DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

BACHELOR OF PHARMACY
I, II, III & IV Year

On PCI Guidelines

(EFFECTIVE FROM THE SESSION: 2019-20)
## Bachelor of Pharmacy (B. Pharm.)
### COURSE OF STUDY & SCHEME OF EVALUATION FOR INTERNAL AND END SEMESTER EXAMINATIONS
#### (W.E.F. Session 2019-20)

### FIRST SEMESTER

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Applicable ONLY for the students who have studied Mathematics/ Physics/ Chemistry at HSC and appearing for Remedial Biology (RB) course.

Applicable ONLY for the students who have studied Physics/ Chemistry/ Botany/ Zoology at HSC and appearing for Remedial Mathematics (RM) course.
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*The lateral entry students taking admission directly to second year shall compulsorily appear for and pass the Communications Skill Subject Examination in the Third Semester.

**Human values & Professional Ethics will be offered as a compulsory course for which passing marks shall be 30% in End Semester Examination and 40% in aggregate.
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*The lateral entry students taking admission directly to second year shall compulsorily appear for and pass the Computer Applications in Pharmacy Subject Examination in the Fourth Semester.
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Evaluation Scheme Bachelor of Pharmacy I, II, III & IV Year syllabus 2019-2020
### SIXTH SEMESTER

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### SEVENTH SEMESTER

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<td>BP702T</td>
<td>Industrial Pharmacy II – Theory</td>
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<td>BP703T</td>
<td>Pharmacy Practice – Theory</td>
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<td>BP704T</td>
<td>Novel Drug Delivery System (NDDS) – Theory</td>
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<td>BP705P</td>
<td>Instrumental Methods of Analysis/ NDDS – Practical</td>
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<td>5</td>
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<td>BP707P</td>
<td>Report on Hospital Training-II</td>
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### EIGHTH SEMESTER

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<td>Biostatistics and Research Methodology</td>
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<td>BP802T</td>
<td>Social and Preventive Pharmacy</td>
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<td>BP803ET</td>
<td>Pharma Marketing Management*</td>
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<td>BP804ET</td>
<td>Pharmaceutical Regulatory Science*</td>
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<td>BP805ET</td>
<td>Pharmacovigilance*</td>
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<td>BP806ET</td>
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<td>BP807ET</td>
<td>Computer Aided Drug</td>
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<td>BP808ET</td>
<td>Cell and Molecular</td>
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<td>BP809ET</td>
<td>Cosmetic Science*</td>
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<td>BP810ET</td>
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<td>BP811ET</td>
<td>Advanced Instrumentation Techniques*</td>
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<td>BP812ET</td>
<td>Dietary Supplements and Nutraceuticals*</td>
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<td>BP814ET</td>
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*(ET: Elective subject) Every candidate has to opt for two of the elective subjects, and has to carry out project on any one of them. The student has the choice to choose both the elective subjects from the already prescribed list of elective subjects by the PCI or choose one elective subject from the existing prescribed list of elective subjects of B. Pharm. programme by the PCI and the other (second subject) elective from list of skill pack/modules available with the LSSSDC from time to time.
BP101T. HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)  
45 Hours

Course Content:

Unit-I 10 hours

**Introduction to human body:** Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

**Cellular level of organization:** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent; b) Paracrine; c) Synaptic; d) Endocrine.

**Tissue level of organization:** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

Unit-II 10 hours

**Integumentary system:** Structure and functions of skin.

**Skeletal system:** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system. Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction.

**Joints:** Structural and functional classification, types of joints movements and its articulation.

Unit-III 10 hours

**Body fluids and blood:** Body fluids, composition and functions of blood, hemopoiesis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo-endothelial system.

**Lymphatic system:** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system.

Unit-IV 08 hours

**Peripheral nervous system:** Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves.

**Special senses:** Structure and functions of eye, ear, nose and tongue and their disorders.

Unit-V 07 hours

**Cardiovascular system**
Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.
BP107P. HUMAN ANATOMY AND PHYSIOLOGY (Practical)

4 Hours/weeks

1. Study of compound microscope.
2. Microscopic study of epithelial and connective tissue.
3. Microscopic study of muscular and nervous tissue.
4. Identification of axial bones.
5. Identification of appendicular bones.
6. Introduction to hemocytometry.
7. Enumeration of white blood cell (WBC) count.
8. Enumeration of total red blood corpuscles (RBC) count.
10. Determination of clotting time.
11. Estimation of hemoglobin content.
12. Determination of blood group.
13. Determination of erythrocyte sedimentation rate (ESR).
15. Recording of blood pressure.

Recommended Books (Latest Editions)

- Physiological Basis of Medical Practice by Best and Tailor, Williams & Wilkins Co, Riverview, MI, USA.
- Textbook of Medical Physiology by Arthur C, Guyton and John, E. Hall, Miamisburg, Ohio, U.S.A.
- Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
- Human Anatomy and Physiology by Marieb E.N., Benjamin Cummings, Pearson Education Inc., San Francisco.
- Preventive and Social Medicine by Park K., Banarsidas Bhanot Publishers, Jabalpur.
- Health Education and Community Pharmacy by Parmar N.S., CBS Publishers, Delhi.
- Human Physiology - Volume 1 and 2 by Dr. C.C. Chatterjee, Academic Publishers, Kolkata.
BP102T. PHARMACEUTICAL ANALYSIS (Theory)  45 Hours
Course Content:

Unit-I  10 Hours
Pharmaceutical analysis: Definition and scope.
i) Different techniques of analysis.
ii) Methods of expressing concentration.
iii) Primary and secondary standards.
iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate.
Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures.
Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.

Unit-II  10 Hours
Acid base titration: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves.
Non-aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl.

Unit-III  10 Hours
Precipitation titrations: Mohr’s method, Volhard’s, Modified Volhard’s, Fajan’s method, estimation of sodium chloride.
Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.
Basic Principles, methods and application of diazotization titration.

Unit-IV  08 Hours
Redox titrations: Concepts of oxidation and reduction, Types of redox titrations (Principles and applications).
Cerimetry, Iodimetry, Iodometry, Bromometry, Dichrometry and titration with potassium-iodate.
Unit-V  

Electrochemical methods of analysis:  

**Conductometry** - Introduction, Conductivity cell, Conductometric titrations, applications.  
**Potentiometry** - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.  
**Polarography** - Principle, Ilkovic equation construction and working of dropping mercury electrode and rotating platinum electrode, applications.
BP108P. PHARMACEUTICAL ANALYSIS (Practical)

4 Hours / Week

I Limit Test of the following:
(1) Chloride.
(2) Sulphate.
(3) Iron.
(4) Arsenic.

II Preparation and standardization of
(1) Sodium hydroxide.
(2) Sulphuric acid.
(3) Sodium thiosulfate.
(4) Potassium permanganate.
(5) Ceric ammonium sulphate.

III Assay of the following compounds along with Standardization of Titrant:
(1) Ammonium chloride by acid base titration.
(2) Ferrous sulphate by Cerimetry.
(3) Copper sulphate by Iodometry.
(4) Calcium gluconate by Complexometry.
(5) Hydrogen peroxide by Permanganatometry.
(6) Sodium benzoate by non-aqueous titration.
(7) Sodium Chloride by precipitation titration.

IV Determination of Normality by electro-analytical methods:
(1) Conductometric titration of strong acid against strong base.
(2) Conductometric titration of strong acid and weak acid against strong base.
(3) Potentiometric titration of strong acid against strong base.

Recommended Books: (Latest Editions)

- A Textbook of Pharmaceutical by Conners K.A., Wiley Inter-science.
- The Pharmacopoeia of India, the Controller of Publications, Delhi.
- Analytical Chemistry Principles by John H. Kennedy, Cengage Learning, Delhi.
BP103T. PHARMACEUTICS-I (Theory)  

Course Content:  

Unit-I  
10 Hours  
**Historical background and development of profession of pharmacy:** History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.  
**Dosage forms:** Introduction to dosage forms, classification and definitions.  
**Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription.  
**Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.  

Unit-II  
10 Hours  
**Pharmaceutical calculations:** Weights and measures– Imperial & Metric system, Calculations involving percentage solutions, allegation, proof spirit and isotonic solutions based on freezing point and molecular weight.  
**Powders:** Definition, classification, advantages and disadvantages. Simple & compound powders– official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.  
**Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques.  

Unit-III  
10 Hours  
**Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.  
**Biphasic liquids:**  
**Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.  
**Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.  

Unit-IV  
08 Hours  
**Suppositories:** Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.  
**Pharmaceutical incompatibilities:** Definition, classification, physical, chemical and therapeutic incompatibilities with examples.  

Unit-V  
07 Hours  
**Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi-solid dosage forms. Evaluation of semi-solid dosages forms.
BP109P. PHARMACEUTICS I (Practical)

3 Hours/week

1. **Syrups**
   
a) Syrup IP’66.
b) Compound syrup of Ferrous Phosphate BPC’68.

2. **Elixirs**
   
a) Piperazine citrate elixir.
b) Paracetamol pediatric elixir.

3. **Linctus**
   
a) Terpen Hydrate Linctus IP’66.
b) Iodine Throat Paint (Mandl’s Paint).

4. **Solutions**
   
a) Strong solution of ammonium acetate.
b) Cresol with soap solution.
c) Lugol’s solution.

5. **Suspensions**
   
a) Calamine lotion.
b) Magnesium Hydroxide mixture.
c) Aluminum Hydroxide gel.

6. **Emulsions**
   
a) Turpentine Liniment.
b) Liquid paraffin emulsion.

7. **Powders and Granules**
   
a) ORS powder (WHO).
b) Effervescent granules.
c) Dusting powder.
d) Divided powders.

8. **Suppositories**
   
a) Glycerol-Gelatin suppository.
b) Coca butter suppository.
c) Zinc Oxide suppository.

9. **Semisolids**
   
a) Sulphur ointment.
b) Non staining-iodine ointment with methyl salicylate.
c) Carbopol gel.

10. **Gargles and Mouthwashes**
    
a) Iodine gargle.
b) Chlorhexidine mouthwash.
Recommended Books: (Latest Editions)

- Pharmaceutical Dosage Form and Drug Delivery System by H.C. Ansel et al., Lippincott Williams and Wilkins, New Delhi.
- Cooper and Gunn’s Dispensing for Pharmaceutical Students by Carter S.J., CBS Publishers, New Delhi.
- Pharmacopoeia of India, The Controller of Publications, Delhi.
- Theory and Practice of Industrial Pharmacy by Lachman, Lea & Febiger Publisher, the University of Michigan.
- Cooper and Gunn’s Tutorial Pharmacy by Carter S.J., CBS Publications, New Delhi.
- Bentley’s Textbook of Pharmaceutics by E.A. Rawlins, English Language Book Society, Elsevier Health Sciences, USA.
- Pharmaceutical Emulsions and Suspensions, Francoise Nieloud and Gilberte Marti-Mestres Marcel Dekker, INC, New York.
- Elementary Pharmaceutical Calculations by Tripathi D.K., PharmaMed Press, Hyderabad.
BP104T. PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

Course Content:

Unit-I

Impurities in pharmaceutical Substances: History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate.

General methods of preparation, assay for the compounds superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes.

Unit-II

Acids, Bases and Buffers: Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

Major extra and intracellular electrolytes: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.

Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.

Unit-III

Gastrointestinal agents

Acidifiers: Ammonium chloride* and Dil. HCl.

Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture.

Cathartics: Magnesium sulphate, Sodium orthophosphate Kaolin and Bentonite.


Unit-IV

Miscellaneous compounds

Expectorants: Potassium iodide, Ammonium chloride*.

Emetics: Copper sulphate*, Sodium potassium tartrate.

Hematinics: Ferrous sulphate*, Ferrous gluconate.

Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite333.

Astringents: Zinc Sulphate, Potash Alum.

Unit-V

Radiopharmaceuticals: Radio activity, measurement of radioactivity, properties of α, β, γ radiations, half-life, radio isotopes and study of radio isotopes- Sodium iodide I^{131}, storage conditions, precautions & pharmaceutical application of radioactive substances.
BP110P. PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)

4 Hours / Week

I  Limit tests for following ions
   Limit test for Chlorides and Sulphates
   Modified limit test for Chlorides and Sulphates
   Limit test for Iron
   Limit test for Heavy metals
   Limit test for Lead
   Limit test for Arsenic

II  Identification test
    Magnesium hydroxide
    Ferrous sulphate
    Sodium bicarbonate
    Calcium gluconate
    Copper sulphate

III Test for purity
    Swelling power of Bentonite
    Neutralizing capacity of aluminum hydroxide gel
    Determination of potassium iodate and iodine in potassium iodide

IV Preparation of inorganic pharmaceuticals
    Boric acid
    Potash alum
    Ferrous sulphate

Recommended Books (Latest Editions)
- Pharmacopoeia of India, the Controller of Publications, Delhi.
- Vogel's Qualitative Inorganic Analysis by Svehla, G. and Sivasankar, B. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), New Delhi.
• Inorganic Pharmaceutical Chemistry by M.L. Schroff, National Book Centre, Kolkata.
BP105T. COMMUNICATION SKILLS (Theory) 30 Hours

Course content:

Unit-I 07 Hours
Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers.

Unit-II 07 Hours
Elements of communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

Unit-III 07 Hours
Basic listening skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in difficult situations.
Effective written communication: Introduction, When and When Not to Use Written Communication- Complexity of the Topic, Amount of Discussion’ Required, Shades of Meaning, Formal Communication.
Writing effectively: Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message.

Unit-IV 05 Hours
Interview skills: Purpose of an interview, Do’s and Don’ts of an interview.
Giving presentations: Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery.

Unit-V 04 Hours
Group discussion: Introduction, Communication skills in group discussion, Do’s and Don’ts of group discussion.
BP111P. COMMUNICATION SKILLS (Practical)

Course content:

The following learning modules are to be conducted using words worth® English language lab software.

**Basic communication covering the following topics**
Meeting People.
Asking Questions.
Making Friends.
What did you do?
Do’s and Don’ts.

**Pronunciations covering the following topics**
Pronunciation (Consonant Sounds).
Pronunciation and Nouns.
Pronunciation (Vowel Sounds).

**Advanced Learning**
Listening Comprehension / Direct and Indirect Speech.
Figures of Speech.
Effective Communication.
Writing Skills.
Effective Writing. Interview
Handling Skills.
E-Mail etiquette. Presentation Skills.

**Recommended Books: (Latest Edition)**
- Developing Your Influencing Skills, Deborah Dalley, Lois Burton, Margaret, Green hall,
Course content:

Unit-I
Living world:
Definition and characters of living organisms.
Diversity in the living world.
Binomial nomenclature.
Five kingdoms of life and basis of classification. Salient features of Monera, Protista, Fungi, Animalia and Plantae, Virus.

Morphology of flowering plants
Morphology of different parts of flowering plants- Root, stem, inflorescence, flower, leaf, fruit, seed.
General Anatomy of Root, stem, leaf of monocotyledons & Dicotyledons.

Unit-II

Body fluids and circulation: Composition of blood, blood groups, coagulation of blood, Composition and functions of lymph, Human circulatory system, Structure of human heart and blood vessels, Cardiac cycle, cardiac output and ECG.

Digestion and absorption: Human alimentary canal and digestive glands, Role of digestive enzymes, Digestion, absorption and assimilation of digested food.

Breathing and respiration: Human respiratory system, Mechanism of breathing and its regulation, Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes.

Unit-III
Excretory products and their elimination: Modes of excretion, Human excretory system-structure and function, Urine formation, Renin angiotensin system.

Neural control and coordination: Definition and classification of nervous system, Structure of a neuron, Generation and conduction of nerve impulse, Structure of brain and spinal cord, Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata.

Chemical coordination and regulation: Endocrine glands and their secretions, Functions of hormones secreted by endocrine glands

Human reproduction: Parts of female reproductive system, Parts of male reproductive system, Spermatogenesis and Oogenesis, Menstrual cycle.

Unit-IV

Plants and mineral nutrition: Essential mineral, macro and micronutrients, Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation


Unit-V

Plant respiration: Respiration, glycolysis, fermentation (anaerobic).

Plant growth and development: Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators

Cell - The unit of life: Structure and functions of cell and cell organelles. Cell division

Tissues: Definition, types of tissues, location and functions.
BP112RBP. REMEDIAL BIOLOGY (Practical)

30 Hours

1. Introduction to experiments in biology.
   a) Study of Microscope.
   b) Section cutting techniques.
   c) Mounting and staining.
   d) Permanent slide preparation.
3. Study of Stem, Root, Leaf, seed, fruit, flower and their modifications.
4. Detailed study of frog by using computer models.
5. Microscopic study and identification of tissues pertinent to Stem, Root, Leaf, seed, fruit and flower.
7. Determination of blood group.
8. Determination of blood pressure.

Textbooks:
• Textbook of Biology by S. B. Gokhale.
• A Textbook of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books:
• A Textbook of Biology by B.V. Sreenivasa Naidu.
• A Textbook of Biology by Naidu and Murthy.
• Botany for Degree Students by A.C. Dutta.
• Outlines of Zoology by M. Ekambaranatha Ayyer and T.N. Ananthakrishnan.

Recommended Books (Latest Edition):
BP106RMT. REMEDIAL MATHEMATICS (Theory)

30 Hours

Course Content:

Unit-I 06 Hours
Logarithms: Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.
Function: Real Valued function, Classification of real valued functions.
Limits and continuity: Introduction, Limit of a function, Definition of limit of a function (ε - δ definition), \( \lim_{x \to a} x^n = na^{n-1} \), \( \lim_{\theta \to 0} \sin \theta = 1 \), \( \lim_{x \to a} x - a = 0 \to 0 \), \( \theta \)

Unit-II 06 Hours
Matrices and Determinant:

Unit-III 06 Hours
Calculus Differentiation: Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function, Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – Without Proof, Derivative of \( x^n \) w.r.t \( x \), where \( n \) is any rational number, Derivative of \( e^x \), Derivative of \( \log_e x \), Derivative of \( a^x \), Derivative of trigonometric functions from first principles (without Proof), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application.
Unit-IV  
Analytical Geometry  
**Introduction:** Signs of the Coordinates, Distance formula.  
**Straight Line:** Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line.  
**Integration:** Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application.

Unit-V  
**Differential Equations:** Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations.  
**Laplace Transform:** Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving chemical kinetics and Pharmacokinetics equations.

**Recommended Books (Latest Edition)**  
- Differential Calculus by Shanthinarayan.  
- Pharmaceutical Mathematics with Application to Pharmacy by Panchaksharappa Gowda D.H.  
- Integral Calculus by Shanthinarayan.  
- Higher Engineering Mathematics by Dr. B.S. Grewal.
Semester II
BP201T. HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)

Course Content:

45 Hours

Unit-I

Nervous system
Organization of nervous system, neuron, neuroglia, classification and properties of nerve fiber, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.
Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity).

Unit II

Digestive system: Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.
Energetics: Formation and role of ATP, Creatinine Phosphate and BMR.

Unit-III

Respiratory system
Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration.
Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

Unit-IV

Endocrine system: Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.

Unit-V

Reproductive system: Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition.
Introduction to genetics: Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance.
BP207P. HUMAN ANATOMY AND PHYSIOLOGY-II (Practical)

4 Hours/week

1. To study the integumentary and special senses using specimen, models, etc.
2. To study the nervous system using specimen, models, etc.
3. To study the endocrine system using specimen, models, etc.
4. To demonstrate the general neurological examination.
5. To demonstrate the function of olfactory nerve.
6. To examine the different types of taste.
7. To demonstrate the visual acuity.
8. To demonstrate the reflex activity.
9. Recording of body temperature.
10. To demonstrate positive and negative feedback mechanism.
11. Determination of tidal volume and vital capacity.
12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
13. Recording of basal mass index.
15. Demonstration of total blood count by cell analyzer.
16. Permanent slides of vital organs and gonads.

Recommended Books (Latest Editions)

- Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
- Human Physiology, Volume 1 and 2 by Dr. C.C. Chatterjee, Academic Publishers Kolkata.
BP202T. PHARMACEUTICAL ORGANIC CHEMISTRY-I (Theory)  

45 Hours  

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-I  
Classification, Nomenclature and Isomerism: Classification of Organic Compounds, Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds). Structural isomerism in organic compounds.  

Unit II  
Alkanes*, Alkenes* and Conjugated dienes*  
sp\(^3\) hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, sp\(^2\) hybridization in alkenes. 
E\(_1\) and E\(_2\) reactions – Kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeff’s orientation and evidences. E\(_1\) verses E\(_2\) reactions, Factors affecting E\(_1\) and E\(_2\) reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff’s orientation, free radical addition reactions of alkenes, Anti-Markownikoff’s orientation. 
Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement.  

Unit III  
Alkyl halides*  
SN\(_1\) and SN\(_2\) reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN\(_1\) versus SN\(_2\) reactions, Factors affecting SN\(_1\) and SN\(_2\) reactions. 
Structure and uses of ethyl chloride, chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.  
Alcohols* - Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol.
Unit-IV 10 Hours

Carbonyl compounds* (Aldehydes and ketones)
Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanillin, Cinnamaldehyde.

Unit-V 08 Hours

Carboxylic acids*: Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids, amide and ester.
Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid.
BP208P. PHARMACEUTICAL ORGANIC CHEMISTRY-I (Practical)

4 Hours / week

A. Systematic qualitative analysis of unknown organic compounds like
   1. Preliminary test: Color, odor, aliphatic/aromatic compounds, saturation and unsaturation, etc.
   2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne’s test.
   5. Melting point/Boiling point of organic compounds.
   6. Identification of the unknown compound from the literature using melting point/boiling point.
   7. Preparation of the derivatives and confirmation of the unknown compound by melting point/boiling point.
   8. Minimum 5 unknown organic compounds to be analyzed systematically.

B. Preparation of suitable solid derivatives from organic compounds.

C. Construction of molecular models.

Recommended Books (Latest Editions)
- Strategic Applications of Named Reactions in Organic Chemistry by Laszlo Kurti and Barbara Czako, Elsevier Academic Press.
- Introduction to Organic Laboratory Techniques by Pavia, Lampman and Kriz, Cengage Learning, Delhi.
BP203T. BIOCHEMISTRY (Theory)  

Course Content:

Unit-I  
**Biomolecules:** Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.  
**Bioenergetics:** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.  
Energy rich compounds; classification; biological significances of ATP and cyclic AMP.

Unit-II  
**Carbohydrate metabolism:**  
Glycolysis- Pathway, energetics and significance.  
Gluconeogenesis- Pathway and its significance.  
Citric acid cycle- Pathway, energetics and significance.  
HMP shunt and its significance- Glucose-6-Phosphate dehydrogenase (G6PD) deficiency.  
Glycogen metabolism Pathways and glycogen storage diseases (GSD).  
Hormonal regulation of blood glucose level and Diabetes mellitus.  
**Biological oxidation:**  
Electron transport chain (ETC) and its mechanism.  
Oxidative phosphorylation & its mechanism and substrate level phosphorylation.  
Inhibitors ETC and oxidative phosphorylation/Uncouplers.

Unit-III  
**Lipid metabolism:** β-Oxidation of saturated fatty acid (Palmitic acid). Formation and utilization of ketone bodies; ketoacidosis. De novo synthesis of fatty acids (Palmitic acid).  
Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D.  
Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.  
**Amino acid metabolism:** General reactions of amino acid metabolism. Transamination, deamination and decarboxylation, Urea cycle and its disorders.  
Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, Alkaptonuria, Tyrosinemia).  
Synthesis and significance of biological substances: 5-HT, melatonin, dopamine, noradrenaline, adrenaline.  
Catabolism of heme; hyperbilirubinemia and jaundice.
Unit-IV                                                                                                                  10 Hours

Nucleic acid metabolism and genetic information transfer
Biosynthesis of purine and pyrimidine nucleotides.
Catabolism of purine nucleotides and Hyperuricemia and Gout disease.
Organization of mammalian genome.
Structure of DNA and RNA and their functions DNA replication (semi conservative model)
Transcription or RNA synthesis.
Genetic code, Translation or Protein synthesis and inhibitors.

07 Hours

Enzymes
Introduction, properties, nomenclature and IUBMB classification of enzymes.
Enzyme kinetics (Michaelis-Menten plot, Line-Weaver Burke plot) Enzyme inhibitors with examples.
Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation.
Coenzymes: Structure and biochemical functions.
Therapeutic and diagnostic applications of enzymes and isoenzymes.
BP209P. BIOCHEMISTRY (Practical)

4 Hours / Week

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch).
2. Identification tests for Proteins (Albumin and Casein).
3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method).
4. Qualitative analysis of urine for abnormal constituents.
5. Determination of blood creatinine.
6. Determination of blood sugar.
7. Determination of serum total cholesterol.
8. Preparation of buffer solution and measurement of pH.
9. Study of enzymatic hydrolysis of starch.
11. Study the effect of Temperature on Salivary amylase activity.
12. Study the effect of substrate concentration on salivary amylase activity.

Recommended Books (Latest Editions)

- Fundamentals of Biochemistry by Voet D., Voet J.G., Pratt C.W., John Wiley and Sons Inc.
• Practical Biochemistry by Harold Varley, CBS Publishers and Distributors. New Delhi.
• Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
• Practical Manual to Biochemistry by Singh S.P., CBS Publisher, New Delhi.
• Modern Experimental Biochemistry by Boyer R.F., Dorling Kindersley (India) Pvt. Ltd.
• Comprehensive Viva and Practical Biochemistry by Deb A.C., New Centre Book Agency (P.) Ltd. London.
BP204T. PATHOPHYSIOLOGY (THEORY)  

45 Hours

Course content:

Unit-I  
**Basic principles of Cell injury and Adaptation:**

**Basic mechanism involved in the process of inflammation and repair:**
Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC’s, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis.

Unit-II  
**Cardiovascular System:**
Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)

**Respiratory system:** Asthma, Chronic obstructive airways diseases.

**Renal system:** Acute and chronic renal failure.

Unit-III  
**Hematological Diseases:**
Iron deficiency, megaloblastic anemia (Vitamin B12 and folic acid), sickle cell anemia, thalassemia, hereditary acquired anemia, hemophilia.

**Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones.

**Nervous system:** Epilepsy, Parkinson’s disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer’s disease.

**Gastrointestinal system:** Peptic Ulcer.

Unit-IV  
8 Hours

Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease.

**Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout.

**Principles of cancer:** classification, etiology and pathogenesis of cancer.
Unit-V                                                                                                                        7 Hours
Infectious diseases: Meningitis, Typhoid, Leptosy, Tuberculosis, Urinary tract infections.
Sexually transmitted diseases: AIDS, Syphilis, Gonorrhea.

Recommended Books (Latest Editions)
- Robbins & Cotran Pathologic Basis of Disease by Vinay Kumar, Abul K. Abas, Jon C. Aster; South Asia edition; India; Elsevier.
- Best and Taylor’s Physiological Basis of Medical Practice by Best, Charles Herbert, Taylor, Norman Burke, John Bernard, 12th edition; United States; William and Wilkins, Baltimore.
- Basic Pathology by V. Kumar, R. S. Cotran and S. L. Robbins, 6th edition; Philadelphia; WB Saunders Company.

Recommended Journals
- The Journal of Pathology. ISSN: 1096-9896 (Online).
- The American Journal of Pathology. ISSN: 0002-9440.
- Pathology. 1465-3931 (Online).
- Indian Journal of Pathology and Microbiology. ISSN-0377-4929.
BP205T. COMPUTER APPLICATIONS IN PHARMACY (Theory)

30 Hours (2 Hours/Week)

Course content:

Unit-I
Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary, binary addition, binary subtraction – One’s complement, Two’s complement method, binary multiplication, binary division.

Concept of Information Systems and Software: Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project.

Unit-II
Web technologies: Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products.
Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database.

Unit-III
Application of computers in Pharmacy – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring.

Unit-IV
Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery.

Unit-V
Computers as data analysis in Preclinical development:
Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS).
BP210P. COMPUTER APPLICATIONS IN PHARMACY (Practical)

1. Design a questionnaire using a word processing package to gather information about a particular disease.
2. Create a HTML web page to show personal information.
3. Retrieve the information of a drug and its adverse effects using online tools.
4. Creating mailing labels Using Label Wizard, generating label in MS WORD.
5. Create a database in MS Access to store the patient information with the required fields using access.
6. Design a form in MS Access to view, add, delete and modify the patient record in the database.
7. Generating report and printing the report from patient database.
10. Creating and working with queries in MS Access.
11. Exporting Tables, Queries, Forms and Reports to web pages.
12. Exporting Tables, Queries, Forms and Reports to XML pages.

Recommended books (Latest edition):

- Computer Application in Pharmaceutical Research and Development by Sean Ekins, Wiley-Interscience, A John Willey and Sons, INC., Publication, USA.
BP206T. ENVIRONMENTAL SCIENCES (Theory) 30 hours

Course content:

Unit-I 10 hours
The multidisciplinary nature of environmental studies.
Natural Resources.
Renewable and non-renewable resources: Natural resources and associated problems
a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit-II 10 hours
Ecosystems
Concept of an ecosystem.
Structure and function of an ecosystem.
Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit-III 10 hours
Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books (Latest edition):
- The Biodiversity of India by Bharucha Erach, Mapin Publishing Pvt. Ltd., Ahmedabad, India.
- Environmental Chemistry by De A.K., Wiley Eastern Ltd.
- Down of Earth, Centre for Science and Environment, Editor Sunita Narain.
SEMESTER III
BP301T. PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory)

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-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, 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.
D. Structure and uses of DDT, Saccharin, BHC and Chloramine T.

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 on basicity, 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
Fatty acids – reactions.
Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.
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: Synthesis, reactions.
Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives.

Unit-V 07 Hours
Cycloalkanes*
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.
BP305P. PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical)  
4 Hrs/week

1. Experiments involving laboratory techniques:
   • Recrystallization.
   • Steam distillation.

2. Determination of following oil values (including standardization of reagents):
   • Acid value.
   • Saponification value.
   • Iodine value.

3. **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-nitrosalicylic acid/meta di-nitrobenzene from salicylic acid/ nitro benzene by nitration reaction.
   • Benzoic acid from benzyl chloride by oxidation reaction.
   • Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.
   • 1-Phenyl azo-2-naphthol from Aniline by diazotization and coupling reactions.
   • Benzil from benzoin by oxidation reaction.
   • Dibenzal acetone from benzaldehyde by Claisen-Schmidt reaction.
   • Cinnamnic acid from benzaldehyde by Perkin reaction.
   • \( p \)-lodo benzoic acid from \( p \)-amino benzoic acid.

**Recommended Books (Latest Editions)**

- Strategic Applications of Named Reactions in Organic Chemistry by Laszlo Kurti and Barbara Czako, Elsevier Academic Press.
• Introduction to Organic Laboratory Techniques by Pavia, Lampman and Kriz, Cengage Learning, Delhi.
• Reaction and Reaction Mechanism by Ahluwalia/Chatwal, Narosa Publishing House, New Delhi.
BP302T. PHYSICAL PHARMACEUTICS-I (Theory)  
45 Hours

Course Content:

Unit-I  

Unit-II  
Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications.

Unit-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, HLB scale, solubilization, detergency, adsorption at solid interface.

Unit-IV  

Unit-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.
BP306P. PHYSICAL PHARMACEUTICS – I (Practical)  
4 Hrs/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.  

Recommended Books: (Latest Editions)  
• Physical Pharmacy by Alfred Martin, Lippincott Williams and Wilkins, USA.  
• Tutorial Pharmacy by Cooper and Gunn, CBS, New Delhi.  
• Pharmaceutical Calculations by Stocklosam J., Lea & Febiger, Philadelphia.  
• Physical Pharmaceutics by Ramasamy C. and Manavalan R., PharmaMed Press, Hyderabad.  
• Experimental Pharmaceutics by Eugene, Parott, Burgess Pub. Co., UK.  
• Physical Pharmaceutics by C.V.S. Subramanyam. CBS Publication  
• Textbook of Physical Pharmacy by Gaurav Jain & Roop K. Khar, Reed Elsevier India Pvt. Ltd., New Delhi.  
• Physical Pharmaceutics by Shotton E & Ridgeway K, Oxford University Press, London.  
• Essentials of Physical Pharmacy by D.V. Derle, BSP Book Pvt. Ltd., Hyderabad.  
• Pharmaceutics: The Design and Manufacture of Medicines by Aulton M.E, Churchill Livingstone.
BP303T. PHARMACEUTICAL MICROBIOLOGY (Theory)  
45 Hours

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 
aerobes, 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.
BP307P. PHARMACEUTICAL MICROBIOLOGY (Practical)

4 Hrs/week

1. Introduction and study of different 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.
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

Recommended Books (Latest edition)

- Lippincott’s Illustrated Reviews-Microbiology by Harvey, Champe and Fisher, Lippincott Williams and Wilkins, New Delhi.
- Pharmaceutical Microbiology by Malcolm Harris, Balliere Tindall and Cox., The Williams & Wilkins Co., NY.
- Fundamental Food Microbiology by Bibek Ray and Arun Bhunia, CRC Press, NY.
- Industrial Microbiology by Rose, Butterworths, USA.
- Cooper and Gunn’s Tutorial Pharmacy, CBS Publisher and Distribution.
- Microbial Technology by Peppler, Academic Press.
- Fundamentals of Microbiology by Edward, Benjamin Cummings, USA.
• Pharmaceutical Microbiology by N.K. Jain, Vallabh Prakashan, Delhi.
• Bergey's Manual of Systematic Bacteriology, Williams and Wilkins, Philadelphia.
BP304T. PHARMACEUTICAL ENGINEERING (Theory)  
45 Hours

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, Venturi meter, Pitot tube and Rotameter.
Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

Unit-II  
10 Hours
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  
10 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.
Unit-IV


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

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 non-ferrous metals, inorganic and organic non-metals, basic of material handling systems.
BP308P. PHARMACEUTICAL ENGINEERING (Practical)

4 Hours/week

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.
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air – From wet and dry bulb temperatures- use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, dehumidifier.
8. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger’s, Bond 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.

Recommended Books: (Latest Editions):

- Unit Operation of Chemical Engineering by McCabe Smith, McGraw Hills, New Delhi.
- Pharmaceutical Engineering Principles and Practices by C.V.S Subrahmanyam et al., Vallabh Prakashan, Delhi.
• Perry’s Chemical Engineers’ Handbook by R.H. Perry and D.W. Green, McGraw-Hill, USA.
• Aulton’s Pharmaceutics: The Design and Manufacture of Medicines; 3rd edition, Churchill Livingstone, UK.
• Bentley’s Textbook of Pharmaceutics edited by E.A. Rawlins, Reed Elsevier India Pvt. Ltd., New Delhi.
• Pharmaceutical Process Engineering by Anthony J. Hickey and David Ganderton, Vol-112, Drugs and Pharmaceutical Sciences, Marcel Dekker, Inc., USA.
KVE301. UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Course Content:

UNIT-I
Course Introduction - Need, Basic Guidelines, Content and Process for Value Education. Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration – what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation - as the mechanism for self-exploration, Continuous Happiness and Prosperity – A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT-II
Understanding Harmony in the Human Being - Harmony in Myself. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’, Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha, Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer), Understanding the characteristics and activities of ‘I’ and harmony in ‘I’, Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-III
Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship Understanding harmony in the Family - the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Udbhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) - from family to world family.
UNIT-IV
Understanding Harmony in the Nature and Existence - Whole existence as Co-existence
Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-Astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-V
Implications of the above Holistic Understanding of Harmony on Professional Ethics
Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Recommended books:
- Energy & Equity by Ivan Illich, 1974, the Trinity Press, Worcester, and Harper Collins, USA.
- How to Practice Natural Farming by Subhas Palekar, 2000, Pracheen (Vaidik) Krishi Shodh, Amravati.
- Fundamentals of Ethics for Scientists & Engineers by E G Seebauer & Robert L. Berry, 2000, Oxford University Press.
BP401T. PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)

45 Hours

Course Content:

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

Unit-I 10 Hours
Stereo isomerism:
Optical isomerism– Optical activity, enantiomerism, diastereomerism, meso compounds.
Elements of symmetry, chiral and achiral molecules.
DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers.
Reactions of chiral molecules.
Racemic modification and resolution of racemic mixture.
Asymmetric synthesis: partial and absolute.

Unit-II 10 Hours
Geometrical isomerism- Nomenclature of geometrical isomers (Cis-Trans, E-Z, Syn-Anti systems). Methods of determination of configuration of geometrical isomers.
Conformational isomerism in Ethane, n-Butane and Cyclohexane.
Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.
Stereospecific and stereoselective reactions.

Unit-III 10 Hours
Heterocyclic compounds:
Nomenclature and classification
Synthesis, reactions and medicinal uses of following compounds/derivatives:
Pyrrole, Furan, and Thiophene.
Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene.

Unit-IV 8 Hours
Synthesis, reactions and medicinal uses of following compounds/derivatives:
Pyrazole, Imidazole, Oxazole and Thiazole.
Pyridine, Quinoline, Isoquinoline, Acridine and Indole.
Basicity of Pyridine.
Synthesis and medicinal uses of Pyrimidine, Purine, Azepines and their derivatives.
Unit-V                                                                                                               07 Hours

Reactions of synthetic importance
Metal hydrid reduction ($\text{NaBH}_4$ and $\text{LiAlH}_4$), Clemmensen reduction, Birch reduction, Wolff-Kishner reduction.
Oppenauer oxidation and Dakin reaction.
Beckmanns rearrangement and Schmidt rearrangement.
Claisen-Schmidt condensation.

Recommended Books (Latest Editions)

- Strategic Applications of Named Reactions in Organic Chemistry by Laszlo Kurti and Barbara Czako, Elsevier Academic Press.
- Heterocyclic Chemistry by Gilchrist T.L., Pearson Education (Singapore) Ltd.
BP402T. MEDICINAL CHEMISTRY – I (Theory) 45 Hours

Course Content:

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

Unit-I 10 Hours
Introduction to Medicinal Chemistry
History and development of medicinal chemistry
Physicochemical properties in relation to biological action
Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.
Drug metabolism
Drug metabolism principles- Phase I and Phase II.
Factors affecting drug metabolism including stereo chemical aspects.

Unit-II 10 Hours
Drugs acting on Autonomic Nervous System
Adrenergic Neurotransmitters:
Biosynthesis and catabolism of catecholamine.
Adrenergic receptors (Alpha & Beta) and their distribution.
Sympathomimetic agents: SAR of sympathomimetic agents
Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.
Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.
Agents with mixed mechanism: Ephedrine, Metaraminol.
Adrenergic Antagonists:
Unit-III                                                                                                                  10 Hours
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.
Cholinesterase reactivator: Pralidoxime chloride.
Cholinergic Blocking agents: SAR of cholinolytic agents
Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Lpratropium bromide*.
Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propanetheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropanide iodide, Ethopropazine hydrochloride.

Unit-IV                                                                                                                     08 Hours
Drugs acting on Central Nervous System
A. Sedatives and Hypnotics:
   Benzodiazepines: SAR of Benzodiazepines, Clorazapate, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem
   Miscellaneous: Amides & imides: Glutethimide.
   Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol.
   Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.
B. Antipsychotics
   Phenothiazines: SAR of Phenothiazines- Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.
   Ring Analogues of Phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.
   Fluoro buterophenones: Haloperidol, Droperidol, Risperidone.
   Beta amino ketones: Molindone hydrochloride.
   Benzamides: Sulpiride.
C. Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action.

Barbiturates: Phenobarbitone, Metharbital.
Hydantoins: Phenytoin*, Mephenytoin, Ethotoin.
Oxazolidine diones: Trimethadione, Paramethadione.
Succinimides: Phensuximide, Methylsuximide, Ethosuximide.*
Urea and monoacylureas: Phenacemide, Carbamazepine.*
Benzodiazepines: Clonazepam.
Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate.

Unit-V
Drugs acting on Central Nervous System

General anesthetics:
Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.
Dissociative anesthetics: Ketamine hydrochloride.*
Narcotic and non-narcotic analgesics
Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartrate, Naloxone hydrochloride.
BP406P. MEDICINAL CHEMISTRY – I (Practical)  
4 Hours/week

I. Preparation of drugs/ intermediates
1. 1,3-pyrazole
2. 1,3-oxazole
3. Benzimidazole
4. Benzotriazole
5. 2,3- diphenyl quinoxaline
6. Benzocaine
7. Phenytin
8. Phenothiazine
9. Barbiturate

II. Assay of drugs
1. Chlorpromazine
2. Phenobarbitone
3. Atropine
4. Ibuprofen
5. Aspirin
6. Furosemide

III. Determination of Partition coefficient for any two drugs

Recommended Books (Latest Editions)
- Wilson and Gisvold’s Organic Medicinal and Pharmaceutical Chemistry by Block J.H. and Beale J.M., Lippincott Williams and Wilkins.
- Foye’s Principles of Medicinal Chemistry by Lemke T.L., Williams D.A., Roche V.F. and Zito S.W., Lippincott Williams and Wilkins.
- An Introduction to Medicinal Chemistry by Patrick Graham L., Oxford University Press.
• Textbook of Drug Design and Discovery by Larsen P.K., Liljefors T. and Madsen U., Taylor and Francis Inc.
• Practical Organic Chemistry by Mann F.G. and Saunders B.C., Orient Longman Limited.
• The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
• Pharmacopoeia of India, the Controller of Publications, Delhi.
BP403T. PHYSICAL PHARMACEUTICS-II (Theory)

45 Hours

Course Content:

Unit-I
Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action.

Unit-II
Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers.
Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus.

Unit-III

Unit-IV
Micromeritics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

Unit-V
Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order.
BP407P. PHYSICAL PHARMACEUTICS-II (Practical)

3 Hrs/week

1. Determination of particle size, particle size distribution using sieving method.
2. Determination of particle size, particle size distribution using Microscopic method.
3. Determination of bulk density, true density and porosity.
4. Determine the angle of repose and influence of lubricant on angle of repose.
5. Determination of viscosity of liquid using Ostwald’s viscometer.
6. Determination sedimentation volume with effect of different suspending agent.
7. Determination sedimentation volume with effect of different concentration of single suspending agent.
8. Determination of viscosity of semisolid by using Brookfield viscometer.
9. Determination of reaction rate constant first order.
10. Determination of reaction rate constant second order.

Recommended Books: (Latest Editions)

- Physical Pharmacy by Alfred Martin, Lippincott Williams and Wilkins, USA.
- Bentley’s Textbook of Pharmaceutics edited by E.A. Rawlins, Reed Elsevier India Pvt. Ltd., New Delhi.
- Ansel’s Pharmaceutical Dosage Forms and Drug Delivery Systems by Loyd V. Allen, Jr., N.G. Popovich and H. C. Ansel, Lippincott Williams & Wilkins, USA.
BP404T. PHARMACOLOGY-I (Theory)  

Course Content:  

Unit-I  
**General Pharmacology**  
Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and noncompetitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.  
Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination.

Unit-II  
**General Pharmacology**  
Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.  
Adverse drug reactions.  
Drug interactions (pharmacokinetic and pharmacodynamic).  
Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

Unit-III  
**Pharmacology of drugs acting on peripheral nervous system**  
Organization and function of ANS.  
Neurohumoral transmission, co-transmission and classification of neurotransmitters.  
Parasympathomimetic, Parasympatholytic, Sympathomimetics, sympatholytic.  
Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).  
Local anesthetic agents.  
Drugs used in myasthenia gravis and glaucoma.

Unit-IV  
**Pharmacology of drugs acting on central nervous system**  
Neurohumoral transmission in the CNS special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.
General anesthetics and pre-anesthetics.
Sedatives, hypnotics and centrally acting muscle relaxants.
Anti-epileptics.
Alcohols and disulfiram.

Unit-V 07 Hours
Pharmacology of drugs acting on central nervous system
Psychopharmacological agents: antipsychotics, antidepressants, anti-anxiety agents, antimanics and hallucinogens.
Drugs used in Parkinson’s disease and Alzheimer’s disease.
CNS stimulants and nootropics.
Opioid analgesics and antagonists.
Drug addiction, drug abuse, tolerance and dependence.
BP408P. PHARMACOLOGY-I (Practical)  
4Hours/Week

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 CPCSEA guidelines.
6. Study of different routes of drugs administration in mice/rats.
7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8. Effect of drugs on ciliary motility of frog oesophagus.
9. Effect of drugs on rabbit eye.
10. Effects of skeletal muscle relaxants using Rota-rod apparatus.
11. Effect of drugs on locomotor activity using Actophotometer.
12. Anticonvulsant effect of drugs by MES and PTZ method.
13. Study of stereotype and anti-catatonic activity of drugs on rats/mice.
15. Study of local anesthetics by different methods.

*Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by software and videos.*

**Recommended Books (Latest Editions)**

- The Pharmacological Basis of Therapeutics by Goodman and Gilman’s, McGraw Hill, USA.
- Lippincott’s Illustrated Reviews- Pharmacology by Myceck M.J., Gelnert S.B. and Perper M.M.
- Principles of Pharmacology by Sharma H. L., Sharma K. K., Paras medical publisher
BP405T. PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)  
45 Hours

Course Content:

Unit-I  
10 Hours

Introduction to Pharmacognosy:
Definition, history, scope and development of Pharmacognosy.
Sources of Drugs – Plants, Animals, Marine & Tissue culture.
Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilage, oleoresins and oleo-gum-resins).

Classification of drugs:
Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs.

Quality control of Drugs of Natural Origin:
Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.
Quantitative microscopy of crude drugs including lycopodium spore method, leaf constant, camera lucida and diagrams of microscopic objects to scale with camera lucida.

Unit-II  
10 Hours

Polyploidy, mutation and hybridization with reference to medicinal plants.

Conservation of medicinal plants.

Unit-III  
7 Hours

Plant tissue culture:
Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance.
Applications of plant tissue culture in pharmacognosy.
Edible vaccines.

Unit-IV  
10 Hours

Pharmacognosy in various systems of medicine:
Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.

Introduction to secondary metabolites:
Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins.
Unit-V 08 Hours
Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs.

**Plant Products:**
Fibers - Cotton, Jute, Hemp.
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):** Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax.

**Marine Drugs:** Novel medicinal agents from marine sources.
BP408P. PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)

4 Hours/Week

1. Analysis of crude drugs by chemical tests:
   (i) Tragacanth.
   (ii) Acacia.
   (iii) Gelatin.
   (iv) Starch.
   (v) Honey.
   (vi) Castor oil.
   (vii) Agar.
2. Determination of stomatal number and index.
3. Determination of vein islet number, vein islet termination and palisade ratio.
4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer.
5. Determination of Fiber length and width.
6. Determination of number of starch grains by Lycopodium spore method.
7. Determination of Ash value.
8. Determination of Extractive values of crude drugs.
9. Determination of moisture content of crude drugs.
10. Determination of swelling index and foaming.

Recommended Books: (Latest Editions)
- Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhale, Vallabh Prakashan, Delhi.
- Pharmacognosy of Powdered Crude Drugs by M.A. Iyengar, PharmaMed Press, Hyderabad.
SEMESTER V
BP501T. MEDICINAL CHEMISTRY – II (Theory)

Course Content:

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

Unit-I

Antihistaminic agents: Histamine, receptors and their distribution in the human body.


H2-antagonists: Cimetidine*, Famotidine, Ranitidine.

Gastric proton-pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole.

Anti-neoplastic agents:

Alkylating agents: Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa.


Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin.

Plant products: Etoposide, Vinblastine sulphate, Vincristine sulphate.

Miscellaneous: Cisplatin, Mitotane.

Unit-II


Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.

Diuretics: Carbonic Anhydrase Inhibitors: Acetazolamide*, Methazolamide, Dichlophenamide.


Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril
hydrochloride, Quinapril Hydrochloride, Methyldopate Hydrochloride*, Clonidine hydrochloride, Guanethidine Monosulphate, Guanabenz Acetate, Sodium Nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

**Unit-III**

10 Hours

**Anti-arrhythmic Drugs**: Quinidine Sulphate, Procainamide Hydrochloride, Disopyramide Phosphate*, Phenytoin Sodium, Lidocaine Hydrochloride, Tocainide Hydrochloride, Mexiletine Hydrochloride, Lorcanide Hydrochloride, Amiodarone, Sotalol.

**Anti-hyperlipidemic agents**: Clofibrate, Lovastatin, Cholestyramine and Colestipol.

**Coagulant & Anticoagulants**: Menadione, Acetomenadione, Warfarin*, Anisindione, Clopidogrel.

**Drugs used in Congestive Heart Failure**: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

**Unit-IV**

08 Hours

**Drugs acting on Endocrine system**: Nomenclature, Stereochemistry and metabolism of steroids.

**Sex hormones**: Testosterone, Andralone, Progestrones, Oestriol, Oestradiol, Oestrone, Diethyl Stilbestrol.

**Drugs for erectile dysfunction**: Sildenafil, Tadalafil.

**Oral contraceptives**: Mifepristone, Norgestrel, Levonorgestrel.

**Corticosteroids**: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone.

**Thyroid and antithyroid drugs**: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

**Unit-V**

07 Hours

**Antidiabetic agents**: Insulin and its preparations.

Sulfonylureas: Tolbutamide*, Chlorpropamide, Glibizide, Glimepiride.

Biguanides: Metformin.

Thiazolidinediones: Pioglitazone, Rosiglitazone, Meglitinides, Repaglinide, Nateglinide.

Glucosidase inhibitors: Acarbose, Voglibose.

**Local Anesthetics**: SAR of Local anesthetics.

Benzoic acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Pirocaine.

Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxyxycaine, Tetracaine, Benoxinate.

Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.

Miscellaneous: Phenacaine, Diperodon, Dibucaaine.
Recommended Books (Latest Editions)

- Wilson and Gisvold’s Organic Medicinal and Pharmaceutical Chemistry by Block J.H. and Beale J.M., Lippincott Williams and Wilkins, NY.
- Foye’s Principles of Medicinal Chemistry by Lemke T.L., Williams D.A., Roche V.F. and Zito S.W., Lippincott Williams and Wilkins.
- Introduction to Medicinal Chemistry by Alex Gringauz, Wiley VCH.
- An Introduction to Medicinal Chemistry by Patrick Graham L., Oxford University Press.
- Introduction to Principles of Drug Design by Smith and Williams, CRC Press, US.
- Textbook of Drug Design and Discovery by Larsen P.K., Liljefors T. and Madsen U., Taylor and Francis Inc.
- Martindale’s Extra Pharmacopoeia.
- The Pharmacopoeia of India, the Controller of Publications, Delhi.
BP502T. INDUSTRIAL PHARMACY I (Theory)

Course content:

Unit-I
Pre-formulation Studies: Introduction to pre-formulation, goals and objectives, study of physicochemical characteristics of drug substances.
Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism.
Chemical Properties: Hydrolysis, oxidation, reduction, racemization, polymerization.
BCS classification of drugs & its significance.
Application of pre-formulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

Unit-II
Tablets:
Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. Quality control tests: In process and finished product tests.
Liquid orals:
Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in Pharmacopoeia.

Unit-III
Capsules:
Soft gelatin capsules: Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.
Pellets: Introduction, formulation requirements, pellitization process, and equipment for manufacture of pellets.
Unit-IV

**Parenteral Products:**
Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity.
Production procedure, production facilities and controls, aseptic processing.
Formulation of injections, sterile powders, large volume parenteral and lyophilized products.
Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

**Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions, methods of preparation, labeling, containers, evaluation of ophthalmic preparations.

Unit-V

**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

**Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems, formulation and manufacture of aerosols, Evaluation of aerosols, Quality control and stability studies.

**Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.
BP506P. INDUSTRIAL PHARMACY I (Practical)  
4 Hours/week

1. Preformulation studies of Paracetamol/Aspirin/or any other drug.
2. Preparation and evaluation of Paracetamol tablets.
3. Preparation and evaluation of Aspirin tablets.
5. Preparation and evaluation of Tetracycline capsules.
6. Preparation of Calcium Gluconate injection.
7. Preparation of Ascorbic Acid injection.
8. Quality control test of (as per IP) marketed tablets and capsules.
11. Evaluation of glass containers (as per IP).

Recommended Books: (Latest Editions)

- Modern Pharmaceutics by Gilbert S. Banker; Christopher T. Rhodes, 4th edition; (Volume-121), Marcel Dekker, Inc., NY.
- Pharmaceutical Dosage Forms by Lieberman H.A., Lachman C., Parenteral Medications, Volume 1-3, Marcel Dekker Inc., USA.
- Pharmaceutical Dosage Forms by Lieberman H.A, Lachman C., Tablets, Volume 1-3, Marcel Dekker Inc., USA.
BP503T. PHARMACOLOGY-II (Theory) 45 Hours

Course Content:

Unit-I
Pharmacology of drugs acting on cardio-vascular system
Introduction to hemodynamic and electrophysiology of heart Drugs used in congestive heart failure.
Anti-hypertensive drugs.
Anti-anginal drugs.
Anti-arrhythmic drugs.
Anti-hyperlipidemic drugs.

Unit-II
Pharmacology of drugs acting on cardio-vascular system
Drug used in the therapy of shock.
Hematinics, coagulants and anticoagulants.
Fibrinolytics and anti-platelet drugs.
Plasma volume expanders.
Pharmacology of drugs acting on urinary system
Diuretics.
Anti-diuretics.

Unit-III
Autacoids and related drugs
Introduction to autacoids and classification of Histamine, 5-HT and their antagonists.
Prostaglandins, Thromboxanes and Leukotrienes.
Angiotensin, Bradykinin and Substance P.
Non-steroidal anti-inflammatory agents.
Antigout drugs, Anti rheumatic drugs.

Unit-IV
Pharmacology of drugs acting on endocrine system
Basic concepts in endocrine pharmacology.
Anterior Pituitary hormones- analogues and their inhibitors.
Thyroid hormones- analogues and their inhibitors.
Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin D.
Insulin, Oral Hypoglycemic agents and glucagon. ACTH and corticosteroids.

Unit-V
Pharmacology of drugs acting on endocrine system
Androgens and Anabolic steroids. Estrogens, progesterone and oral contraceptives. Drugs acting on the uterus.
Bioassay
Principles and applications of bioassay. Types of bioassay.
Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT.
BP507P. PHARMACOLOGY-II (Practical)

4 Hours/Week

1. Introduction to *in-vitro* pharmacology and physiological salt solutions.
2. Effect of drugs on isolated frog heart.
3. Effect of drugs on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DRC of acetylcholine using frog *rectus abdominis* muscle.
6. Effect of *physostigmine* and atropine on DRC of acetylcholine using frog *rectus abdominis* muscle and rat ileum respectively.
10. Bioassay of acetylcholine using rat ileum/colon by four-point bioassay.
12. Determination of PD2 value using guinea pig ileum.
13. Effect of spasmogens and spasmolytic using rabbit jejunum.
15. Analgesic activity of drug using central and peripheral methods

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

**Recommended Books (Latest Editions)**

- The Pharmacological Basis of Therapeutics by Goodman and Gilman’s, McGraw Hill, USA.
- Lippincott’s Illustrated Reviews - Pharmacology by Myeek M.J, Gelnet S.B and Perper M.M.
- Principles of Pharmacology by Sharma H. L., Sharma K. K., Paras medical publisher.
- Modern Pharmacology with Clinical Applications by Charles R. Craig & Robert, Lippincott Williams & Wilkins, USA.
BP504T. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)

Course Content:

Unit-I  7 Hours
Metabolic pathways in higher plants and their determination
Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

Unit-II  14 Hours
General introduction, composition, chemistry & chemical classes, bio -sources, therapeutic uses and commercial applications of following secondary metabolites:
- Alkaloids: Vinca, Rauwolfia, Belladonna, Opium.
- Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta.
- Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis.
- Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander.
- Tannins: Catechu, Pterocarpus.
- Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony.
- Glycosides: Senna, Aloes, Bitter Almond.
- Iridoids, Other terpenoids & Naphthaquinones: Gentian, Artemisia, Taxus, carotenoids.

Unit-III  06 Hours
Isolation, Identification and Analysis of Phytoconstituents.
- Terpenoids: Menthol, Citral, Artemisin.
- Glycosides: Glycyrrhetinic acid & Rutin.
- Alkaloids: Atropine, Quinine, Reserpine, Caffeine
- Resins: Podophyllotoxin, Curcumin.

Unit-IV  10 Hours
Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine.

Unit-V  8 Hours
Basics of Phytochemistry
Modern methods of extraction, application of latest techniques like Spectroscopy, Chromatography and electrophoresis in the isolation, purification and identification of crude drugs.
1. Morphology, histology and powder characteristics & extraction & detection of:
   Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander.
2. Exercise involving isolation & detection of active principles:
   a. Caffeine - from tea dust.
   b. Diosgenin from Dioscorea.
   c. Atropine from Belladonna.
   d. Sennosides from Senna.
4. TLC of herbal extract.
5. Distillation of volatile oils and detection of phytoconstituents by TLC.
6. Analysis of crude drugs by chemical tests:
   (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh.

**Recommended Books: (Latest Editions)**
- Herbal Drug Industry by R.D. Choudhary, 1st Ed, Eastern Publisher, New Delhi.
- Essentials of Pharmacognosy by Dr. S.H. Ansari, 2nd Ed, Birla publications, New Delhi.
- Pharmacognosy & Pharmacobiotechnology by James Bobbers, Marilyn KS, VE Tylor.
- The Formulation and Preparation of Cosmetic, Fragrances and Flavors by Louis Appell, Micelle Press.
- Biosynthesis of Natural Products by Manitto P., Ellis Horwood Limited.
BP505T. PHARMACEUTICAL JURISPRUDENCE (Theory)  
45 Hours

Course Content:

Unit-I  
10 Hours
Drugs and Cosmetics Act, 1940 and its rules 1945:
Objectives, Definitions, Legal definitions of schedules to the Act and Rules.
Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties.
Manufacture of drugs – Prohibition of manufacture and sale of certain drugs,
Conditions for grant of license and conditions of license for manufacture of drugs,
Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

Unit-II  
10 Hours
Drugs and Cosmetics Act, 1940 and its rules 1945
Sale of Drugs – Wholesale, Retail sale and restricted license. Offences and penalties.
Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.
Administration of the Act and Rules– Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, licensing authorities, controlling authorities, Drugs Inspectors.

Unit-III  
10 Hours
Pharmacy Act-1948: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties.
Narcotic Drugs and Psychotropic substances Act-1985 and Rules: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties.
Unit-IV 08 Hours

Study of Salient Features of Drugs and Magic Remedies Act and its rules: Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties.


Unit-V 07 Hours

Pharmaceutical Legislations - A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee.

Code of Pharmaceutical ethics - Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist’s oath.

Medical Termination of Pregnancy Act

Right to Information Act

Introduction to Intellectual Property Rights (IPR)

Recommended books: (Latest Edition)

- Forensic Pharmacy by B. Suresh, Birla Publication Pvt. Ltd., Delhi.
- Textbook of Forensic Pharmacy by B.M. Mittal, Vallabh Prakashan, Delhi.
- Handbook of Drug Law by M.L. Mehra, the University Book Agency, Lucknow.
- Drugs and Cosmetics Act/Rules, Govt. of India publications.
- Medicinal and Toilet Preparations Act 1955, Govt. of India Publications.
- Narcotic Drugs and Psychotropic Substances Act, Govt. of India Publications.
- Drugs and Magic Remedies Act, Govt. of India Publication.
- Bare Acts of the Laws.
BP509P. HOSPITAL TRAINING-I

Training of students at a hospital establishment for a minimum duration of 45 days. The hospital training shall include: First aid (wound dressing, artificial respiration etc.), different routes of injection, study of patient observation charts, prescriptions and dispensing, simple diagnostic reports, etc.

May be performed at the end of the 4th semester.
SEMESTER VI
BP601T. MEDICINAL CHEMISTRY – III (Theory)  
45 Hours

Course Content:

Unit-I  
Antibiotics: Historical background, Nomenclature, Stereochemistry, Structure-activity relationship, Chemical degradation classification and important products of the following classes.
β-Lactam antibiotics: Penicillin, Cephalosporin, β-Lactamase inhibitors, Monobactams.
Aminoglycosides: Streptomycin, Neomycin, Kanamycin.
Tetracycline: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline.

Unit-II  
Antibiotics: Historical background, Nomenclature, Stereochemistry, Structure-activity relationship, Chemical degradation classification and important products of the following classes.
Macrolide: Erythromycin Clarithromycin, Azithromycin.
Miscellaneous: Chloramphenicol*, Clindamycin.
Prodrugs: Basic concepts and application of prodrugs design.
Antimalarial: Etiology of malaria.
Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.
Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil.
Miscellaneous: Pyrimethamine, Artesunate, Artemether, Atovaquone.

Unit-III  
Anti-tubercular Agents:
Synthetic anti tubercular agents: Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.*
Ant-tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine, Streptomycin, Capreomycin sulphate.
Urinary tract anti-infective agents:
Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine.
Unit-IV 08 Hours

Antifungal agents:

Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole, Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate.*


Sulphonamides and Sulfones: Historical development, chemistry, classification and SAR of Sulphonamides: Sulphamethizole, Sulfoxazole, Sulphamethazine, Sulfacetamide*, Sulphapyridine, Sulphamethoxazole*, Sulphadiazine, Mefenide acetate, Sulfasalazine.

Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole.

Sulfones: Dapsone*.

Unit-V 07 Hours

Introduction to Drug Design
Various approaches used in drug design.
Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett’s electronic parameter, Taft’s steric parameter and Hansch analysis.
Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications of combinatorial Chemistry: Solid phase and solution phase synthesis.
BP607P. MEDICINAL CHEMISTRY- III (Practical)  

4 Hours/week

I Preparation of drugs and intermediates:  
1 Sulphanilamide.  
2 7-Hydroxy, 4-methyl coumarin.  
3 Chlorobutanol.  
4 Triphenyl imidazole.  
5 Tolbutamide.  
6 Hexamine.

II Assay of drugs:  
1 Isonicotinic acid hydrazide.  
2 Chloroquine.  
3 Metronidazole.  
4 Dapsone.  
5 Chlorpheniramine maleate.  
6 Benzyl penicillin.

III Preparation of medicinally important compounds or intermediates by Microwave irradiation technique.

IV Drawing structures and reactions using chem draw ®.

V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinski’s RO5).

Recommended Books (Latest Editions)

- Wilson and Gisvold’s Organic Medicinal and Pharmaceutical Chemistry by Block J.H. and Beale J.M., Lippincott Williams and Wilkins.
- Foye’s Principles of Medicinal Chemistry by Lemke T.L., Williams D.A., Roche V.F. and Zito S.W., Lippincott Williams and Wilkins.
- An Introduction to Medicinal Chemistry by Patrick Graham, L., Oxford University Press.
- Introduction to Principles of Drug Design by Smith and Williams.
• Textbook of Drug Design and Discovery by Larsen P.K., Liljefors T. and Madsen U., Taylor and Francis Inc.

• Martindale’s Extra Pharmacopoeia.
• The Organic Chemistry of Drug Design and Drug Action by Richard B. Silverman, Academic Press, USA.
• Elementary Practical Organic Chemistry by Vogel A.I., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.
• The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1 to 5.
• The Pharmacopoeia of India, the Controller of Publications, Delhi.
BP602T. PHARMACOLOGY-III (Theory)  

Course Content

Unit-I  
**Pharmacology of drugs acting on Respiratory system:**
- Anti-asthmatic drugs.
- Drugs used in the management of COPD.
- Expectorants and antitussives.
- Nasal decongestants.
- Respiratory stimulants.

**Pharmacology of drugs acting on the Gastrointestinal Tract:**
- Antiulcer agents.
- Drugs for constipation and diarrhoea.
- Appetite stimulants and suppressants.
- Digestants and carminatives.
- Emetics and anti-ematics.

Unit-II  
**Chemotherapy:** General principles of chemotherapy.
- Sulfonamides and Cotrimoxazole.
- Antibiotics- Penicillins, cephalosporin, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides.

Unit-III  
**Chemotherapy:**
- Antitubercular agents.
- Antileprotic agents.
- Antifungal agents.
- Antiviral drugs.
- Anthelmintics.
- Antimalarial drugs.
- Antiamoebic agents.
Unit-IV

Chemotherapy:  
Urinary tract infections and sexually transmitted diseases.
Chemotherapy of malignancy.

Immunopharmacology:  
Immunostimulants.
Immunosuppressant.
Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars.

Unit-V

Principles of toxicology:
Definition and basic knowledge of acute, sub-acute and chronic toxicity.
Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity.
General principles of treatment of poisoning.
Clinical symptoms and management of barbiturates, morphine, and organophosphorus compound and lead, mercury and arsenic poisoning.

Chronopharmacology:
Definition of rhythm and cycles.
Biological clock and their significance leading to chronotherapy.
BP608P. PHARMACOLOGY-III (Practical)  

1. Dose calculation in pharmacological experiments.
2. Anti-allergic activity by mast cell stabilization assay.
4. Study of effect of drugs on gastrointestinal motility.
5. Effect of agonist and antagonists on guinea pig ileum.
7. Effect of saline purgative on frog intestine.
8. Insulin hypoglycemic effect in rabbit.
9. Test for pyrogens (rabbit method).
10. Determination of acute oral toxicity (LD50) of a drug from a given data.
11. Determination of acute skin irritation / corrosion of a test substance.
12. Determination of acute eye irritation / corrosion of a test substance.
13. Calculation of pharmacokinetic parameters from a given data.
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test).

*Experiments are demonstrated by simulated experiments/videos.

Recommended Books (Latest Editions)

- The Pharmacological Basis of Therapeutics by Goodman and Gilman’s, McGraw Hill, USA.
- Lippincott’s Illustrated Reviews- Pharmacology by Myeek M.J., Gelnet S.B. and Perper M.M.
- Principles of Pharmacology, Sharma H.L., Sharma K.K., Paras Medical Publisher.
- Modern Pharmacology with Clinical Applications by Charles R. Craig & Robert.
- Handbook of Experimental Pharmacology by Kulkarni S.K., Vallabh Prakashan,
BP603T. HERBAL DRUG TECHNOLOGY (Theory)  

Course content:

Unit-I  
Herbs as raw materials: Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation, Source of Herbs, Selection, identification and authentication of herbal materials, Processing of herbal raw material.  

Unit-II  
Nutraceuticals  
General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases.  
Study of following herbs as health food: Alfa-alfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina.  
Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypericum, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

Unit-III  
Herbal Cosmetics: Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.  
Herbal excipients: Herbal Excipients – Significance of substances of natural origin as excipients- colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.  
Herbal formulations: Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes.
Unit-IV  
**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs. Stability testing of herbal drugs.  
**Patenting and Regulatory requirements of natural products:** Definition of the terms: Patent, IPR, Farmers right, Breeder’s right, Bioprospecting and Biopiracy. Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.  
**Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.

Unit-V  
**General Introduction to Herbal Industry:** Herbal drugs industry: Present scope and future prospects. A brief account of plant-based industries and institutions involved in work on medicinal and aromatic plants in India.  
**Schedule T – Good Manufacturing Practice of Indian systems of medicine:** Components of GMP (Schedule –T) and its objectives. Infrastructural requirements working page, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.
P609P. HERBAL DRUG TECHNOLOGY (Practical)  
4 Hours/ week

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista.
3. Evaluation of excipients of natural origin.
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
6. Monograph analysis of herbal drugs from recent Pharmacopoeias.
7. Determination of Aldehyde content.
8. Determination of Phenol content.

Recommended Books: (Latest Editions)

- Poucher's Perfumes, Cosmetics and Soaps edited by Hilda Bulter, Springer (India) Pvt. Ltd., New Delhi.
- Textbook of Pharmacognosy by C.K. Kokate, Purohit, Gokhale, Nirali Prakashan, New Delhi.
- Essential of Pharmacognosy by Dr. S.H. Ansari, Birla Publications Pvt. Ltd., Delhi.
- Pharmacopoeial Standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).
BP604T. BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

45 Hours

Course Content:

Unit-I 10 Hours
**Introduction to Biopharmaceutics:**
**Absorption:** Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from non per-oral extra-vascular routes.

Unit-II 10 Hours
**Elimination:** Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs.
**Bioavailability and Bioequivalence:** Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

Unit-III 10 Hours
**Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. Intravenous Injection (Bolus), Intravenous infusion and Extra vascular administrations. Pharmacokinetics parameters – $K_E$, $t_{1/2}$, $V_d$, $AUC$, $K_a$, $Cl_t$ and $CL_R$- definitions, methods of eliminations, understanding of their significance and application.

Unit-IV 08 Hours
**Multicompartment models:** Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.

Unit-V 07 Hours
**Nonlinear Pharmacokinetics:** Introduction, Factors causing Non-linearity. Michaelis-Menten method of estimating parameters, Explanation with example of drugs.
**Recommended Books: (Latest Editions)**

- Biopharmaceutics and Pharmacokinetics-A Treatise by D.M. Brahman and Sunil B. Jaiswal, Vallabh Prakashan Pitampura, Delhi.
- Handbook of Clinical Pharmacokinetics by Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
- Biopharmaceutics by Swarbrick, Lea and Febiger, USA.
- Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, PharmaMed Press, Hyderabad.
- Basic Pharmacokinetics by Mohsen A. Hedaya, CRC Press, NY.
- Biopharmaceutics and Pharmacokinetics by V. Ventashevarlu, PharmaMed Press, Hyderabad.
BP605T. PHARMACEUTICAL BIOTECHNOLOGY (Theory)

Course content:

Unit-I
Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.
Enzyme Biotechnology- Methods of enzyme immobilization and applications.
Biosensors- Working and applications of biosensors in Pharmaceutical Industries.
Brief introduction to Protein Engineering.
Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.
Basic principles of genetic engineering.

Unit-II
Study of cloning vectors, restriction endonucleases and DNA ligase.
Recombinant DNA technology. Application of genetic engineering in medicine.
Application of r DNA technology and genetic engineering in the production of:
i) Interferon
ii) Vaccines- hepatitis- B
iii) Hormones-Insulin.
Brief introduction to PCR.

Unit-III
Types of immunity- humoral immunity, cellular immunity.
Structure of Immunoglobulins.
Structure and Function of MHC.
Hypersensitivity reactions, Immune stimulation and Immune suppressions.
General method of the preparation of bacterial infections, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.
Storage conditions and stability of official vaccines.
Hybridoma technology- Production, Purification and Applications, Blood products and Plasma Substitutes.

Unit-IV
Immuno-blotting techniques- ELISA, Western blotting, Southern blotting.
Genetic organization of Eukaryotes and Prokaryotes.
Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.
Introduction to Microbial biotransformation and applications.
Mutation: Types of mutation/mutants.
Unit-V 07 Hours
Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.
Large scale production fermenter design and its various controls.
Study of the production of - Penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin.
Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.

Recommended Books (Latest edition):

- Kuby Immunology by R.A. Goldsby et. al., W.H. Freeman and Company, NY.
- Crueger’s Biotechnology- A textbook of Industrial Microbiology by Crueger and Aneja, Medtech, New Delhi.
- Molecular Biology and Biotechnology by J.M. Walker and E.B. Gingold, Royal Society of Chemistry.
- Immobilized Enzymes by Zaborsky, CRC Press, Ohio.
- Molecular Biotechnology by S.B. Primrose, Blackwell Scientific Publication.
- Pharmaceutical Biotechnology: Concepts and Applications by G. Walsh, Wiley and Sons Pvt. Ltd., USA.
- Pharmaceutical Biotechnology: Biochemistry and Biotechnology by G. Walsh, Wiley and Sons Pvt. Ltd., USA.
Course content:

Unit-I  
Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP.  
Total Quality Management (TQM): Definition, elements, philosophies.  
ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines.  
Quality by design (QbD): Definition, overview, elements of QbD program, tools.  
ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration.  
NABL accreditation: Principles and procedures.

Unit-II  
Organization and personnel: Personnel responsibilities, training, hygiene and personal records. Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.  

Unit-III  
Quality Control: Quality control test for containers, rubber closures and secondary packing materials.  

Unit-IV  
Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.  
Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.

Unit-V  
Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.  
Warehousing: Good warehousing practice, materials management.
**Recommended Books: (Latest Edition)**

- Quality Assurance Guide by Organization of Pharmaceutical Products of India.
- How to Practice GMPs by P.P. Sharma, Vandana Publications Pvt. Ltd., Delhi.
- How to Practice GLP by P.P. Sharma, Vandana Publications Pvt. Ltd., Delhi.
- Good Laboratory Practices by Marcel Dekker Series.
- ICH guidelines, ISO 9000 and 14000 guidelines.
- Quality Control of Packaging Materials in the Pharmaceutical Industry by Kenneth and Harburn, Marcel Dekker, Inc., NY.
- cGMP (Current Good Manufacturing Practices) for Pharmaceuticals, Manohar A. Potdar, PharmaMed Press, Hyderabad.
- Production and Operation Management by S.N. Chary, 3rd edition, Tata McGraw-Hill Education
- Pharmaceutical Quality Assurance and Quality management by Bhusari K.P; Shivhare U.D; Goupale D.C., PharmaMed press, Hyderabad.
- Modern Pharmaceutics by Gilbert S. Banker; Christopher T. Rhodes, 4th edition; (vol-121), Marcel Dekker, Inc., NY.
BP610P. REPORT ON INDUSTRIAL TRAINING

Training of students at an industrial establishment or an approved research laboratory. The industrial training shall include: in case of industry- different sections and subsections of the industry, an idea about the functioning of the industry, product range of the industry and various approvals of the industry; in case of research laboratory- different departments of the laboratory, an idea about the interdisciplinary coordination, contribution of the laboratory to the society and various approvals of the laboratory. A proper report of the same shall be submitted by the students, which shall be subsequently evaluated to assess the impact of the visit.

May be performed at the end of the 5th semester.
Semester VII
BP701T. INSTRUMENTAL METHODS OF ANALYSIS (Theory)  

Course Content:  

Unit -I  
UV Visible spectroscopy: Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert’s law, Derivation and deviations. Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors-Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Applications- Spectrophotometric titrations, Single component and multi component analysis. 

Fluorimetry: Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications. 

Unit-II  
IR spectroscopy: Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations. Instrumentation- Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications. 
Flame Photometry- Principle, interferences, instrumentation and applications. 
Atomic absorption spectroscopy- Principle, interferences, instrumentation and applications. 
Nephelo-turbidimetry- Principle, instrumentation and applications. 

Unit-III  
Introduction to chromatography: 
Adsorption and partition column chromatography- Methodology, advantages, disadvantages and applications. 
Thin layer chromatography- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications. 
Paper chromatography- Introduction, methodology, development techniques, advantages, disadvantages and applications. 
Electrophoresis– Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications. 

Unit-IV  
Gas chromatography - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications. 
High performance liquid chromatography (HPLC)- Introduction, theory, instrumentation, advantages and applications. 

Unit-V  
Ion exchange chromatography- Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications. 
Gel chromatography- Introduction, theory, instrumentation and applications. 
Affinity chromatography- Introduction, theory, instrumentation and applications.
1. Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds.
2. Estimation of sulphanilamide by colorimetry.
4. Estimation of quinine sulphate by fluorimetry.
5. Study of quenching of fluorescence.
6. Determination of sodium by flame photometry.
7. Determination of potassium by flame photometry.
8. Determination of chlorides and sulphates by nephelo-turbidimetry.
9. Separation of sugars by thin layer chromatography.
10. Separation of plant pigments by column chromatography.
11. Demonstration experiment on HPLC.
12. Demonstration experiment on Gas Chromatography.
14. To prepare sustained release matrix tablets and evaluate by UV spectroscopy.
15. Formulation of nanoparticles and evaluate by HPLC.
16. Formulation and evaluation of liposomes.
17. To prepare buccal dosage form and evaluate by UV spectroscopy.
18. To prepare Paracetamol transdermal patch and evaluate by UV spectroscopy.

Recommended Books (Latest Editions)

- Instrumental Methods of Chemical Analysis by B.K. Sharma, Krishna Prakashan Media (P) Ltd., Meerut, India.
- Pharmaceutical Chemistry Instrumental Technique by Leslie G. Chatten, CBS Publisher and Distributer Pvt. Ltd., New Delhi.
- Vogel’s Textbook of Quantitative Chemical Analysis by A.I. Vogel, Addison Wesley Logman, Singapore.
- Organic Spectroscopy by William Kemp, Palgrave, NY.
BP702T. INDUSTRIAL PHARMACY II (Theory)

Course Content:

Unit-I
Pilot plant scale up techniques: General considerations- including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology.

Unit-II
Technology development and transfer: WHO guidelines for Technology Transfer (TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from RD to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipment, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE /SIDBI, TT related documentation - confidentiality agreement, licensing, MoUs, legal issues.

Unit-III
Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals.

Unit-IV
Quality management systems: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP.

Unit-V
Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.
Recommended Books: (Latest Editions)

- How to Practice GLP by P.P. Sharma, Vandana Publications Pvt. Ltd., Delhi.
- Validation of Active Pharmaceuticals Ingredients by Ira R. Bony & Daniel Harpaz., CRC Press.
BP703T. PHARMACY PRACTICE (Theory) 45 Hours

Course Content:

Unit-I 10 Hours

Hospital and it's organization
Definition, Classification of hospital - Primary, Secondary and Tertiary hospitals, Classification based on clinical and non-clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.

Hospital pharmacy and its organization
Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.

Adverse drug reaction
Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction - beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.

Community Pharmacy
Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.

Unit-II 10 Hours

Drug distribution system in a hospital
Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labeling. Dispensing of drugs to ambulatory patients and dispensing of controlled drugs.

Hospital formulary
Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.

Therapeutic drug monitoring
Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.

Medication adherence
Causes of medication non-adherence, pharmacist role in the medication adherence and monitoring of patient medication adherence.

Patient medication history interview
Need for the patient medication history interview, medication interview forms.

Community pharmacy management
Financial, materials, staff, and infrastructure requirements.
Unit-III 10 Hours

**Pharmacy and therapeutic committee**
Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.

**Drug information services**
Drug and Poison information centre, Sources of drug information, Computerized services, and storage and retrieval of information.

**Patient counselling**
Definition of patient counselling; steps involved in patient counselling, and Special cases that require the pharmacist

**Education and training program in the hospital**
Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

**Prescribed medication order and communication skills**
Prescribed medication order- interpretation and legal requirements, and Communication skills-communication with prescribers and patients.

Unit-IV 8 Hours

**Budget preparation and implementation:** Budget preparation and implementation. **Clinical Pharmacy:** Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring- medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern.

**Over the counter (OTC) sales:** Introduction and sale of over the counter and rational use of common over the counter medications.

Unit-V 7 Hours

**Drug store management and inventory control**
Organization of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure.

**Investigational use of drugs**
Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

**Interpretation of Clinical Laboratory Tests** Blood chemistry, haematology and urine analysis.
Recommended Books (Latest Edition):

- Hospital Pharmacy by Tipnis Bajaj, 1st ed. Maharashtra: Career Publications.
- Basic Skills in Interpreting Laboratory Data by Scott L.T., 4thed. American Society of Health System Pharmacists Inc.

Journals:

- Therapeutic Drug Monitoring. ISSN: 0163-4356
- Journal of Pharmacy Practice. ISSN: 0974-8326
- American Journal of Health System Pharmacy. ISSN: 1535-2900 (Online)
- Pharmacy Times (Monthly Magazine)
BP704T. NOVEL DRUG DELIVERY SYSTEMS (NDDS) (Theory)  

**Course content:**

**Unit-I**  
**Controlled drug delivery systems:** Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design-controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations. 
**Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

**Unit-II**  
**Microencapsulation:** Definition, advantages and disadvantages, microspheres/microcapsules, microparticles, methods of microencapsulation, applications. 
**Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion/mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems. 
**Implantable Drug Delivery Systems:** Introduction, advantages and disadvantages, concept of implants and osmotic pump.

**Unit-III**  
**Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches. 
**Gastro-retentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS– Floating, high density systems, inflatable and gastro-adhesive systems and their applications. 
**Naso-pulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers.

**Unit-IV**  
**Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications.

**Unit-V**  
**Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome–Preliminary study, ocular formulations and ocuserts. 
**Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications.
Recommended Books: (Latest Editions)

- Modern Pharmaceutics by Gilbert S. Banker; Christopher T. Rhodes, 4th edition; (vol-121), Marcel Dekker, Inc., NY.
- Handbook of Pharmaceutical Controlled Release Technology by Donald L. Wise, Marcel & Dekker Inc., NY.
- Dermatological and Transdermal Formulations by Kenneth A. Walters, Mercell & Dekker Inc., NY.
- Design of Controlled Release Drug Delivery System by Xialing Li, Bhaskara R. Jasti, Mc-Graw Hill.

Journals

- Indian Journal of Pharmaceutical Sciences (IPA)
- Indian Drugs (IDMA)
- Journal of Controlled Release (Elsevier Sciences)
- Drug Development and Industrial Pharmacy (Marcel & Decker)
- International Journal of Pharmaceutics (Elsevier Sciences)
BP706PS. PRACTICE SCHOOL

Course content:
Every candidate shall undergo practice school for a period of 150 hours evenly distributed throughout the semester. The student shall opt any one of the domains. Every student shall submit a printed report (in triplicate) on the practice school he/she attended (not more than 25 pages).

Domains (anyone to be opted):
- Phytomedicine
- Formulation development
- Quality control and quality assurance
- Drug design and process chemistry
- Pharmaceutical software
- Artificial intelligence
- 3D printing
- Nutraceuticals
- Cosmeceuticals
- Alternative medicine

Recommended Books (Latest Editions)
- An Introduction to Medicinal Chemistry by Patrick Graham, L., Oxford University Press.
BP707P. HOSPITAL TRAINING-II

Training of students at a hospital establishment for a minimum duration of 45 days. The hospital training shall include: First aid (wound dressing, artificial respiration etc.), different routes of injection, study of patient observation charts, prescriptions and dispensing, simple diagnostic reports etc.

May be performed at the end of the 6th semester.
SEMESTER VIII
BP801T. BIOSTATISTICS AND RESEARCH METHODOLOGY (Theory)

Course content:

Unit-I
Measures of central tendency: Mean, Median, Mode- Pharmaceutical examples.
Measures of dispersion: Dispersion, Range, standard deviation, Pharmaceutical problems.
Correlation: Definition, Karl Pearson’s coefficient of correlation, multiple correlation- Pharmaceuticals examples.

Unit-II
Regression: Curve fitting by the method of least squares, fitting the lines y = a + bx and x = a + by, Multiple regression, standard error of regression– Pharmaceutical examples. Probability: Definition of probability, Binomial distribution, Normal distribution, Poisson’s distribution, properties– problems.
Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples.
Parametric test: t-test (Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significance difference.

Unit-III
Non-Parametric tests: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test.
Introduction to Research: Need for research, Need for design of Experiments, Experiential Design Technique, Plagiarism.
Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph
Designing the methodology: Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.

Unit-IV
8 Hours
Blocking and confounding system for Two-level factorials.
Regression modeling: Hypothesis testing in Simple and Multiple regression models
Introduction to Practical components of Industrial and Clinical Trials Problems: Statistical Analysis Using Excel, SPSS, MINITAB®, Design of experiment, R- Online Statistical Software’s to Industrial and Clinical trial approach.
Unit-V

Design and Analysis of experiments: 7 Hours

Factorial Design: Definition, $2^2$, $2^3$ design. Advantages of factorial design.

Response Surface methodology: Central composite design, Historical design, Optimization Techniques.

Recommended Books (Latest edition):

- Design and Analysis of Experiments by R. Pannerselvam, PHI Learning Private Limited.
BP802T. SOCIAL AND PREVENTIVE PHARMACY (Theory)

Course content:

Unit-I 10 Hours
Concept of health and disease: Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick.
Social and health education: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.
Sociology and health: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health.
Hygiene and health: personal hygiene and health care; avoidable habits.

Unit-II 10 Hours
Preventive medicine: General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse.

Unit-III 10 Hours
National health programs, its objectives, functioning and outcome of the following: HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.

Unit-IV 08 Hours
National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program.

Unit-V 07 Hours
Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.
Recommended Books (Latest edition):

- Short Textbook of Preventive and Social Medicine, G.N. Prabhakara, 2\textsuperscript{nd} Edition, Jaypee Publications.
- Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4\textsuperscript{th} Edition, Japyee Publications.
- Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6\textsuperscript{th} Edition, Jaypee Publications.
- Park Textbook of Preventive and Social Medicine, K. Park, 21\textsuperscript{st} Edition, Banarasidas Bhanot Publishers.
- Community Pharmacy Practice by Ramesh Adepu, BSP publishers, Hyderabad.
- Sociology for Pharmacist by Kevin Taylor, Sarah Nettleton and Geoffery Harding.

Recommended Journals:

- Research in Social and Administrative Pharmacy, Elsevier, Ireland.
BP803ET. PHARMA MARKETING MANAGEMENT (Theory)

Course content:

Unit-I 10 Hours
Marketing:

Pharmaceutical market:
Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patient's choice of physician and retail pharmacist. Analysing the Market; Role of market research.

Unit-II 10 Hours
Product decision:
Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.

Unit-III 10 Hours
Promotion:
Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.

Unit-IV 08 Hours
Pharmaceutical marketing channels:
Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.
Professional sales representative (PSR):
Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.

Unit-V 07 Hours
Pricing:
Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).
Emerging concepts in marketing:
Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.
**Recommended Books: (Latest Editions)**

- Marketing Management by Philip Kotler and Kevin Lane Keller, Prentice Hall of India, New Delhi.
- Textbook of Forensic Pharmacy by B.M. Mittal, Vallabh Prakashan, Delhi.
- A textbook of Forensic Pharmacy by N.K. Jain, Vallabh Prakashan, Delhi.
- Pharmaceutical Industrial Management by Vidya Sagar, PharmaMed Press, Hyderabad.
- Drugs and Cosmetics Act 1940 by Vijay Malik, EBC Publishing House Pvt. Ltd. Lucknow.
BP804ET. PHARMACEUTICAL REGULATORY SCIENCE (Theory)

Course content:

Unit-I
New Drug Discovery and development
10 Hours
Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

Unit-II
Regulatory Approval Process
10 Hours
Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

Regulatory authorities and agencies
Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications).

Unit-III
Registration of Indian drug product in overseas market
10 Hours

Unit-IV
Clinical trials
08 Hours
Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials.

Unit-V
Regulatory Concepts
07 Hours
**Recommended books (Latest edition):**

- Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
- Drugs: From Discovery to Approval by Rick Ng., 2nd Edition, Wiley-Blackwell.
- Validation of Active Pharmaceuticals Ingredients by Ira R. Bony & Daniel Harpaz, CRC Press, US.
BP805ET. PHARMACOVIGILANCE (Theory) 45 hours

Course Content

Unit-I 10 Hours
Introduction to Pharmacovigilance
History and development of Pharmacovigilance, Importance of safety monitoring of Medicine, WHO international drug monitoring programme, Pharmacovigilance Program of India (PvPI).

Introduction to adverse drug reactions
Definitions and classification of ADRs, Detection and reporting, Methods in Causality assessment, Severity and seriousness assessment, Predictability and preventability assessment, Management of adverse drug reactions.

Basic terminologies used in pharmacovigilance
Terminologies of adverse medication related events, Regulatory terminologies.

Unit-II 10 hours
Drug and disease classification
Anatomical, therapeutic and chemical classification of drugs, International classification of diseases, Daily defined doses, International Non-proprietary names for drugs.

Drug dictionaries and coding in pharmacovigilance

Information resources in pharmacovigilance
Basic drug information resources, Specialized resources for ADRs.

Establishing pharmacovigilance programme
Establishing in a hospital, Establishment & operation of drug safety department in industry, Contract Research Organizations (CROs), Establishing a national program.

Unit-III 10 Hours
Vaccine safety surveillance
Vaccine Pharmacovigilance, Vaccination failure, Adverse events following immunization.

Pharmacovigilance methods
Passive surveillance – Spontaneous reports and case series, Stimulated reporting, Active surveillance– Sentinel sites, drug event monitoring and registries. Comparative observational studies– Cross sectional study, case control study and cohort study. Targeted clinical investigations.

Communication in pharmacovigilance
Unit-IV 8 Hours

Safety data generation: Pre clinical phase, Clinical phase, Post approval phase (PMS).
ICH Guidelines for Pharmacovigilance: Organization and objectives of ICH, Expedited reporting, Individual case safety reports, Periodic safety update reports, Post approval expedited reporting, Pharmacovigilance planning, Good clinical practice in pharmacovigilance studies

Unit-V 7 Hours

Pharmacogenomics of adverse drug reactions: Genetics related ADR with example focusing PK parameters.
Drug safety evaluation in special population: Paediatrics, Pregnancy and lactation, Geriatrics.

CIOMS: CIOMS Working Groups, CIOMS Form.
CDSCO (India) and Pharmacovigilance: D & C Act and Schedule Y, Differences in Indian and global pharmacovigilance requirements.

Recommended Books (Latest edition):
- Quintessence of Pharmacovigilance by Tapan Kumar Chatterjee, PharmaMed Press.
- Practical Drug Safety from A to Z by Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.
- An Introduction to Pharmacovigilance by Patrick Waller, Wiley Publishers.
- National Formulary of India.
- Textbook of Medicine by Yashpal Munjal.
- http://www.cioms.ch/
- http://cdsco.nic.in/
- http://www.who.int/vaccine_safety/en/
- http://www.ipc.gov.in/PvPI/pv_home.html
BP806ET. QUALITY CONTROL AND STANDARDIZATION OF HERBALS
(Theory) 45 Hours

Course Content

**Unit-I** 10 hours
Basic tests for drugs—Pharmaceutical substances, Medicinal plants materials and dosage forms.
WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use.

**Unit-II** 10 hours
Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine.
WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.

**Unit-III** 10 hours
EU and ICH guidelines for quality control of herbal drugs.
Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines.

**Unit-IV** 08 hours
Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products.
Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.

**Unit-V** 07 Hours
Regulatory requirements for herbal medicines.
WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems
Comparison of various Herbal Pharmacopoeias.
Role of chemical and biological markers in standardization of herbal products.
Recommended Books: (Latest Editions)


- EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products.
BP807ET. COMPUTER AIDED DRUG DESIGN (Theory)

Course Content:

UNIT-I
Introduction to Drug Discovery and Development: Stages of drug discovery and development.
Lead discovery and Analogue Based Drug Design: Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.
Analogue Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies.

UNIT-II
Quantitative Structure Activity Relationship (QSAR)
SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet’s substituent constant and Taft’s steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

UNIT-III
Molecular Modeling and virtual screening techniques:
Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening,
Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.

UNIT-IV
Informatics & Methods in drug design:
Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.

UNIT-V
**Recommended Books (Latest Editions)**

- An Introduction to Medicinal Chemistry by Patrick Graham, L., Oxford University Press.
- Molecular Modelling and Design by Vinter J.V. and G. Mark, CRC Press, NY.
BP808ET. CELL AND MOLECULAR BIOLOGY (Theory)

Course content:

**Unit-I**
Properties of cells and cell membrane.
Prokaryotic versus Eukaryotic.
Cellular Reproduction.
Chemical Foundations – an Introduction and Reactions (Types).

**Unit-II**
DNA and the Flow of Molecular Information. DNA Functioning.
DNA and RNA. Types of RNA. Transcription and Translation.

**Unit-III**
Regularities in Protein Pathways.
Cellular Processes.
Positive Control and significance of Protein Synthesis.

**Unit-IV**
Science of Genetics.
Transgenics and genomic analysis. Cell cycle analysis.
Mitosis and Meiosis.
Cellular Activities and checkpoints.

**Unit-V**
Signaling Pathways: Overview.
Misregulation of Signaling Pathways.
Protein-Kinases: Functioning.
**Recommended Books (latest edition):**

- Pharmaceutical Microbiology by Malcolm Harris, Balliere Tindall and Cox.
- Industrial Microbiology by Rose, Butterworths, USA.
- Cooper and Gunn’s Tutorial Pharmacy by Carter S.J., CBS Publications, New Delhi.
- Microbial Technology by Peppler, Academic Press.
- Fundamentals of Microbiology by Edward, Benjamin Cummings, USA.
- Pharmaceutical Microbiology by N.K. Jain, Vallabh Prakashan, Delhi.
- Bergey’s Manual of Systematic Bacteriology by Williams and Wilkins, A Waverly company.
- Kuby Immunology by R.A. Goldsby *et. al.*, W.H. Freeman and Company, NY.
BP809ET. COSMETIC SCIENCE (Theory) 45 Hours

Unit-I 10 Hours
Classification of cosmetic and cosmeceutical products. Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs.

**Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives.
**Skin:** Basic structure and function of skin.
**Hair:** Basic structure of hair. Hair growth cycle.
**Oral Cavity:** Common problem associated with teeth and gums.

Unit-II 10 Hours

**Principles of formulation and building blocks of skin care products:**
Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals.

**Antiperspirants & deodorants:** Actives & mechanism of action.

**Principles of formulation and building blocks of Hair care products:** Conditioning shampoo, Hair conditioner, anti-dandruff shampoo, Hair oils.

Unit-III 10 Hours

**Sun protection, Classification of Sunscreens and SPF.**

**Role of herbs in cosmetics:**
**Skin Care:** Aloe and turmeric.
**Hair care:** Henna and amla.
**Oral care:** Neem and clove.

**Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin-cream and toothpaste.

Unit-IV 08 Hours

**Principles of Cosmetic Evaluation:** Principles of sebumeter, corneometer. Measurement of TEWL, Skin Colour, Hair tensile strength, Hair combing properties.
Soaps and syndet bars. Evolution and skin benefits.

Unit-V 07 Hours

Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis.

Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odour. Antiperspirants and Deodorants- Actives and mechanism of action.
Recommended Books (latest edition):

- Poucher’s Perfumes, Cosmetics and Soaps edited by Hilda Bulter, Springer (India) Pvt. Ltd., New Delhi.
- Cosmeceuticals by Madhusudan Rao, PharmaMed Press, Hyderabad.
- Drugs and Cosmetics Act/Rules, Govt. of India Publications.
- Drugs and Cosmetics Act 1940 by Vijay Malik, EBC Publishing House Pvt. Ltd. Lucknow.
BP810ET. PHARMACOLOGICAL SCREENING METHODS (Theory)

Course content:

Unit-I
Laboratory Animals:
Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals.
Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.

Unit-II
Preclinical screening models
Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study.
Study of screening animal models for:
Diuretics, nootropics, anti-Parkinson’s, anti-asthmatics.

Unit-III
Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics.

Unit-IV
Preclinical screening models: for CVS activity – anti-hypertensives, diuretics, antiarrhythmic, anti-dyslipidemic, anti-aggregatory, coagulants, and anticoagulants. Preclinical screening models for other important drugs like antiulcer, anti-diabetic, anticancer and anti-asthmatics.

Unit-V
Research methodology and Bio-statistics:
Selection of research topic, review of literature, research hypothesis and study design. Preclinical data analysis and interpretation using Students ‘t’ test and One-way ANOVA. Graphical representation of data.
Recommended Books (latest edition):
- CPCSEA Guidelines for Laboratory Animal Facility.
- Screening Methods in Pharmacology by Tumer, Elsevier a Division of Reed India Pvt. Ltd. Noida.
BP811ET. ADVANCED INSTRUMENTATION TECHNIQUES (Theory)

45 Hours

Course Content:

Unit-I 10 Hours
Nuclear Magnetic Resonance spectroscopy
Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications.

Mass Spectrometry - Principles, Fragmentation, Ionization techniques- Electron impact, chemical ionization, MALDI, FAB, Analyzers -Time of flight and Quadrupole, instrumentation, applications.

Unit-II 10 Hours
Thermal Methods of Analysis: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC).
X-Ray Diffraction Methods: Origin of X-rays, basic aspects of crystals, X-ray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.

Unit-III 10 Hours
Calibration and validation- as per ICH and USFDA guidelines.
Calibration of following Instruments: Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC.

Unit-IV 08 Hours
Extraction techniques: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction.

Unit-V 07 Hours
Hyphenated techniques- LC-MS/MS, GC-MS/MS, HPTLC-MS.
Recommended Books (Latest Editions)

- Instrumental Methods of Chemical Analysis by B.K. Sharma, Krishna Prakashan Media (P) Ltd., Meerut, India.
- Pharmaceutical Chemistry Instrumental Technique by Leslie G. Chatten, CBS Publisher and Distributer Pvt. Ltd., New Delhi.
- Vogel’s Textbook of Quantitative Chemical Analysis by A.I. Vogel, Addison Wesley Logman, Singapore.
- Organic Spectroscopy by William Kemp, Palgrave, NY.
BP812ET. DIETARY SUPPLEMENTS AND NUTRACEUTICALS (Theory)

45 Hours

Course Content:

Unit-I 10 Hours
Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. Public health nutrition, maternal and child nutrition. Nutrition and ageing, nutrition education in community.
Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soybean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds.

Unit-II 10 Hours
Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following:
Carotenoids: α and β-Carotene, Lycopene, Xanthophylls, leutin.
Sulfides: Diallyl sulfides, Allyl trisulfide.
Polyphenolics: Reservetrol.
Flavonoids: Rutin, Naringin, Quercitin, Anthocyanidins, catechins, Flavones.
Prebiotics/Probiotics: Fructo-oligosaccharides, Lacto bacillus.
Phyto estrogens: Isoflavones, daidzein, Geebustin, lignans.
Tocopherols.
Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

Unit-III 10 Hours
Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids. Dietary fibres and complex carbohydrates as functional food ingredients.

Unit-IV 08 Hours
Functional foods for chronic disease prevention.
**Unit-V**

Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.

Regulatory Aspects: FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety.

Adulteration of foods.

Pharmacopeial Specifications for dietary supplements and nutraceuticals.

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**Recommended Books (Latest editions)**

- Role of Dietary Fibers and Nutraceuticals in Preventing Diseases by K.T. Agusti and P. Faizal: BS Publication.
- Essentials of Food Process Engineering by Chandra Gopala Rao, BS Publications, Hyderabad.
BP813ET. PHARMACEUTICAL PRODUCT DEVELOPMENT (Theory)

45 Hours

Course Content:

Unit-I  10 Hours
Introduction to pharmaceutical product development, objectives, and regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms.

Unit-II  10 Hours
An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories:
Solvents and solubilizers. Cyclodextrins and their applications.
Non-ionic surfactants and their applications. Polyethylene glycols and sorbitols.
Suspension and emulsifying agents. Semi solid excipients.

Unit-III  10 Hours
An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories:
Excipients in parenteral and aerosols products. Excipients for formulation of NDDS.
Selection and application of excipients for pharmaceutical formulations, with specific industrial applications.

Unit-IV  08 Hours
Optimization techniques in pharmaceutical product development. A study of various optimization techniques for pharmaceutical product development with specific examples.
Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development.

Unit-V  07 Hours
Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.
Recommended Books (Latest editions)

- Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, Charles Bon; Marcel Dekker Inc., USA.
- Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, by A. Lieberman, Leon Lachman and Joseph B. Schwartz, Marcel Dekker Inc., USA.
- Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, by H.A. Liberman, Martin, M.R and Gilbert S. Banker, Marcel Dekker Inc., USA.
- Martin’s Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, Lippincott Williams & Wilkins, USA.
- Ansel’s Pharmaceutical Dosage Forms and Drug Delivery Systems by Loyd V. Allen, Jr., N.G. Popovich and H. C. Ansel, Lippincott Williams & Wilkins, USA.
- Advanced Review Articles related to the topics.
BP803ET to BP814ET (Elective Subjects)

The student has the choice to choose both the elective subjects from the already prescribed list of elective subjects by the PCI or choose one elective subject from the existing prescribed list of elective subjects of B. Pharm. programme by the PCI and the other (second subject) elective from list of skill pack/modules available with the LSSSDC from time to time.
BP815PW. PROJECT WORK (On Elective)

All the students shall undertake a project under the supervision of a teacher and submit a report. The area of the project shall directly relate any one of the elective subjects opted by the student in semester VIII. The project shall be carried out in group not exceeding 5 in number. The project report shall be submitted in triplicate (typed & bound copy not less than 25 pages).
BP816P. REPORT ON INDUSTRIAL TOUR

Visit of students to an industrial establishment or an approved research laboratory. The industrial visit shall include: in case of industry- visit to different sections and subsections of the industry, an idea about the functioning of the industry, product range of the industry and various approvals of the industry; in case of research laboratory-visit to different departments of the laboratory, an idea about the interdisciplinary coordination, contribution of the laboratory to the society and various approvals of the laboratory. A proper report of the same shall be submitted by the students, which shall be subsequently evaluated to assess the impact of the visit.

May be performed at the end of the 7th semester.