, pathogenesis, morphology of cell injury. Cellular adaptations, atrophy, hypertrophy. acute and chronic inflammation, mediators of inflammation, brief outline of the process of repair.

**Outcomes:** Knowledge on structure and functions of various organs of the human body and the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body and the pathological states

**TEXT BOOKS**

1. Tortora, G.J and Anagnodokas, Principles of Anatomy and Physiology, N.P Harper & Row Publishers N.Y
2. Ross & Willson, Text Book of Human Anatomy, M.J.Mycek S.B Gerther and MMPER
3. Robbins, SL & Kumar, Basic Pathology.
4. Human physiology by D.U Silverthorn and Bruce R. Johnson:PHI Learning publication

**REFERENCES:**

1. Guyton, Textbook of Medical Physiology, AC Guyton WB Sannders Company, 1995.
2. K. Sembulingam and Prema Sembulingam, Essentials of Medical Physiology, 3rd Edition, Jaypee Bros., New Delhi.
3. M.N.Gosh, Human Physiology
4. Julia F. Gui, Learning Human Anatomy: A Laboratory Text
5. Elaine N. Marieb, Essential of Human Anatomy & Physiology
6. C.C.Chatterjee, Human Physiology.
7. Mc Kinley,Human Anatomy.
8. Rizzo, fundamental of Anatomy Physiology.
9. Cinnamon.V, Jennifer. R, Andrew.R, Seeley's Fundamentals of human anatomy and physiology

II Year B. Pharm I-Sem	L	P	C
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**(R15206) PHARMACEUTICAL ORGANIC CHEMISTRY-II LAB**

**I. Synthesis of some simple heterocyclic compounds.**

- 3, 5-Dimethylpyrazole from Acetylacetone.
- 3, 5-Dimethylisoxazole from Acetylacetone.
- 4, 5-Diphenylimidazole from Benzil.
- Benzoxazole from o-Aminophenol.
- 2, 5-Dioxopiperazine from Glycine.
- Oxazolone from Benzoylglycine.

**II. Molecular rearrangements and named reactions**

- Benzimidazole from o-phenylenediamine (Phillip's Reaction).
- O-hydroxyacetophenone from phenyl acetate (Fries migration)
- Benzanilide from benzophenone oxime (Beckmann's rearrangement)
- Preparation of 2-phenylindole from Phenylhydrazine by Fischer's method.

**III. Systematic analysis of organic binary mixtures (Minimum 4 numbers)**

**REFERENCES**

1. Indian Pharmacopoeia– 2010.
2. A.I. Vogel's – Practical Organic Chemistry
3. Mann and Saunders, Pratical organic chemistry

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II Year B. Pharm I-Sem	L	P	C
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**(R15207) STATISTICAL METHODS AND COMPUTER APPLICATIONS LAB**

1. **Solving biostatistics problems** related to inference, sampling, graphical representation of data etc., with the help of calculators & software programs like Graph-pad.
2. **Sample programs in C:** Program to calculate simple and complex arithmetic expressions, program using structures, program using loops and nested loops, program using functions and simple programs using arrays.
3. **Operating systems** like WINDOWS, UNIX, etc.
4. **Software packages** like MS-WORD, EXCEL, ACCESS, and POWER POINT.

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(R15208) PHYSICAL PHARMACY – I LAB

1. Percent composition determination by Capillary Flow method
2. Percent composition determination by polarimeter & refractometer
3. Molecular weight determination by Landsberger method.
4. Molecular weight determination by Rast camphor method.
5. Calibration of pH Meter
6. pH Estimation – pH meter
7. pH Estimation – colourimetric method.
8. pH Estimation by Half Neutralization Method
9. Refractive index of liquids.
10. Molar refraction determination
11. Effect of dielectric constant on the solubility of the drug.
12. Phenol water system – CST
13. Lower consolute temperature – Terehanol amine and Water
14. Heat of neutralization
15. Phase diagram - Phenol – Water, Effect of Impurities.
16. Ternary phase diagram.
17. Preparation of Buffers and Buffer Capacity Determination.

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REFERENCES:

1. Physical pharmacy practical book by C.V.S. Subramanyam
2. Physical pharmacy practical text by Guru Prasa Mohanta, Prabal Kumar Manne

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II Year B. Pharm I-Sem

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(R15209) ANATOMY, PHYSIOLOGY & PATHOPHYSIOLOGY

(14 Experiments)

1. Study of reproductive system with the help of charts and models – 2 Experiments.
2. Various devices used in Family planning like Copper T, Lippers loop, Pills, Diaphragm and Condom.
3. Microscopic studies of abnormal tissue sections – 4 Experiments.
4. Simple experiments involved in the analysis of normal and abnormal urine; collection of specimen, appearance, determination of pH, sugars, proteins, urea and creatinine – 4 Experiments.
5. Study of special senses with the help of charts and models

REFERENCES

1. Plummer, Practical Biochemistry
2. Chatterjee, Human Physiology
3. C.L. Ghai, Practical Physiology

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