B.PHARM. (FOUR YEAR) COURSE STRUCTURE
(2nd Year onwards)

B.PHARM. PART-II: Semester–III

<table>
<thead>
<tr>
<th>Subjects</th>
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<tr>
<td>Theory:</td>
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<tr>
<td>01. PH-2101</td>
<td>Pharmaceutical Technology</td>
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<tr>
<td>02. PH-2102</td>
<td>Pharmaceutical Organic Chemistry – II</td>
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<td>03. PH-2103</td>
<td>Pharmaceutical Physical Chemistry</td>
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<tr>
<td>04. PH-2104</td>
<td>Pharmacology–I (Anatomy &amp; Physiopharmacology)</td>
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<td>05. PH-2105</td>
<td>Pharmaceutical Microbiology</td>
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<td>06. PH-2301</td>
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<td>07. PH-2302</td>
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<td>08. PH-2303</td>
<td>Pharmaceutical Physical Chemistry</td>
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<td>09. PH-2304</td>
<td>Pharmacology – I</td>
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B.PHARM. PART-II: Semester–IV

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<tr>
<td>01. PH-2201</td>
<td>Dispensing and Hospital Pharmacy</td>
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<td>02. PH-2202</td>
<td>Pharmaceutical Analysis – I</td>
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<tr>
<td>03. PH-2203</td>
<td>Pharmacognosy – I</td>
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<td>04. PH-2204</td>
<td>Pharmacology – II</td>
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<td>05. CH-2221A</td>
<td>Pharmaceutical Engineering</td>
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### B.PHARM. PART-III: Semester–V

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<tr>
<td>01. PH-3101</td>
<td>Pharmaceutical Medicinal Chemistry – I</td>
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<td>02. PH-3102</td>
<td>Pharmacognosy – II</td>
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<td>03. PH-3103</td>
<td>Pharmaceutical Biochemistry</td>
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<td>04. PH-3104</td>
<td>Pharmacology – III</td>
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<td>05. PH-3105</td>
<td>Pharmaceutical Jurisprudence</td>
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<td>07. PH-3302</td>
<td>Pharmacognosy – II</td>
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<td>09. PH-3304</td>
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### B.PHARM. PART-III: Semester–VI

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<td>01. PH-3201</td>
<td>Pharmaceutical Analysis – II</td>
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<td>02. PH-3202</td>
<td>Pharmaceutical Biotechnology</td>
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<td>03. PH-3203</td>
<td>Pharmacology – IV</td>
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<td>04. PH-3204</td>
<td>Pharmaceutical Management</td>
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<td>HU-3201: History of Science &amp; Technology</td>
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<td>HU-3202: Industrial &amp; Organizational Psychology</td>
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<td>HU-3203: Intellectual Property Rights</td>
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<td>HU-3206: Ethics, Philosophy &amp; Values</td>
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<td>HU-3207: Entrepreneurship Development</td>
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<td>Pharmaceutical Microbiology</td>
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### B.PHARM. PART-IV: Semester–VII

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<tr>
<td>01. PH-4101 Pharmaceutical Instrumental Analysis</td>
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<tr>
<td>02. PH-4102 Dosage Formulation Design</td>
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<td>03. PH-4103 Pharmaceutical Medicinal Chemistry – II</td>
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<td>04. PH- Elective [PH-4204 / PH-4105]</td>
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#### Seventh Semester Elective Subjects:
- PH-4104: Bioavailability & Therapeutic Drug Monitoring
- PH-4105: Drug Design

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<td>05. PH-4301 Dosage Formulation Design</td>
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<td>06. PH-4302 Pharmaceutical Medicinal Chemistry – II</td>
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<td>07. PH-4303 Project</td>
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<td>08. PH-4304 Seminar/Group Discussion</td>
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<td>09. PH-4305 Training/Tour Viva-voce</td>
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### B.PHARM. PART-IV: Semester–VIII

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<td>02. PH-4202 Pharmaceutical Medicinal Chemistry – III</td>
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<td>03. PH-4203 Pharmacognosy – III</td>
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<td>04. PH- Elective [PH-4204 / PH-4205]</td>
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#### Eighth Semester Elective Subjects:
- PH-4204: Cosmetology
- PH-4205: Quality Assurance

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<td>05. PH-4401 Pharmaceutical Instrumental Analysis</td>
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<td>06. PH-4402 Pharmacognosy – III</td>
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<td>07. PH-4403 Project</td>
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<td>08. PH-4404 Comprehensive Viva-voce</td>
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**Total for Part-IV**

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**GRAND TOTAL FOR B.PHARM. COURSE**

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<td><strong>228</strong></td>
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B.PHARM. (FOUR YEAR) COURSES – DETAILED SYLLABI
(2nd Year onwards)

Third Semester

PH-2101: Pharmaceutical Technology [Credits: 3]

1. Disperse Systems including Interfacial Phenomena:
   - Suspension – Objective, Theory, Properties of ideal suspension, Interfacial properties, Electrical properties at the interfaces, Electrical double layer, Zeta Potential, Nernst Potential, Application and Formulation consideration.
   - Colloids and gels: Types, solute permeation to and through colloids and gels – theories affecting solute permeation; preparations and evaluation.


Suggested books: Latest editions of:


1. Fats, oils, waxes and wool fat, chemistry analysis and Pharmaceutical importance.

2. Preparation, properties and Pharmaceutical importance of the following aromatic compounds - halides, sulphonic acids, phenols, amino and nitrophenols, nitrocompounds, amines, diazonium compounds, aldehyds, hydroxy aldehydes, ketone, acids, hydroxy acids, amino acids, acyl derivatives.

3. Chemistry of polynuclear hydrocarbons and their derivatives-naphthalene anthracene and phenanthrene.

4. Chemistry of five and six-membered heterocyclic compounds containing one heteroatom and their medicinal uses (furan, thiophene, pyrrole and pyridine).

5. Study of carbohydrates, structure and ring-size of glucose and fructose, synthesis of aldohexoses from glyceraldehyde, acetylation, methylation and osazone formation and the pharmaceutical importance of the carbohydrates.

6. Terpenes: Isolation from natural sources, structure elucidation and properties of compounds e.g. Terpineol, Carvone, Menthol, Citral.

7. Molecular re-arrangement and synthetic applications associated with the following reactions:

8. Stereochemistry, conformational and configurational analysis: (i) (Acyclic compounds upto Butane (ii) Cyclic systems upto decalin.)
Suggested books: Latest editions of-

PH-2103: Pharmaceutical Physical Chemistry [Credits: 3]
1. Chemical kinetics-rate and order of reaction, molecularity, specific rate constants, mathematical treatment of rate, zero and first order reactions, thermodynamics vs kinetics control, effect of temperature of and other factors on reaction rate, classical collision theory of reaction rates, transition state theory, effect of solvents dielectric constant and catalysis, decomposition of medical agents, oxidation and stability analysis.
2. Application of Thermodynamic principles in Pharmacy.
3. Physical properties of drug molecules - dielectric constant induced. Polarization of non-polar molecules, refractive index, molar refraction, optical rotation, optical rotatory dispersion.
4. Partition coefficient. Hansch equation and Hansch analysis, and the importance in the field of pharmacy.
5. Inter-facial phenomena-adsorption, various types of adsorption, isothenm, and their medicinal importance.
6. Conductivity and transport number, strong and weak electrolytes, voltaic cell, reversibility, polarization, single electrode potential, concentration cell, oxidation-reduction potentials, standard electrodes, determination of hydrogen ion concentration and solubility.

Suggested books: Latest editions of-
- 02. A.N. Martin: Physical Pharmacy, Lippincott Williams and Wilkins, Baltimore, USA.

PH-2104: Pharmacology – I (Anatomy & Physiopharmacology) [Credits: 3]
2. Structure of the gastro-intestinal tract, functions of its different parts including those of liver, pancreas and gall bladder; various gastrointestinal secretions and their role in the digestion and absorption of food. An introduction to disorders of digestive system with reference to drugs acting on gastrointestinal tract.
3. Structure of respiratory organs, functions of respiration, mechanism and regulation of respiration, respiratory volumes and vital capacity. An introduction to respiratory disorders with reference to drugs acting on the respiratory system.
4. Central Nervous System: Functions of different parts of brain and spinal cord. Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain, cranial nerves and their functions.
5. Autonomic Nervous System: Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in ANS.
7. Sense Organs: Structure and physiology of the eye (vision), ear (hearing), taste buds, nose (smell) and skin (superficial receptors). Drugs acting on ocular and aural disorders.

Suggested books: Latest editions of-
PH-2105: Pharmaceutical Microbiology  [Credits: 4]
1. General techniques of microbiology, morphology, life history, habit, variation, reproduction, mode of nutrition and cultivation of bacteria, yeasts, moulds and common protozoa.
2. Principles of isolation and identification of pure culture, different staining methods, preparation of staining solutions and culture media.
4. Ligatures and sutures, manufacturing units and their manufacture and standardization.
5. Effects of physical and chemical agents on bacteria, disinfectants and antiseptics, mode of action and standardization of disinfectants.
6. Aseptic methods, mode of contamination and determination of degree of contamination. Aseptic handling of sterile materials and medicaments and test for sterility of medicaments, culture media, ligatures and sutures.
7. Reaction of micro-organism to disease, common infections and communicable diseases, their causative organism, mode and route of infection. Methods of control and diagnostic test of organisms of special interest to India.

Suggested books: Latest editions of-
02. A.J. Salle, “Fundamental Principles of Bacteriology”.
03. G. Sykes, “Disinfection and Sterilization”.

Practical:
PH-2301: Pharmaceutical Technology  [Credits: 2]
PH-2302: Pharmaceutical Organic Chemistry – II  [Credits: 2]
PH-2303: Pharmaceutical Physical Chemistry  [Credits: 2]
PH-2304: Pharmacology – I  [Credits: 2]

Fourth Semester

PH-2201: Dispensing and Hospital Pharmacy  [Credits: 3]
1. The prescription-form of the prescription order, handling of prescription, prescription containers, legal considerations.
2. Labeling, weights & measures; calculations, and working knowledge of Latin in prescription handling.
3. Principles and procedures of dispensed products - Solutions, suspensions, emulsions, powders and oral unit dosage forms, pills, ointments, creams, pastes, jellies, suppositories and pessaries.
5. Hospital Pharmacy - education and training, hospital development and expansion, organization and administration, financing, standards of practice and administration; in patient drug distribution, prescription errors.

Suggested books: Latest editions of-
PH-2202: Pharmaceutical Analysis – I [Credits: 3]

1. Computation of analytical results, rejection of doubtful values with special reference to volumetric and gravimetric analysis.
2. Sources of errors in volumetric and gravimetric analysis and their avoidance, standard or the Gaussian error distribution curve.
3. Fundamentals of volumetric analysis, methods of expressing concentration, standardization, primary and secondary standards.
4. General principles of acidimetry, alkalimetry, oxidation-reduction and precipitation methods as exemplified by standard reagents such as Potassium hydrogen phthalate, carbonate, permanganate, dichromate, thiosulphate, silver nitrate etc.
5. Ionic equation and solution of stoichiometric and analytical problems.
7. Complexation - metal complexes, chelates, molecular organic complexes of pharmaceutical importance, complexometric titrations.

Suggested books: Latest editions of-

PH-2203: Pharmacognosy - I [Credits 3]

1. History of Pharmacognosy - Crude vegetable and animal drugs, official and non-official drugs and Classification of crude drugs.
2. A brief survey of different systems of medicine existing in India, their basic principles and their relation to pharmacognosy.
3. General account of Cultivation and Collection of plants.
4. Salient features of preparation of crude drugs for market.
5. Deterioration of drugs due to insects and pests.
6. Study of earths used in pharmacy: Talc, Diatomite, Asbestos, Kaolin, Fuller’s earth, Chalk, Bentonite.
7. Study of the following fibres used in the manufacture of surgical dressing and/or filtering aids: Vegetable fibres - cotton, oxidised cellulose. Animal fibres - silk and wool. Synthetic fibres - rayon, nylon.
8. Study of the diagnostic characters of the following families with emphasis on plants of medicinal and economic value: Ranunculaceae, Leguminosae, Papaveraceae, Umbelliferae, Compositae, Apocynaceae, Solanaeae, Rubiaceae, Scrophulariaceae, Nyctaginaceae, Loganiaceae, Euphorbiaceae, Asclepiadaceae & Acanthaceae.
9. Preparation and preservation of herbarium sheets of medicinal plants and their importance in identification work.
10. Study of photosynthesis with special reference to its role in biosynthesis of natural products.
11. Study of the following: Starch, Honeybee, Cantharides & Cochineal.

Suggested books: Latest editions of-
02. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
PH-2204: Pharmacology - II

1. Drug ADME, Pharmacogenetics.
2. Pharmacology of Peripheral Nervous System:
   (a) Parasympathomimetics, Parasympatholytics, Sympathomimetics, Adrenergic Receptor
   and Neuron blocking agents, ganglionic stimulants and blocking agents.
   (b) Neuromuscular blocking agents.
3. Pharmacology of Central Nervous System:
   (a) General anesthetics and Local anesthetics.
   (b) Alcohol and disulfiram.
   (c) Sedatives, hypnotics, anti-anxiety agents and centrally acting muscle relaxants.
   (d) Narcotic and non-narcotic analgesics.
   (e) C.N.S. stimulants.
   (f) Antidepressants
   (g) Psychopharmacological
   (h) Anti-epileptic drugs.
   (i) Anti-Parkinsonian drugs.
   (j) Drug addiction and drug abuse.
4. Male and female reproductive organs and their hormones. Menstruation, coitus and
   fertilization physiology. Contraception.

Suggested books: Latest editions of -
01. Goodman and Gilman’s "The Pharmacological basis of Therapeutics", 
02. Best and Taylor’s Physiological Basis of Medical Practice, Williams & Wilkins, Baltimore.

CH-2209A: Pharmaceutical Engineering

1. Units and dimensions.
2. Fluid Flow: Properties of fluids, Types of fluids, Newtonian and non Newtonian fluids,
   Basic equations of fluid flow, Pipes and pipe fittings, Pressure and flow measurements.
3. Mechanical operations: Crushing and grinding, Laws of crushing and grinding, Sieving and
   particle classification, Mixing of powders, Dispersion of fine particles; Granulation in tablet
   making.
   transfer, conduction and convection, insulation, Convective heat transfer, Individual and
   overall heat transfer coefficients, Types of heat exchangers. Evaporation, basic concepts,
   factors affecting evaporation, evaporators, types of evaporators, single and multiple effect
   evaporators.
5. Mass transfer: Humidification and dehumidification: Basic concepts and definition, wet bulb
   and adiabatic saturation temperatures, psychometric chart and measurement of humidity,
   equipment for dehumidification operations.
6. Distillation: Raoult’s law, phase equilibria, volatility; batch and continuous distillation,
   steam and flash distillations, azeotropic and extractive distillations.

Practical:
PH-2401: Dispensing Pharmacy
PH-2402: Pharmacognosy – I
CH-2409A: Pharmaceutical Engineering
Fifth Semester

PH-3101: Pharmaceutical Medicinal Chemistry – I

1. Heterocyclic Chemistry:
   (a) Synthesis, reaction and pharmaceutical importance of the following:
      (i) Two hetero atoms in five and six membered ring. Pyrazole, Imidazole, Thiazole, Oxazole, Pyrimidines.
      (ii) Five or six membered hetero cycles fused to one Benzene ring : Benzofurane, Indole, Benzimidazole, Benzoxazole, Benzthiazole Coumarins, Quinoline and Isoquinoline
      (iii) Benzodiazepine, phenothiazines, thioxanthenes, acridines, Dibenzoazepins.
   (b) Purine and Pyrimidines derivatives: Xanthenes, guanine, nucleic acid. Uric and methylated xanthenes, their structural elucidation and pharmaceutical importance.

2. Alkaloids: Methods of extraction and structure determination, classification and synthesis of the following alkaloids: Ephedrine, Nicotine, Atropine, Cocaine, Papaverine, Pilocarpine, Physostigmine.

3. Chemistry of Essential amino acids, peptides (Insulin), simple proteins.

4. SAR and synthesis and mechanism of action of compounds leading to the following classes of drugs.

5. Local Anaesthetics, Sedatives and Hypnotics (Barbiturates), Anti-convulsants, Non-opiate analgesics, Anti-tussives, Antispasmodics, Antihistaminics (ethylenediamines, aminoalkylesters, and tricyclic systems), Tranquillizers (Phenothiazines).

**Suggested books: Latest editions of**


PH-3102: Pharmacognosy – II

1. A study of source, geographical distribution, cultivation (only those in italics), collection, preparation for market, macroscopical characters/description, commercial varieties, substitutes, adulterants, chemical constituents and tests, uses and pharmacopeial standards of the following:

2. Acacia, Agar, Tragacanth, Gelatin, Ispsaghul, Sterculia, Benzoins, Balsam Tolu, Storax, Colophony, Asafoetida, Turpentine oil, Arachis oil, Castor oil, Shark liver oil, Bees wax, Catechu, Cannabis, Valerian, Chirata, Kalnemegh, Picorrhica, Punarnava, Aloe, Opium, Lemongrass, Brahmi, Taxus.

3. Biological Source, preparation, description, identification tests and uses of the following enzymes: Diastase, Hyaluronidase, Penicillinase, Papain, Pepsin, Trypsin, Pancreatin and Streptokinase.

4. Introduction to tissue culture with reference to phytopharmaceuticals.

5. Commercial aspects of drug production, preservation and storage of crude drugs. Changes occurring in drying and comminution. Enzyme action in vegetable drugs.

6. Adulteration and evaluation of crude drugs.

7. Types and significance of standards of crude drugs included in I.P. and B.P.

**Suggested books: Latest editions of**

PH-3103: Pharmaceutical Biochemistry [Credits: 4]
1. Introduction: Scope of Biochemistry
3. Amino Acids: Metabolism, urea cycle, Zwitterions.
4. Proteins: Primary, secondary, tertiary and quaternary structures, types and functions, biosynthesis, purification, isoenzymes.
5. Lipids: Metabolism of fatty acids, phospholipids, cholesterol biosynthesis, regulation of fatty acid metabolism.
7. Enzymes: Classification, assay, kinetic derivation of Michaelis – Menten’s equation, mechanism of action, regulation (allosteric and feed back).
9. Hormones: Molecular mechanism of actions (epinephrine/glucagons and insulin and estradiol or testosterone), Cyclic AMP.
11. Memory and consciousness: Biochemical, physiological and molecular basis, short term, intermediate term and long term memory, consolidation of short term memory.

Suggested books: Latest editions of-
01. B. Harrow and A. Mazur, Text Book of Biochemistry, W.B. Saunders Co., Philadelphia.

PH-3104: Pharmacology – III [Credits: 3]
1. Pharmacology of cardiovascular system:
   (a) Digitalis and cardiac glycosides
   (b) Antiarrythmic drugs
   (c) Coronary dilators
   (d) Anti-hypertensive drugs
   (e) Drugs used in atherosclerosis
2. Drugs acting on the Hemopoietic system:
   (a) Hematinics and growth hormones
   (b) Anticoagulants, Vitamin K and Hemostatic agents
   (c) Fibrynolytic and anti-platelet drugs
   (d) Blood and plasma volume expanders
3. Drugs acting on urinary system:
   (a) Fluid and electrolyte balance restorers
   (b) Diuretics and antidiretics
5. Autacoids:
   (a) Histamine, 5-HT and their antagonists.
   (b) Prostaglandins, thromboxones and leukotrienes and kinins.
6. Drugs acting on the respiratory system:
   (a) Anti-asthmatic drugs including bronchodilators and mucolytics.
   (b) Anti-tussive and expectorants.
   (c) Respiratory stimulants.
Suggested books: Latest editions of-


**PH-3105: Pharmaceutical Jurisprudence** [Credits: 3]

Suggested books: Latest editions of-


**Practical:**

**PH-3301: Pharmaceutical Medicinal Chemistry - I** [Credits: 2]
**PH-3302: Pharmacognosy - II** [Credits: 2]
**PH-3303: Pharmaceutical Biochemistry** [Credits: 3]
**PH-3304: Pharmacology – II** [Credits: 2]

**Sixth Semester**

**PH-3201: Pharmaceutical Analysis – II** [Credits: 3]
Theoretical considerations and applications in drug analysis and quality control of the following analytical techniques:
2. Extraction procedures of separation of drugs from excipients.
3. Construction, theory and application of modern analytical- and electro-chemical instruments used in pharmaceutical analysis, such as necessary of the following: Electrode assemblies, Electrical potential, pH measurement, Potentiometry, Conductometry, Polarography and Amperometry

Suggested books: Latest editions of-


**PH-3202: Pharmaceutical Biotechnology** [Credits: 3]
1. Immunology and Immunological Preparations. Principles, antigens and haptns, immune system, cellular humoral immunity, immunological tolerance, antigen – antibody reactions and their applications. Active and passive immunization, vaccines, their preparations, standardization and storage.
2. Genetic recombination: Transformation Conjugation, transduction, protoplast fusion and gene cloning and their applications. Development of hybridoma for monoclonal antibodies. Study of drugs produced by biotechnology such as insulin, GH, Hbs Ag, streptokinase etc.
3. Antibiotics, Historical development of antibiotics, Screening of soil for organisms producing antibiotics, fermenter, its design, control of different parameters; isolation of mutants, factors affecting rate of mutation; Design of fermentation process; Isolation of fermentation products with special reference to penicillin or vitamin B12.
4. Enzyme immobilization, techniques of enzyme immobilization, factors affecting enzyme kinetics; Study of some of the immobilized enzymes; Immobilization of bacteria and plant cells.

5. Tissue culture (Elementary knowledge) – Animal and plant tissue culture techniques.

**Suggested books: Latest editions of**


**PH-3203: Pharmacology – IV**

[Credits: 3]


2. Drugs acting on gastrointestinal disorders:
   (a) Antacids, anti-secretary and anti-ulcer drugs
   (b) Laxatives and antidiarrhoeal drugs
   (c) Appetite stimulants and suppressants
   (d) Emetics and anti-ematics

3. Pharmacology of endocrine system:
   (a) Hypothalamic and pituitary hormones
   (b) Thyroid and anti-thyroid drugs
   (c) Antidiabetics
   (d) Adrenals and hormones
   (e) Drugs acting on the uterus

4. Chemotherapy:
   (a) General principles of chemotherapy
   (b) Sulphonamides and co-trimoxazole
   (c) Antibiotics: Pencillins, cephalosporins, chloramphenicol, erythromycin, quinolones and miscellaneous antibiotics.
   (d) Chemotherapy of malaria, tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases.
   (e) Chemotherapy of malignancy and immunosuppressing agents
   (f) Anthelmintics and Anti-amoebics

**Suggested books: Latest editions of**


**PH-3204: Pharmaceutical Management**

[Credits: 3]

1. Establishing a Pharmaceutical Factory:
   (a) Law governing the establishment of a pharmaceutical factory and how to abide by it in starting such factory.
   (b) Choice of site,
   (c) Placement of the building/buildings within the site.
   (d) Area and other requirements of each department such as maintenance, manufacturing, packing, warehousing services etc.
   (e) Nature of building-single vs. multi-storied.
   (f) Juxtaposition of each department
   (g) Expansion possibilities in relation to projected future demand on the factory.
(h) Layout of each department from the point of view of efficiency as well as from the drug legislation, Excise and Factory Act angle.
(i) Safety, Industrial pollutants, types, prevention.
(j) Materials handling of Pharmaceuticals

2. Organization of a pharmaceutical house, Types of Organization, Capital requirement, its relation between sales, laboratories and Production units.


4. Main equipments necessary in the industry, their cost, cost control, availability and efficiency of performance.

5. Methods of communication within various departments of the factory.

6. Personnel requirements of the pharmaceutical factory and the Labour law; selection and training of personnel; motivation, importance in industry, types and hierarchy.

7. Certain practices of commerce in pharmaceutical industry:
   (a) Collection of statistics for import and export of raw materials and pharmaceuticals and application.
   (b) Matters related to trade mark and patent laws in relation to pharmaceuticals.
   (c) Inventory control.
   (d) Market Research for pharmaceuticals; Production, Planning & Material management.

Suggested books: Latest editions of-

HU- Open Elective (Humanities) [Credits: 3]
(Syllabi will be provided at Institute Level)

Practical:
PH-3401: Pharmaceutical Analysis – I [Credits: 3]
PH-3402: Pharmaceutical Microbiology [Credits: 3]
PH-3403: Pharmacology - III [Credits: 3]

Seventh Semester

PH-4101: Pharmaceutical Instrumental Analysis [Credits: 4]
2. General treatment of the construction theory and application of modern optical and analytical instruments used in Pharmaceutical Analysis, such as necessary for working of the following:
   (a) Colorimetry, fluorimetry, nephelometry and turbidimetry
   (b) Spectrophotometry - visible, ultra violet and infrared
   (c) Raman Spectra and Emission Spectroscopy
   (d) Optical Rotation
   (e) Radiochemical Analysis and use of Geiger Muller and Scintillation counters
   (f) Elementary idea of X Ray Diffraction

Suggested books: Latest editions of-
PH-4102: Dosage Formulation Design [Credits: 4]
1. Pre-formulations studies of dosage forms; Pharmaceutical aids; their classification, nature, properties and uses in formulations.
5. Parenteral medications: types of injections, clinical administration, product components and manufacturing process, design and working of clean room.
6. Dermatological preparations and Cosmetology: Their formulation, bases used, stability and their evaluation.
7. Aerosols: principles, different systems, propellants, containers and valve systems.

Suggested books: Latest editions of-
03. S.H.Willing: Good Manufacturing Practices for Pharmaceuticals, Marcel Dekker Inc., NY.

PH-4103: Pharmaceutical Medicinal Chemistry – II [Credits: 3]
1. Elementary principles of Drug designing: SAR, PAR and QSAR; Hansch approach, Bio-isosters.
2. Reactions of drug detoxification with representative examples.
3. Study of the development and synthesis of the compounds belonging to the following classes of drugs:
   General and Basal Anaesthetics, Antipyretics, Antihypertensives, Analectics, Antituberculars, Antileptics, Anti-helmintics, Antiamoebics, Antimalarials, Anticoagulants (Heparin and Oval), Antithyroids, Oral Hypoglycemics, Diuretics and Sulphonamides.
4. A short account of the following classes of drugs:
   Antineoplastics (Alkylating Agents and Antimetabolites), Antiseptics, Antifungal, Antiarrhythmics, NSAIDs, Diagnostics, Medicinal Dyes and Expectorants.

Suggested books: Latest editions of-
Seventh Semester Elective Subjects:

PH-4104: Bioavailability & Therapeutic Drug Monitoring [Credits: 3]
1. Principles of Drug Dissolution Related to Bioavailability; Dissolution Rate; Elementary idea of \textit{in vitro} and \textit{in vivo} correlation and its significance.
2. Explanation of terms: Bioavailability (Absolute and Relative), Bioequivalence, chemical and clinical and therapeutic equivalence, pharmaceutical alternative; Purpose and methods of bioavailability studies using blood level and urinary excretion data, Federal Requirements.
3. Definition of Pharmacokinetics and introduction to different pharmacokinetic parameters, such as rate constants for absorption and elimination, half-life, apparent volume of distribution, clearance, steady state plasma drug concentrations and factors affecting it. Calculation of Dosage regimen.
4. Therapeutic Drug Monitoring – Individualization of need based Dose requirement. Design of Dosage regimen; Pharmacokinetic evaluation of drug levels in body, readjustment of dosage regimen, clinical examples.

Suggested books: Latest editions of-

PH-4105: Drug Design [Credits: 3]
2. Principles of Drug Design (Theoretical Aspect), Traditional analog (QSAR) and mechanism based approaches:
   (a) Objectives and Limitation of Quantitative Structure-activity relationship.
   (b) QSAR Parameters
   (c) QSAR Methods
   (d) Substituent constants
   (e) Linear relationship between Log P and Biological activity
   (f) Non-Linear relationship between Log P and Biological activity
   (g) Steric substituent constants
   (h) Methods used in QSAR studies.
3. Introduction to Graph theory, Application and Quantum mechanics, Computer Aided Drug Designing and Molecular Modeling.

Suggested books: Latest editions of-

Practical:
PH-4301: Dosage Formulation Design [Credits: 2]
PH-4302: Pharmaceutical Medicinal Chemistry – II [Credits: 2]
PH-4303: Project [Credits: 2]
PH-4304: Seminar/Group Discussion [Credits: 2]
PH-4305: Training/Tour Viva-voce [Credits: 2]
**Eighth Semester**

**PH-4201: Clinical Pharmacy**

1. Introduction: History, Scope and Status of Clinical Pharmacy in India.
2. Drug Information.
3. Introduction to different pharmacokinetic parameters and Clinical Pharmacokinetics, Therapeutic drug monitoring. Important disorders and their management.
4. Concept of essential drugs and rational drug use.
5. Adverse drug reactions and pharmacovigilance.
8. Drug use during infancy and in the elderly (Pediatrics & Geriatrics).
10. Interpretation of Clinical Laboratory Tests.

**Suggested books: Latest editions of**

**PH-4202: Pharmaceutical Medicinal Chemistry – III**

1. Principles and applications of $^1H$ NMR & $^{13}C$ NMR and Mass Spectra in structure elucidation of simple organic molecules.
2. Structure, synthesis, stereo-chemistry and physiological significance of:
   a. Cardiac glycosides and cardiac aglycones
   b. Vitamins A, B1, C and E
   c. Alkaloids - Gnoscapine (Isoquinoline), Yohimbine (Indole), Conessine (Steroidal) and Vasicine (Quinazole)
   d. Natural colouring matters - Rutin (flavonoid), Cyanin (Anthocyanin)
4. Chemistry of Steroidal hormones - Sex hormones (testosterone, progesterone and estrogens) and corticoids (Cortisone).
5. Antibiotics - Structure, synthesis and assay of penicillin; and chloramphenicol, Semi-synthetic penicillin; Chemistry of streptomycin and tetracyclines.

**Suggested books: Latest editions of**

**PH-4203: Pharmacognosy – III**

1. The study of biological source, geographical distribution, cultivation (only those bracketed), collection, preparation for market, microscopical characters, commercial varieties, substitutes adulterants, detailed microscopical characters (only those underlined), chemical constituents and pharmacopoeial standards of the following (Dill), Fennel, (Coriander), Senna, Cardamom, Nutmeg, (Nux-vomica), Clove, Aconite, Liquorice, Ippecac, Rauwolfia, Rhubarb, Ginger, Scilla, Ephedra, Ergot, Vasaka, Belladona, Digitalis, Hyoscyamus, Cinchona, Cinnamon, Kurchi, Quassia, Mentha, Pyrethrum, Ginseng.
2. Principles and methods of Quantitative microscopical analysis:-
   Stomatal index, Stomatal number, Palisade ratio, Vein islet number and vein
termination number; Lycopodium Spore method for the evaluation of starches.
3. General principles of plant genetics dealing with pharmaceutical examples and applications.
4. General methods of investigations of biosynthetic pathways in vegetable drugs.
5. An elementary treatment of biosynthetic pathways of alkaloids, isoprenoids, coumarins,
   flavones and glycosides.
6. Separation techniques as applied to isolation of plant constituents.
7. Steroids from natural sources of commercial use.
8. Microbial Transformation of steroids.

Suggested books: Latest editions of-
   01. Trease, G.E. and Evans, W.C., Pharmacognosy, Bailliere Tindall,
       Eastbourne, U.K.
   03. Medicinal Plants of India, Indian Council of Medical Research, New
       Delhi.

Eighth Semester Elective Subjects:

PH-4204: Cosmetology [Credits: 3]

1. Perfumes: Basic principles of perfumery and fragrance; perfumery raw materials (natural as
   well as synthetic), fixatives (animal secretions, resinous fixatives, essential oil fixatives,
   synthetic fixatives), improvers. Formulation of perfumes.
2. Cosmetics:
   (a) Principles of formulation and manufacture of cosmetics.
   (b) Emulsification in cosmetics, preparation, preservation and stability of cosmetic
       products creams.
   (c) Formulation of following classes of cosmetic preparations:
      i. Face products: Vanishing creams, cold creams, emollient creams, cleansing
         creams, moisturizing creams, face powder, lipstick.
      ii. Hand Products: Protective creams, hand creams and lotions, liquid creams, hand
         cleaners, nail lacquers.
      iii. Body Cosmetics: Antiperspirants and deodorants. Depilatories. Talcum and
         dusting powders, perfumes.
      iv. Preparations for Oral hygiene: Mouthwash, dentifrices.
      v. Hair Products: Shampoos, hair grooming & conditioning products, hair waving
         and setting products.
      vi. Shaving Products: Pre-shave and after-shave lotions, shaving preparations.
3. Colours: Natural and Synthetics; Characteristics.
4. Preservatives and Antioxidants: Classification, effective concentration, incompatibility.
5. Packaging and labeling of cosmetics.

Suggested books: Latest editions of-
   01. "Cosmetic Science and Technology", Sagarin and M.S.Balsam, John
       Wiley & sons, NY.
   02. S.G.Thomssen, “Modern Cosmetics”, Universal Publishing Corporation,
       Mumbai.
PH-4205: Quality Assurance

1. Introduction and scope of: cGMP, cGLP, ISO, TQM with reference to pharmaceutical products.
2. Control of quality variation: raw materials control, in-process items control, quality assurance during packaging.
3. Control and assurance of manufacturing process.
4. Regulatory drug analysis and interpretation of data.
5. Validation of equipment, analytical instruments and manufacturing environment.

Suggested books: Latest editions of -
01. A.N. Martin: Physical Pharmacy, Lippincott Williams and Wilkins, Baltimore, USA.
02. S.H. Willing: Good Manufacturing Practices for Pharmaceuticals, Marcel Dekker Inc., NY.

Practical:
PH-4401: Pharmaceutical Instrumental Analysis  [Credits: 2]
PH-4402: Pharmacognosy - III  [Credits: 2]
PH-4403: Project  [Credits: 6]
PH-4404: Comprehensive Viva-voce  [Credits: 2]