Dr. H. S. Gour Central University, Sagar (MP)
Proposed Curriculum for B. Pharm. Course: w.e.f. Session 2009 - 2010

B.Pharm. – Second Year ( III Sem. and IV Sem.)
(Structure of courses)

<table>
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<th>Hints for Course Code :</th>
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<th>Second Digit</th>
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<td>PHSC denotes Pharmaceutical Sciences, First Digit denotes Semester No., 2\textsuperscript{nd} Digit denotes Course Level 1 for UG and 2 for PG, Third digit(s) denotes paper No.</td>
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B.PHARM. – III SEMESTER (Theory & Tutorials)

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B.PHARM. – III SEMESTER (Practicals)

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Note: * - L - Lecture T - Tutorial   P- Practical   C- Total Credit

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B.PHARM. – III SEMESTER

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Physical Pharmaceutics

Theory: 4h/week

State of matter: State of matter, gaseous state, liquid state, solid and crystalline state, liquid crystalline state, phase equilibrium and phase rule (one component, two component system containing liquid phase and solid & liquid phase), thermal analysis.

Kinetics and drug stability: Rate and order of reactions, factors affecting rate of reaction, decomposition and stabilization of medicinal agents, kinetics in the solid state, accelerated stability analysis


Micromeritics: Particle size and size distribution, methods for determining particle size, particle shape and surface area, methods for determining surface area, pore size, derived properties of powders.

Rheology: Introduction, newtonian system, Non Newtonian system, thixotropy, determination of rheologic properties, viscoelasticity, psychorheology, applications to Pharmacy.

Surface and interfacial phenomena: Liquid interfaces, adsorption at liquid interfaces, adsorption at solid interfaces, electrical properties of interfaces.

Colloids: Introduction, Types of colloidal systems, optical, kinetic and electric properties of colloids, solubilization.

Coarse Dispersions: Suspensions, interfacial properties of suspended particles, settling in suspensions, Emulsions, theories of emulsification, physical stability of emulsions, preservation of emulsions, rheologic properties of emulsions, phase equilibria and emulsion formulation, special emulsion systems.


Compaction and compression: Compression characteristics of powders and granules, physics of tablet compression, measurement of punch forces, transmission of forces through powders, distribution of forces in powder mass, factors affecting strength of tablets.

Crystallization: Introduction, Nucleation and crystal growth, crystal type, theory of crystallization, batch crystallizers, simple vacuum crystallizers, prevention of crystals caking.

Books Recommended:

1. Physical Pharmacy - Martin, Swarbrick & Cammarata.
2. Physical Pharmaceutics - Schotton
5. Chemical Engineering - Richardson and Coulson.
6. Introduction to Unit Operation - McCabe and Smith.
7. Theory and Practice of Industrial Pharmacy-Lachman,Lieberman and Kanig

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**Hours Per Week**

**Cell and Molecular Biology**

**Theory: 2h/week**

2. Structure of prokaryotic and eukaryotic cell.
4. Transport of nutrients ions and drug substances across membranes, ion channels, endocytosis, pinocytosis, potosis, diffusion and active transport systems.
5. Cellular energy transduction role of mitochondria and chloroplast systems.
8. Cytoskeleton: microtubules and their role in cell structural organization; intracellular trafficking and cell motility.
9. DNA / RNA structure: Organization of genetic material, replication, DNA repair, chromosomal morphology (condensation/decondensation) transcription, RNA polymerase, transcription factors, regulatory element, mechanism of transcription regulation, gene splicing, post transcriptional RNA modifications, 5’cap formation, transcription formation, 3’end polyadenylation, splicing, mRNA its stability and transportation, translation, prokaryotic and eukaryotic translation machinery, initiation; elongation, regulation; co-post translational modification of protein.

**Books Recommended:**


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Pharmaceutical Chemistry - IV (Chemistry of Natural Product)

Theory: 4h/week

**Heterocyclic compounds:** Nomenclature, structure and reaction of imidazoles, oxazoles, thiazoles, pyrazole, pyran, pyrimidines, indole, purine, quinoline, isoquinoline, carbazole, acridine and phenothiazine.

**Carbohydrates:** Classification, monosaccharides, glucose, fructose and their reactions, configuration of aldoses, cyclic structure of D-glucose, mutarotation and conformations, amino sugars, D-ribose, 2-deoxy D-ribose, disaccharides, maltose, lactose, sucrose, polysaccharides, starch, cellulose, dextrin, glycogen, inulin, dextrans.

**Glycosides:** Classification and methods of isolation alpha and beta D-methylglucoside, structure of salicin, arbutin, amygdalin, sinigrin, anthraquinone glycosides, tannins, cardiac glycosides and saponins.

**Proteins and amino acids:** Isolation and classification of proteins, hydrolysis, fibrous and globular proteins, classification, methods of synthesis and properties of amino acids, nucleoproteins and nucleic acids and general knowledge of nitrogenous bases in nucleic acids, structure of nucleosides and nucleotides, structure of nucleic acids.

**Favones & isoflavones, coumarines, porphyrines**

**Lipids fats oils and waxes, fatty acids:** Characterization and their physico-chemical properties, general knowledge of phospholipids, lecithins, cephalines, sphingomyelins, glycolipids, lipoproteins.

**Terpenes:** Isolation, classification, general methods of determining structure with reference to citral, carvone, thymol, menthol and camphor. An elementary treatment of rubber.

**Alkaloids:** General methods of determining structure of alkaloids, classification with an acquaintance with the structure of alkaloids of IP, structure elucidation of ephedrine, nicotine and xanthine derivatives like caffeine, theobromine and theophylline.

**Books Recommended:**

2. Acheson, “An introduction to heterocyclic compounds”
3. Indian Pharmacopoeia.
4. Hendrikson, Organic Chemistry
B.PHARM. – III SEMESTER

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Pharmaceutical Microbiology

1. Introduction to the scope of microbiology, Historical background, Scope of Microbiology
2. Classification of microbes and their taxonomy. Actinomycetes, bacteria, rickettsiae, spirochetes and viruses.
3. Identification of microbes: stain and types of staining techniques, electron microscopy.
5. Control of microbes by physical and chemical methods
   A. Disinfection, factors influencing disinfectants, dynamics of disinfection, disinfectants, antiseptics and their evaluation.
   B. Sterilization: different methods, validation of sterilization methods and equipments.
   C. Clean area classification
6. Sterility testing of pharmaceutical products, preservative efficacy.
7. Microbial assay of antibiotics and vitamin B12.
8. Immunology and immunological preparations: principles, antigens and haptens, immune system, cellular and humoral immunity, immunological tolerance, antigen-antibody reactions and their applications.
9. Hypersensitivity, active and passive immunization products, their preparation, standardization and storage.
10. Bacterial enzymes: Techniques of immobilization of enzymes, kinetics and factors affecting enzyme kinetics. Study of enzymes such as hyaluronidase, penicillinase, streptokinase and streptodornase, amylases and proteases. Immobilization of bacteria and plant cells.

Books Recommended:

3. “Microbiology”- Davis, Dulbecco, Eisen.
7. N.K. Jain,“Pharmaceutical Microbiology” Vallabh Prakashan, Delhi.
10. Laboratory Manual of Bacteriology- Salle

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| Hours Per Week |

Commerce in Crude Drugs: Collection, preparation, drying and storage of drugs with special emphasis on factors influencing quality of drugs.

Classification and general treatment of alkaloids and glycosides of different categories including methods of isolations physico chemical properties and chemical tests for identification.

Systematic Study of Crude Drugs: Including synonyms, biological / geographical sources, identification, chemical constituents, chemical tests, uses, adulteration and evaluation of glycosidal and alkaloidal drugs of following groups:

- Anthraquinone glycosidal drugs: Senna, Aloe, Rhubarb, Cascara etc.
- Saponin glycosidal drugs: especially, Dioscorea, Solanum, Licorice, Senega, Ginseng.
- Cyanogenetic glycosidal drugs: Wild Cherry.
- Coumarins and Furancoumarin glycosidal drugs including Psoralea.
- Miscellaneous glycosidal drugs: Gentian, Quassia, and Saffron etc.
- Indole alkaloidal drugs : especially Ergot, Nux-vomica, Rauwolfia, Catharanthus.
- Isoquinoline alkaloidal drugs: including Ipecac, Opium, Curare.
- Tropane alkaloidal drugs: Stramonium, Hyoscyamus, Datura, Belladonna, Duboisia etc.
- Quinoline alkaloidal drugs: including Cinchona.
- Pyridine alkaloidal drugs: especially Areca, Lobelia, Nicotiana.
- Imidazole alkaloidal drugs: including Pilocarpus.
- Quinazoline alkaloidal drugs: including Vasaka.
- Steroidal alkaloidal drugs: especially Ashwagandha, Kurchi, Veratrum, Solanum.
- Proto-alkaloidal drugs: Ephedra, Colchicum etc.
- Terpenoid alkaloidal drugs: including Aconite.

Books Recommended:

1. Pharmacognosy: Trease and Evans
2. Pharmacognosy: Tyler and Brady
5. A Text Book of Pharmacognosy – T. E. Wallis
7. Pharmacopia of India
B.PHARM. – III SEMESTER

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<td>PHYSICAL PHARMACEUTICS</td>
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Hours per week

PHYSICAL PHARMACEUTICS

Practicals: 3 Hours/Week

1. Experiments based on phase rule,
2. Experiments based on dissolution and diffusion,
3. Experiments based on micromeritics,
4. Experiments based on rheology and thixotropy,
5. Experiments based on interfacial and surface tension,
6. Experiments based on colloids, suspensions, and emulsions,
7. Experiments based on complexation & drug protein binding,
8. Experiments based on compaction and compression,
9. Experiments based on crystallization.

Books Recommended:

1. Physical Pharmacy - Martin, Swarbrick & Cammarata.
2. Physical Pharmaceutics - Schotton
5. Chemical Engineering - Richardson and Coulson.
6. Introduction to Unit Operation - McCabe and Smith.
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Pharmaceutical Chemistry - IV (Chemistry of Natural Product)

Practicals: 3 Hours/Week

1. Identification of organic compounds from a binary mixture.
2. Study the importance of different physicochemical properties to identify and establish the purity of the natural products.
3. Analysis of oils.

Books Recommended:

2. Acheson, “An introduction to heterocyclic compounds”
3. Indian Pharmacopoeia.
4. Hendrikson, Organic Chemistry
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Pharmaceutical Microbiology

Practicals: 3 Hours/Week

Experiments devised to prepare various types of culture media, sub-culturing of common aerobic and anaerobic bacteria, fungus, and yeast, various staining methods, various methods of isolation and identification of microbes, sterilization techniques and their validation evaluation of antiseptics and disinfectants, testing the sterility of pharmaceutical products as per IP requirements, microbial assay of antibiotics and vitamin B₁₂.

Books Recommended:

3. “Microbiology”- Davis, Dulbecco, Eisen.
10. Laboratory Manual of Bacteriology- Salle
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<td>PHARMACOGNOSY AND PHYTOCHEMISTRY- II</td>
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Practicals: 3 Hours/Week

1. Identification and Evaluation of Representative Pharmacopia Drugs belonging to categories mention in theory in whole and powdered form by Morphology and Microscopy.

2. Phytochemical test for the crude drugs in mentioned in theory.

3. Extraction and isolation of important phytoconstituents including caffeine, piperine, solanaceous alkaloids, podophyllotoxin, sennosides, glycyrrhizine.


5. Study of Drugs of Herbal Museum.

Books Recommended:

1. Practical Pharmacognosy: C.K. Kokate and Purohit
2. Evaluation of Phytopharmaceuticals : Turner
3. Pharmacopia of India
4. Pharmacognosy: Trease and Evans
5. Pharmacognosy: Tyler and Brady
7. A Text Book of Pharmacognosy – T. E. Wallis
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\[\text{Total: } 20 \text{ L, 0 T, 20 Credits}\]

\[\text{Total: } 15 \text{ P, 05 Credits}\]

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B.PHARM. IV SEMESTER

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**Hours Per Week**

**Human Physiology and Pathophysiology of Common Diseases**

**Theory: 4h/week**

**Digestive system:** Gross anatomy 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 absorption and digestion of food. Disorders of digestive system.

**Respiratory system:** Anatomy of respiratory organs and its functions, respiration, mechanism and regulation of respiration, respiratory volumes and vital capacity.

**Central nervous system:** Function of different parts of brain and spinal cord. Neurohumoral transmission in the central nervous system, reflux action electroencephalopathy, specialized functions of the brain, cranial nerves and their function.

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

**Renal System:** Various parts, structures and functions of the kidney and urinary tract. Physiology of urine formation and acid base balance. Disease of the urinary system.

**Sense organs:** Basic physiology of the eye, ear, taste buds, nose and skin (superficial receptors).

**Reproductive systems:** Male and female reproductive systems, menstruation pathophysiology of sexually transmitted disease, spermatogenesis, oogenesis and pregnancy.

**Endocrine system:** anatomy and physiology of pituitary, thyroid, parathyroid, adrenal, pancreas, control of hormone secretion, pathophysiology of hypo and hyper secretion of endocrine glands and the disorders e.g. diabetes mellitus.

**Pathophysiology of disorders** related to digestive system peptic ulcers, ulcerative colitis, Crohns disease, Zollinger Ellison syndrome, hepatic disorders- hepatitis, cirrhosis of liver, pancreatitis. Pathophysiology of arthritis, gout, myasthenia gravis, spasticity, tetany. Fatigue, Pathophysiology of anemia, hypersensitivity, allergic conditions, psychosis, epilepsy, AIDS, Parkinson’s and Alzheimer’s disease and other neurodegenerative diseases, Pathophysiology of cataract and glaucoma.

**Books Recommended:**

1. C.C. Chatterjee. Human Physiology.
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**Dosage Form Design**

1. **Preformulation study:** (a) Study of physical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability.
   
   (b) Study of chemical properties of drugs like hydrolysis, oxidation-reduction, racemisation, polymerization etc. and their influence on formulation and strength of products, stabilization and stability testing protocol provision pharmaceutical products.
   
   (c) Study of prodrugs in solving problems related to stability, bioavailability and elegance of formulation.

2. **Polymer sciences:** Introduction, classification and pharmaceutical applications of polymers, Polymers as thickening agents, Preparing polymer solutions, Phase separation, Gel formation, Mechanical properties of polymeric films, Future trends in pharmaceutical and other biomedical uses of polymers.


4. **SOP for different dosage forms:** Introduction and purpose of SOPs, benefits and types of SOPs, SOP development and format. SOP of oral liquids, tablet and capsule manufacturing.

5. **Optimization techniques in pharmaceutical operation and processes:** Introduction, optimization parameters, methods used for optimization, applications of optimization.


7. **Mixing:** Mechanism of mixing, equipment and selection, solid-solid, solid-liquid and liquid-liquid mixers used in pharmaceutical industry.

8. **Material for construction of Pharmaceutical Plant:** The nature, properties and uses of important materials employed in the construction of plants. Corrosion heat and corrosion resistant alloys and other materials, methods of reducing corrosion, protective coating.

**Books Recommended:**


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**Pharmaceutical Biotechnology**

**Theory: 4h/week**

1. **Active, Passive immunization:** Vaccines, types of Vaccines and principle involved, 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 Activase, Humulin, Humatrope, HB etc.

3. **Antibiotics:** Historical development of antibiotics. Antimicrobial spectrum and methods used for their standardization. Screening of soil for organisms producing antibiotics, fermenter, its design, control of different parameters. Isolation of mutants, factors influencing rate of mutation. Design of fermentation process. Isolation of fermentation products with special reference to penicillins, streptomycins tetracyclines and vitamin B12.

4. **Microbial Transformation:** Introduction, types of reactions mediated by microorganisms, design of biotransformation processes, selection of organisms, biotransformation process and its improvements with special reference to steroids.

5. **Enzyme immobilization:** Techniques of immobilization, factors affecting enzyme kinetics. Study of enzymes such as hyaluronidase, penicillinas, streptokinase and streptodornase, amylases and proteases etc. Immobilization of bacteria and plant cells.

6. Historical development of plant tissue culture, types of tissue cultures, their nutritional requirements, growth and main features, Applications of plant tissue culture in pharmacy.

**Books Recommended:**


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**Pharmaceutical Analysis I**

**Theory: 4h/week**

- The course shall cover-computation of analytical results, Significant figures, Concept of error, Precision and Accuracy, Standard deviations, Rejection of doubtful values with special reference to volumetric and gravimetric analysis, Calibration of analytical equipments. Fundamentals of volumetric analysis, method of expressing concentrations, primary and secondary standards.
- Fundamentals of following volumetric analysis techniques-

**Acid Base Titrations:** Acid base concepts, Role of solvents, Relative strengths of acids and bases, Ionization, Law of mass action, Common ion effect, Ionic product of water, pH, Hydrolysis of salt, Henderson-Hesselbach equation, buffer solutions, Neutralization curve, Acid-base indicators, Choice of indicators, mixed indicators, polyprotic systems, polyamine and amino acid systems, amino acid titration, differential titration, Assay of sodium carbonate, sodium hydroxide etc.

**Oxidation Reduction Titration:** Concept of oxidation and reduction, Oxidation numbers, Half reactions, Strength and equivalent weight of oxidizing and reducing agents, Theory of redox titrations, Redox indicators. Redox titrations Principles and Techniques using potassium permanganate, potassium dichromate, Ceric sulphate, Iodine-iodate, Bromide-bromate, Titanous chloride solutions.

**Precipitation Titrations:** General discussion, theory of indicators, argentimetric titrations, ammonium thiocyanate-silver salt titrations, Mohr’s method, Volhard’s method and Fajan’s method.

**Gravimetric Analysis:** Principle of gravimetric analysis, typical methods involving precipitation, coagulation, incineration and digestion, procedures.

**Group Estimations:** Determination of aldehyde, ketones, hydroxyl, phenolic, carboxylic acid, methoxy groups as applied to photochemicals.

**Use of Polarimetry, Refractometry** in analysis of drugs.

**Books Recommended:**

4. Pharmacopoeia of India.
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**Pharmacy Practice (Dispensing and Community Pharmacy)**

**Theory: 4h/week**

1. **Prescription:** Definition, parts, handling, sources of errors in prescriptions, knowledge of latin terms commonly used in prescription writing and their translation into English. Modern concepts of dispensing pharmacy.

2. **Compounding of medication:** Powders, Tablets, Capsules, Tablet triturates, Pills, Lozenges, Ointments, Creams, Pastes, Jellies, Suppositories, Suspensions, Emulsions, Mixtures, Sprays, Inhalations, Paints. Labeling of dispensed products.

3. **Incompatibility:** Physical, chemical and therapeutic incompatibilities and their corrections.

4. **Radiopharmaceuticals:** Radioactivity and radionuclide, Production of radiopharmaceuticals, Radioactive decay, Measurement of radiation, Radiopharmaceutical dosage forms, methods of radiation detection, radiopharmaceutical having therapeutic/diagnostic applications, storage and handling of radiopharmaceutical products. Environmental control and protection against exposure to radiopharmaceuticals.

5. **Community pharmacy:** Introduction and management. Community Pharmacy Organization and structure of retail and wholesale drug store- types of drug stores and design - Legal requirements for establishment, maintenance of drug store, Dispensing of proprietary products, Maintenance of records of retail and wholesale.

6. **Inventory Control in community Pharmacy:** Definition, various methods of inventory control. ABC, VED, EOQ, Lead time, safety, stock.


8. **Health education:** WHO definition, health promotion care of child, pregnant & breast feeding women and geriatric patient, role of pharmacist in family planning. Prevention of communicable diseases i.e., tuberculosis, hepatitis, leprosy, AIDS, syphilis, gonorrhea.

**Books Recommended:**


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Hours Per Week

**Human Physiology and Pathophysiology of Common Diseases (Practical)**

**Practical: 3h/week**

1. Study of different systems with the help of charts and models.
2. Microscopic study of different tissues.
3. Study of surgical instruments.
4. Recording of body temperature by various techniques.

**Books Recommended:**

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**Dosage Form Design (Practical)**

**Practical: 3h/week**

- Experiments on polymer science, mixing and standard operational procedure.

**Books Recommended:**

8. Pharmacopoeia of India, 1996, Controller of Publication. Ministry of Health and Family Welfare, Govt. of India. Delhi,
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Hours Per Week

**Pharmaceutical Biotechnology (Practical)**

**Practicals: 3h/week**

1. Estimation of the given protein sample by UV spectrophotometric method.
2. Preparation of standard curve of given protein by UV spectrophotometric, Lowry and Bradford method and determine the concentration of given protein sample by all the three methods.
3. Isolation and characterisation of DNA from cheek cell.
4. Preparation of standard curve of DNA by UV spectrophotometric method and determine its concentration and purity of given protein sample.
5. Isolation and characterization of DNA from onion.
6. Fermentation from yeast cell and determination of the concentration of ethanol produced.
7. Preparation and sterilization of nutrient broth and agar medium.
8. Aseptic transfer.
10. Immobilization of given enzymes in alginate beads.
11. Elucidate the effect of temperature pH and substrate concentration on enzyme activity.
12. Comparison of the activity of enzyme in its native and immobilized form.
13. Preparation of culture media its sterilization and performing plant tissue culture.

**Books Recommended:**

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**Pharmaceutical Analysis I (Practical)**

**Practicals: 3h/week**

The students should have a clear understanding of the principle and working of a typical analytical balance, the requirements of a good balance, precautions to be taken during handling of a balance, methods of weighing and errors in weighing sensitivity of a two pan, one pan and a top pan balance. The students should also be acquainted with the use of appropriate apparatus for various analytical procedures.

- Study of balances and its parts (both mechanical & electrical).
- Calibration of glasswares and weights to be used narrating their importance.
- Preparation and standardization of acids and bases.
- Analysis of Mixtures of Carbonates.
- Preparation, standardization and storage of KMnO₄, Iodine, Bromine, Cerric ammonium sulphate.
- Uses of the above mentioned chemicals for analysis of drugs.

Practicals involving:

1. Potassium permanganate, Iodine, Bromine, Cerric ammonium sulphate and Titanous chloride (redox Titrations).
2. Argentimetric titration (Precipitation methods).

**Books Recommended:**

4. Pharmacopoeia of India.
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**Pharmacy Practice (Dispensing and Community Pharmacy) (Practical)**

**Practical: 3h/week**

Practice in Dispensing of not less than 100 prescriptions comprising of Solutions, Mixtures, Powders, Tablets, Capsules, Lozenges, Ointments, Creams, Pastes, Jellies, Suppositories, Suspensions, Emulsions, Sprays, Inhalations, Paints, Incompatibilities.

**Books Recommended:**