

BACHELORS DEGREE IN PHARMACY**ACADEMIC REGULATIONS****1. Duration of the Course**

The duration of the Bachelors degree in Pharmacy course shall be of four academic years, with each academic year spread over a period of at least 25 weeks excluding the days spent in the examinations.

2. Eligibility for admission

- (a) No candidate shall be admitted to B.Pharm first year unless he/she has passed Senior Higher Secondary Certificate Examination (Standard-XII of the Board or an examination recognized by the University as equivalent thereto) in all the optional subjects and the compulsory subjects (Physics, Chemistry and Biology / Mathematics / Biotechnology / Computer Science).

Admission of candidates to B.Pharm first year shall be made as per the rules / directions of the central admission authority / State Government.

(b) **Lateral entry to Diploma holders in B.Pharm second year**

Lateral entry in B.Pharm second year is allowed to the students who have passed a Diploma in Pharmacy course with a minimum of 50% marks in aggregate from an AICTE and PCI approved institution. In addition to sanctioned intake at first year level, 10% of the sanctioned intake will be reserved for such lateral entry. The admission through lateral entry in B.Pharm second year shall be made as per the rules / directions of the central admission authority/State Government.

3. Candidates for the Bachelor of Pharmacy course shall be instructed and examined as per the Teaching and Examination Scheme and Course Content of respective year. The medium of instruction and examination shall be English.

4. Eligibility for appearing in the examination

- (a) No candidate shall be allowed to appear in any examination unless he / she has attended 75% of the classes held in each theory and practical separately in each subject.
- (b) A candidate who has been admitted to B.Pharm first year and has attended a regular course of study in an affiliated college shall be eligible to appear at B.Pharm first year examination of the University.
- (c) A candidate who has been promoted to B.Pharm Second year as per the provisions for conditions of passing or has been admitted directly to B.Pharm second year through lateral entry and has attended as regular course of study in an affiliated college shall be eligible to appear at B.Pharm second year examination of the University.
- (d) A candidate who has been promoted to B.Pharm third year as per the provisions for conditions of passing and has attended a regular course of study in an affiliated college shall be eligible to appear at B.Pharm third year examination of the University.
- (e) A candidate who has been promoted to B.Pharm final year as per the provisions for conditions of passing and has attended a regular course of study in an affiliated college shall be eligible to appear at B.Pharm final year examination of the University.

5. Sessional examinations (Internal assessment)

The sessional marks in each theory and practical subject shall be awarded out of a maximum of 20 marks in the following manner:

(a) *Theory sessional (20 marks):*

At least two written tests of 20 marks each in every theory subject shall be conducted by the institute at regular interval during each academic year. The average of best two performances shall be taken into consideration for computation of theory sessional marks. Duration of each written test shall be of one hour.

(b) *Practical sessional (20 marks):*

The sessional marks in practicals shall be computed on the basis of the performance in the practical test (10 marks) and day-to-day assessment (10 marks) in the practical class.

(i) *Practical test (10 marks):*

At least two practical tests of 10 marks each in every subject shall be conducted by the institute at regular interval during each academic year. The average of best two performances shall be taken into consideration for computation of practical test marks. Duration of each practical test

shall be same as prescribed for practical class in respective practical subject. Each practical test may be conducted in different parts, viz., synopsis/spotting, exercise/experiment and viva-voce etc.

- (ii) Day-to-day evaluation of practical work (10 marks):
The concerned teacher shall make the evaluation of day-to-day practical work in the laboratory on the basis of the performance of the candidate and maintenance of practical record.
- (c) The regular record of marks of sessional examinations and that of professional training as well as of project conducted at an affiliated college shall be maintained for each student and that must be submitted to the university before the commencement of university examination.
- (d) A candidate failing in any of the subjects shall have a chance to improve his / her sessional marks both in theory and practical by appearing in one additional sessional examination. The aggregate of best two performances from all the sessionals shall form the basis of calculating the average for computation of improved sessional marks. Marks for day to day assessment in the practicals cannot be improved unless a candidate attends a regular course of study again.

6. University Examination:

There shall be a main and a supplementary university examination in a year for B.Pharm first year, second year, third year and final year. Main examination shall be held in the month of March/April or on such dates as may be fixed by the University. Supplementary examination shall be conducted within 30 days of the declaration of the result or on such dates as may be fixed by the university.

7. Professional Training and Project:

(a) Professional training:

Every candidate, after the completion of B.Pharm Part-III or B.Pharm Part-IV course, shall undergo practical training in a training center (Pharmaceutical Manufacturing Unit / Analytical Laboratory / Bulk Drug Manufacturing Unit / Hospital Pharmacy / Drug store) allotted by the institute. The professional training shall be of not less than 200 hours to be covered in not less than one month. Candidate shall prepare and submit two copies of training report in prescribed format printed or type written in bound form. One copy is to be submitted to the institute on or before the prescribed date for evaluation and one copy to be retained by the candidate for his / her own reference. The report shall contain the certificate of training from the Head of the respective training center and shall be duly accepted and certified by the Head of the institution.

Marks for professional training shall be awarded on the basis of training report, interview and viva voce by a board consisting of training in-charge and one examiner (appointed by the Head of the institution) and the Head of the institution or his nominee who shall be the chairman of the board.

b) Project:

Before the end of B.Pharm Part-III, for each candidate, a project supervisor shall be appointed by the Head of the institution. The candidate shall choose a project topic in consultation with the supervisor. A synopsis on the project topic should be prepared in the prescribed format and submitted to the Head of the institution for approval. Candidate shall carry out literature survey on the approved topic during B.Pharm Part-IV under the guidance of the supervisor.

Candidate shall prepare three copies of his / her project report in prescribed format printed or type written in bound form. One copy is to be submitted to the institute and one to the supervisor on or before the prescribed date for evaluation and one copy to be retained by the candidate for his/her own reference. The project report should contain a copy of approved synopsis and certificate from the supervisor, certifying that the work has been undertaken and written under his/her supervision and guidance and meets the requirements of the course, countersigned and duly forwarded by the Head of the institution.

Marks for project shall be awarded on the basis of project report, seminar and viva voce by a board consisting of supervisor, one examiner (appointed by the Head of the institute) and the Head of the institute or his nominee who shall be the chairman of the board.

8. Conditions of Passing:

- (a) No candidate shall be declared as having passed in a subject unless he / she has secured 50% of the maximum marks in the university and sessional examination marks put together in each theory and practical subject. Each theory and practical shall be considered as separate subject. In B.Pharm final year, professional training and project shall be considered as separate subjects.
- (b) A candidate who has failed in more than three subjects in B.Pharm first year examination will not be allowed to pursue courses for B.Pharm second year. Such candidate will be allowed to appear as

an ex-student in the university examination of subsequent batch of B.Pharm first year in the failing subjects.

- (c) A candidate who has failed in not more than three subjects in B.Pharm first year examination will be allowed to appear in the supplementary examination of B.Pharm first year in the failing subjects. Candidates failing in any subject in the supplementary examination will be allowed to appear as an ex-student in the university examination of subsequent batch of B.Pharm first year in the failing subjects.
- (d) A candidate who has passed in all the subjects of B.Pharm first year will be promoted to B.Pharm second year.
- (e) A candidate who has failed in more than three subjects in B.Pharm second year examination will not be allowed to pursue courses for B.Pharm third year. Such candidate will be allowed to appear as an ex-student in the university examination of subsequent batch of B.Pharm Part-II in the failing subjects.
- (f) A candidate who has failed in not more than three subjects in B.Pharm second year examination will be allowed to appear in the supplementary examination of B.Pharm second year in the failing subjects. Candidates failing in any subject in the supplementary examination will be allowed to appear as an ex-student in the university examination of subsequent batch of B.Pharm second year in the failing subjects.
- (g) A candidate who has passed in all the subjects of B.Pharm second year will be promoted to B.Pharm third year.
- (h) A candidate who has failed in more than three subjects in B.Pharm third year examination will not be allowed to pursue courses for B.Pharm final year. Such candidate will be allowed to appear as an ex-student in the university examination of subsequent batch of B.Pharm third year in the failing subjects.
- (i) A candidate who has failed in not more than three subjects in B.Pharm third year examination will be allowed to appear in the supplementary examination of B.Pharm third year in the failing subjects. Candidates failing in any subject in the supplementary examination will be allowed to appear as an ex-student in the university examination of subsequent batch of B.Pharm third year in the failing subjects.
- (j) A candidate who has passed in all the subjects B.Pharm third year will be promoted to B.Pharm final year.
- (k) A candidate who has failed in more than three subjects in B.Pharm final year examination will be allowed to appear as an ex-student in the university examination of subsequent batch of B.Pharm final year in the failing subjects.
- (l) A candidate who has failed in not more than three subjects in B.Pharm final year examination will be allowed to appear in the supplementary examination of B.Pharm final year in the failing subjects. Candidates failing in any subject in the supplementary examination will be allowed to appear as an ex-student in the next university examination of B.Pharm final year in the failing subjects.
- (m) A candidate, who is unable to appear at any examination in any subject(s) due to any reason whatsoever, shall be considered as having failed in that subject(s).
- (n) In no case, will a candidate, who has not passed finally after 8 academic years from the year of admission, will be allowed to continue the course.

9. Award of Degree, Division and Rank:

- (a) After passing the final examination, a candidate shall be awarded B.Pharm degree.
- (b) The division to a successful candidate shall be awarded on the basis of aggregate of marks obtained by him / her in B.Pharm first year, B.Pharm second year, B.Pharm third year, and B.Pharm final year examinations regardless of the number of attempts, as shown below:

Percentage of marks	Division
75% or above	Honors
60% or above	First Division
50% or above	Second Division

- (c) The division to a successful candidate admitted directly to B.Pharm second year, shall be awarded on the basis of aggregate percentage of marks obtained in B.Pharm second year, B.Pharm third year and B.Pharm final year examinations regardless of the number of attempts.
- (d) Rank shall be conferred on the basis of aggregate percentage of marks obtained in all the four years to those candidates who have passed the whole examination in first attempt. For those admitted directly to B.Pharm second year, the rank shall be conferred on the basis of aggregate percentage of marks obtained in all the three years to those candidates who have passed the whole examination in first attempt.

Teaching and Examination scheme

B.Pharm First Year

Paper No.	Subject	Teaching hrs. per week	Univ. exam. hrs.	Marks		
				Sessi onal	Univ. Exam	Total
B.Ph. 101T	Pharmaceutical Inorganic Chemistry, Theory	2	3	20	80	100
B.Ph. 102P	Pharmaceutical Inorganic Chemistry, Practical	3	3	20	80	100
B.Ph. 103T	Pharmaceutical Biochemistry & Clinical Pathology, Theory	2	3	20	80	100
B.Ph. 104P	Pharmaceutical Biochemistry & Clinical Pathology, Practical	3	3	20	80	100
B.Ph. 105T	Dispensing Pharmacy, Theory	2	3	20	80	100
B.Ph. 106P	Dispensing Pharmacy, Practical	3	3	20	80	100
B.Ph. 107T	Pharmaceutical Technology-I, Theory	2	3	20	80	100
B.Ph. 108P	Pharmaceutical Technology-I, Practical	3	3	20	80	100
B.Ph. 109T	Pharmaceutical Biology and Introductory Pharmacognosy, Theory	3	3	20	80	100
B.Ph. 110P	Pharmaceutical Biology and introductory Pharmacognosy, Practical	3	3	20	80	100
B.Ph. 111T	Human Anatomy, Physiology and Health Education, Theory	3	3	20	80	100
B.Ph. 112P	Human Anatomy, Physiology and Health Education, Practical	3	3	20	80	100
B.Ph. 113T	Pharmaceutical Jurisprudence, Theory	2	3	20	80	100
B.Ph. 114T	Pharmacy Practice, Theory	2	3	20	80	100
	Total	36	42	280	1120	1400

B.Pharm Second Year

Paper No.	Subject	Teaching hrs. per week	Univ. exam. hrs.	Marks		
				Sessi onal	Univ. Exam	Total
B.Ph. 201T	Pharmaceutical Organic Chemistry, Theory	3	3	20	80	100
B.Ph. 202P	Pharmaceutical Organic Chemistry, Practical	3	3	20	80	100
B.Ph. 203T	Chemistry of Natural Drugs, Theory	3	3	20	80	100
B.Ph. 204P	Chemistry of Natural Drugs, Practical	3	3	20	80	100
B.Ph. 205T	Physical Pharmacy, Theory	2	3	20	80	100
B.Ph. 206P	Physical Pharmacy, Practical	3	3	20	80	100
B.Ph. 207T	Pharmaceutical Engineering, Unit Operations and Engineering Drawing, Theory	3	3	20	80	100
B.Ph. 208P	Pharmaceutical Engineering, Unit Operations and Engineering Drawing, Practical	3	3	20	80	100
B.Ph. 209T	Pharmacology-I and Pathophysiology, Theory	2	3	20	80	100
B.Ph. 210T	Computer Applications, Theory	2	3	20	80	100
B.Ph. 211P	Computer Applications, Practical	3	3	20	80	100
B.Ph. 212T	Mathematics and Bio-Statistics, Theory	3	3	20	80	100
	Total	33	36	240	960	1200

B.Pharm. Third Year

Paper No.	Subject	Teaching hrs. per week	Univ. exam. hrs.	Marks		
				Sessi onal	Univ. Exam	Total
B.Ph. 301T	Pharmaceutical Analysis, Theory	2	3	20	80	100
B.Ph. 302P	Pharmaceutical Analysis, Practical	3	3	20	80	100
B.Ph. 303T	Medicinal Chemistry-I , Theory	3	3	20	80	100
B.Ph. 304P	Medicinal Chemistry-I, Practical	3	3	20	80	100
B.Ph. 305T	Pharmaceutical Microbiology and Biotechnology, Theory	3	3	20	80	100
B.Ph. 306P	Pharmaceutical Microbiology and Biotechnology, Practical	3	3	20	80	100
B.Ph. 307T	Pharmaceutical Formulation, Theory	2	3	20	80	100
B.Ph. 308P	Pharmaceutical Formulation, Practical	3	3	20	80	100
B.Ph. 309T	Hospital & Community Pharmacy, Theory	2	3	20	80	100
B.Ph. 310T	Pharmacology –II and Pathophysiology, Theory	3	3	20	80	100
B.Ph. 311P	Pharmacology-II and Pathophysiology, Practical	3	3	20	80	100
B.Ph. 312T	Pharmacognosy-I, Theory	3	3	20	80	100
B.Ph. 313P	Pharmacognosy-I, Practical	3	3	20	80	100
	Total	36	39	260	1040	1300

B.Pharm Final Year

Paper No.	Subject	Teaching hrs. per week	Univ. exam. hrs.	Marks		
				Sessi onal	Univ. Exam	Total
B.Ph. 401T	Instrumental Analysis, Theory	2	3	20	80	100
B.Ph. 402P	Instrumental Analysis, Practical	3	3	20	80	100
B.Ph. 403T	Medicinal Chemistry-II, Theory	3	3	20	80	100
B.Ph. 404P	Medicinal Chemistry-II, Practical	3	3	20	80	100
B.Ph. 405T	Dosage Form Design and Cosmeticology, Theory	2	3	20	80	100
B.Ph. 406P	Dosage Form Design and Cosmeticology, Practical	3	3	20	80	100
B.Ph. 407T	Biopharmaceutics & Pharmacokinetics, Theory	2	3	20	80	100
B.Ph. 408P	Biopharmaceutics & Pharmacokinetics, Practical	3	3	20	80	100
B.Ph. 409T	Pharmacology –III and Clinical Pharmacy, Theory	3	3	20	80	100
B.Ph. 410P	Pharmacology-III and Clinical Pharmacy, Practical	3	3	20	80	100
B.Ph. 411T	Pharmacognosy-II, Theory	3	3	20	80	100
B.Ph. 412P	Pharmacognosy-II, Practical	3	3	20	80	100
B.Ph. 413T	Pharmaceutical Industrial Management, Theory	2	3	20	80	100
B.Ph. 414P	Project	1	-	50	-	50
B.Ph. 415P	Professional Training	*	-	50	-	50
	Total	36	39	360	1040	1400

* Professional training to be carried out for 400 Hrs as per clause 7 of academic regulations.

B.Pharm First year

B.Ph. 101T	Pharmaceutical Inorganic Chemistry	50 Hrs
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Unit-I

- 1. Structure and properties:** Atomic structure, atomic orbitals, valence bond theory, molecular orbital theory, wave equation, molecular orbital, bonding and anti-bonding orbitals, covalent bonds, hybrid orbitals, intermolecular forces, bond dissociation energy, polarity of bonds, polarity of molecules, structure and physical properties, intermolecular forces.
- 2. Accuracy & precision:** Accuracy and precision, classification of errors, minimization of errors, rejection of doubtful values, significant figures & computations.
- 3. Acids, Bases and Buffers:** Acids & bases : Hydrochloric Acid, Sulphuric Acid, Nitric Acid, Phosphoric Acid, Sodium Hydroxide, Strong Ammonia Solution. Buffers: An introduction, pharmaceutical buffer selection, pharmaceutical buffer system
- 4. Sources of impurities in pharmaceutical substances.**
An outline of preparation, properties, uses, tests for purity and identification, including limit tests for Iron, Arsenic, Lead, Heavy metals, Chloride, Sulphate and the special tests if any, of the following classes of inorganic pharmaceuticals included in the Indian Pharmacopoeia 1996.

Unit-II

- 5. Gastrointestinal agents: Acidifying agents:** Dilute hydrochloric acid.
Antacids: Sodium bicarbonate, Aluminum hydroxide gel, Calcium carbonate, Tri basic calcium phosphate, Milk of magnesia, Magnesium oxide, Magnesium trisilicate.
Protective and adsorbents: Bismuth subcarbonate, Bismuth subnitrate, Kaolin, Activated charcoal.
Cathartics: Sodium carboxy methylcellulose, Bisacodyl, Sodium phosphate, Potassium sodium tartrate.
- 6. Topical agents: Protectives:** Talc, Zinc oxide, Calamine, Zinc stearate, Titanium dioxide.
Astringents: Alum, Aluminium Sulphate.
Anti-microbial agents: Hydrogen peroxide, Potassium permanganate, Iodine, Silver nitrate, Boric acid, Chlorinated lime, Borax, Sodium antimony gluconate.
- 7. Complexing and chelating agents:** Disodium edetate, Dimercaprol.

Unit-III

- 8. Major intra - and extra-cellular electrolytes:** Major physiological ions. Electrolytes used for replacement therapy, acid-base balance and electrolyte combination therapy - Sodium chloride and its preparations, Potassium chloride and its preparation, Calcium chloride, Calcium lactate, Calcium gluconate, Zinc Sulphate, Sodium acetate, Potassium acetate, Sodium bicarbonate, Sodium dihydrogen phosphate dihydrate, Sodium citrate.
- 9. Essential and trace elements:** Transition elements and their compounds of pharmaceutical importance:
Iron and haematinic- Ferrous Sulphate, Ferrous gluconate, Ferrous fumarate, Iron-dextran injection, Ferric ammonium citrate.
Mineral supplements.
- 10. Dental products:** Dentrifrices, anti-caries agents- Sodium fluoride, Calcium carbonate, Dicalcium phosphate.

Unit-IV

- 11. Miscellaneous agents: Sclerosing agents.**
Expectorants- Ammonium chloride, Potassium iodide.
Emetics.
Antidotes- Sodium nitrite, Sodium Thiosulphate, Activated charcoal, Light Kaolin,
Anti-oxidants- Sodium metabisulphite, Sodium bisulphite.
Waters - Purified water, water for injection and sterile water for injection.
- 12. Inorganic radio pharmaceuticals:** Nuclear radio pharmaceuticals, reactions, nomenclature, methods of obtaining their standards and units of activity, measurements of activity (G.M. counters), clinical applications and dosage, hazards and precautions & radioimmuno assay.
Biological applications of radioactive drug: cobalt compounds, gold compounds., iodine preparations, phosphorous preparations. Radio opaque contrast media Barium Sulphate.
- 13. Gases & vapours**
(a) Inhalant - Oxygen
(b) Anesthetic gas- Nitrous oxide

Unit-V

- 14. Titrimetric analysis –** Theoretical considerations, classification of reactions in titrimetric analysis, standard solutions, primary and secondary standards.
Aqueous acid – base titration – Neutralization, indicators, universal indicators, assay of sodium bicarbonate, sodium carbonate, ammonia solution, boric acid, ammonium chloride.
Oxidation – reduction titrations including iodometry & iodimetry – Introduction, determination of the end point in oxidation reduction titrations, assay of ferrous sulphate, hydrogen peroxide solution, iodine solution, chlorinated lime and copper-sulphate.

B.Ph. 102P	Pharmaceutical Inorganic Chemistry	75 Hrs
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1. Introduction to the use and care of apparatus & equipment.
2. Limit tests & test for purity of pharmaceutical substances. The background and systematic qualitative analysis of inorganic mixture of upto four radicals. Six mixtures to be analyzed, preferably by semi micro methods. All qualitative identification tests for pharmacopoeial inorganic pharmaceuticals.
3. Preparation and standardization of 0.1 N hydrochloric acid solution.
4. Preparation and standardization of 0.1 N sodium hydroxide solution.
5. Assay of sodium hydroxide, sodium bicarbonate, sodium carbonate, strong ammonia solution.
6. Estimation of the mixtures of hydroxide and carbonate, hydroxide and bicarbonate and carbonate and bicarbonate.
7. Preparation and standardization of 0.1 N potassium permanganate solution.
8. Assay of ferrous sulphate, hydrogen peroxide
9. Preparation and standardization of 0.1 N solution of ceric ammonium sulphate.
10. Estimation of using ceric ammonium sulphate as standard.
11. Preparation and standardization of 0.1 N solution of sodium thiosulphate and iodine solution.
12. Assay of copper sulphate, iodine solution, chlorinated lime and other iodimetric analysis.
13. Other assays and estimations based on theory.

B.Ph. 103T	Pharmaceutical Biochemistry and Clinical Pathology	50 Hrs
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Unit-I

1. **Foundation of biochemistry:** Cellular, chemical, physical, genetic, evolutionary, transport process across cell membrane.
2. **Enzymes:** Properties, Nomenclature, Classification, Mechanism of action, kinetics, Michaelis Menten equation, enzyme inhibition, factor affecting enzyme action, iso-enzymes, co-enzymes, metalloenzymes, allosteric-enzymes, regulatory enzymes, clinical and therapeutic uses of enzymes.

Unit-II

3. **Vitamins:** Classification and biological importance of vitamin A, vitamin D, vitamin E, vitamin K, vitamin B-complex and ascorbic acid.
4. **Carbohydrates:** Properties, classification, metabolism-glycolysis, citric acid cycle, hexose monophosphate shunt, uronic acid pathway, gluconeogenesis, glycogenolysis, glycogenesis, glyoxylate cycle, regulation of metabolism, metabolism of fructose, galactose, abnormalities of carbohydrate metabolism, qualitative identification tests.

Unit-III

5. **Lipids:** Properties, classification, storage of lipids, structural lipids in membranes, lipids as signals, cofactors and pigments, digestion, mobilization and transport of fats, oxidation of glycerol, oxidation of fatty acids, ketone bodies, biosynthesis of fatty acids, eicosanoids, triglycerides, phospholipids, cholesterol, steroids, isoprenoids, regulation of fatty acids metabolism, phospholipids, sphingolipids, eicosanoids, abnormalities of lipid metabolism, qualitative identification tests.
6. **Biological oxidation:** Redox-potential, enzymes and co-enzymes involved in oxidations, reduction and its control, respiratory chain, its role in energy capture and its control, energetics, and mechanism of oxidative phosphorylation, inhibitors of respiratory chain.

Unit-IV

7. **Amino acids, peptides and proteins:** Properties, structure, classification, three-dimensional structure of proteins – primary, secondary, tertiary and quaternary, functions of protein-reversible binding of protein to a ligand, complementary interactions between proteins and ligands, protein interactions modulated by chemical energy, catabolism of amino acids, biosynthesis of amino acids, urea cycle, biosynthesis of porphyrin and bile pigments, regulation and abnormalities of metabolism of amino acids, peptides and proteins, qualitative identification test of amino acids and proteins.
8. **Nucleic acids:** Brief introduction of genetic organization (genes and chromosomes), structure and chemistry of nucleic acids, biosynthesis of purine and pyrimidine, biosynthesis and degradation of nucleotides, biosynthesis and replication of DNA, biosynthesis of RNA, mutagenesis, qualitative identification test of RNA and DNA.

Unit-V

9. **Genetic code and protein biosynthesis:** Genetic code, protein biosynthesis and its inhibition, regulation of gene expression – principles, regulation in prokaryotes and eukaryotes.
10. **Clinical pathology:**
 - i) Lymphocytes and platelets: role in health and disease
 - ii) Erythrocytes: Role, abnormal cells and their significance
 - iii) Liver and kidney: Functions, normal and abnormal constituents of urine and their significance, kidney and liver function tests.
11. **Metabolic effects of insulin and glucagon.**

B.Ph. 104P	Pharmaceutical Biochemistry and Clinical Pathology	75 Hrs
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1. Qualitative identification test for carbohydrates, lipids, proteins, amino acid and nucleic acids.
2. Quantitative estimation of amino acids.
3. Quantitative estimation of proteins.
4. Identification of c-terminal amino acids of protein.
5. Determination of glucose by means of enzyme glucose oxidase.
6. Isolation and assay of glycogen from the liver and skeletal muscle of rats.
7. Enzyme hydrolysis of glycogen by alpha and beta amylases.
8. Isolation and determination of RNA and DNA.
9. Effect of temperature on activity of alpha amylase.
10. Estimation of SGOT, SGPT, ALP and BRN in the serum.
11. Examination of sputum and faeces (microscopic & staining).
12. Practice in injecting drugs by intramuscular, subcutaneous and intravenous routes, Withdrawal of blood samples.

B.Ph. 105T	Dispensing Pharmacy	50 Hrs
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Unit-I

1. **Introduction:** Definition, general dispensing procedure, introduction to different dosage forms with examples, sources of information including different pharmacopoeias, labeling of different preparations, containers and closures, storage, Latin terms.
2. **Prescription:** Definition, various parts, handling and sources of errors.

Unit-II

3. **Pharmaceutical calculations:** Metric system (weights and measures), enlarging and reducing of recipes, isotonic solutions, alcohol dilutions, alligation method, proof spirit, percentage solution, displacement value.
4. **Posology:** Definition, factors influencing doses, calculation of doses.

Unit-III

5. **Incompatibility:** Definition, physical, chemical (including double decomposition and other chemical reactions), therapeutic and methods of correction.

Unit-IV

6. **Principles involved and procedure adopted in dispensing of:** Typical prescriptions like mixtures, syrups, elixirs, linctuses, liniments, lotions, colloidions, gargles, mouthwashes, throat paints, douches, enemas, eardrops, nasal drops, nasal sprays, inhalations, ophthalmic and sterile dosage forms.

Unit-V

7. **Principles involved and procedure adopted in dispensing of:** Typical prescriptions like suspensions, emulsions, ointments, creams, pastes, jellies, poultices, suppositories, powders, pills, pastilles, lozenges, capsules, granules, cachets, tablet triturates and compressed tablets.

B.Ph. 106P	Dispensing Pharmacy	75 Hrs
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1. Dispensing of prescriptions falling under the categories: Mixtures, solutions, emulsions, creams, ointments, powders, suppositories, ophthalmics, capsules, pastes, jellies, pastilles, lozenges, pills, tablet triturates, lotions, liniments, inhalations, paints, etc.
2. Identification of various types of incompatibilities in prescriptions, correction thereof and dispensing of such prescriptions.
3. Dispensing procedures involving pharmaceutical calculations, pricing of prescriptions and dosage calculations for pediatric and geriatric patients.
4. Dispensing of prescriptions involving adjustment of tonicity.
5. Categorization and storage of pharmaceutical products based on legal requirements of labeling and storage.
6. Project report on visit to the nearby community for counseling on the rational use of drugs and aspects of health care.

B.Ph. 107T	Pharmaceutical Technology-I	50 Hrs
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Unit-I

1. **Semisolid Dosage Forms:** Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection, general formulation of semisolid bases, clear gels manufacturing procedure, evaluation and packaging.
2. **Suppositories:** Ideal requirements, bases, manufacturing procedure, packaging and evaluation.

Unit-II

- 3. Extraction and galenical products:** Principle and method of extraction, percolation, maceration, continuous hot extraction, preparation of infusion, tincture, dry and soft liquid extracts.

Unit-III

- 4. Liquid Dosage Forms:** Introduction, types of additives used in formulations, Vehicles, stabilisers, preservatives, suspending agents, emulsifying agents, solubilisers, colors, flavours and the others, manufacturing packaging and evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia.

Unit-IV

- 5. Pharmaceutical Aerosols:** Definition, propellants, general formulation, method of preparation, packaging and containers, evaluation
- 6. Ophthalmic preparations:** Requirements of formulation, methods of preparation, containers, evaluation.

Unit-V

- 7. Blood Products and Plasma Substitutes:** Collection, processing of storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human normal immunoglobulins, human fibrin foam, plasma substitutes- ideal requirements, PVP, dextrans etc.

B.Ph. 108P	Pharmaceutical Technology-I	75 Hrs
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- Preparation, evaluation and packaging of liquid orals like solutions, suspensions and emulsions, ointments, suppositories, aerosols, eye drops, eye ointments etc.
- Preparation of pharmacopoeial extracts and galenical products utilizing various methods of extraction.
- Collection processing, storage and fractionation of blood.

B.Ph. 109T	Pharmaceutical Biology and introductory Pharmacognosy	75 Hrs
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Unit-I

- Scope and significance of biology in pharmaceutical sciences. Methods of classification of plants.
- Plant cell, its structure and non-living cell inclusions; mitosis and meiosis; different types of plant tissues and their functions. Morphology, histology and uses different part of such as root, stem, bark, wood, leaf, flower, fruit and seeds.
- Techniques in microscopy: Various tools used in microscopy (microscopes, micrometers, camera lucida, microphotography etc.) preparation of drugs for microscopical examination, general use of different reagents used in microscopy. Quantitative microscopy: Lycopodium spore method and leaf constants viz. stomatal number, stomatal index, vein-islet number, vein-termination number and palisade ratio.

Unit-II

- 4. Plant taxonomy:** Study of the following families with special reference to medicinally important plants- Apocynaceae, Solanaceae, Rutaceae, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Graminae, Labiatae, Cruciferae, Papaveraceae. Cultivation, collection, processing and storage of crude drugs. Factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Pest management and natural pest control agents.

Unit-III

- Definition, history, scope and development of Pharmacognosy. Sources of drugs: Biological, marine, mineral and plant tissue cultures as sources of drugs. Classification of drugs: Alphabetical, morphological, taxonomical, chemical and pharmacological classification of drugs.
- 6. Carbohydrates and derived products:** Agar, guar gum, acacia, honey, isabgol, pectin, starch, sterculia and tragacanth.

Unit-IV

- General survey of animal kingdom; structure and life history of parasites like amoeba, entamoeba, trypanosoma, plasmodium, taenia, ascaris and schistosoma. General structure and life history of insects like mosquito, housefly, mites and silkworm.
- 8. Lipids:** Bees wax, castor oil, cocoa butter, cod-liver oil, hypnocarpus oil, kokum butter, lard, linseed oil, rice bran oil, shark liver oil and wool fat.

Unit-V

- 9. Quality control of crude drugs:** Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation. An introduction to active constituents of drugs: Their isolation, classification and properties.
- Plant hormones and their application. Polyploidy, mutation and hybridization with reference to medicinal plants.

B.Ph. 110P	Pharmaceutical Biology and introductory Pharmacognosy	75 Hrs
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1. Morphology of plant parts indicated in theory.
2. Care, use and types of microscopes.
3. Gross identification of slides of structure and life cycle of lower plants, animals mentioned in theory.
4. Preparation, microscopic examination of stem, root and leaf of monocot and dicot plants.
5. Structure of human parasites and insects mentioned in theory with the help of specimen & charts.
6. Morphological characteristics of plant families mentioned in theory.
7. Microscopic measurements of cells and cell contents: Starch grains, calcium oxalate crystals and phloem fibers.
8. Determination of leaf constants such as stomatal index, stomatal number, vein-islet number, vein-termination number and palisade ratio, lycopodium spore method.
9. Identification of crude drugs belonging to carbohydrates and lipids.
10. Preparation of herbarium sheets.

B.Ph. 111T	Human Anatomy, Physiology and Health Education	75 Hrs
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Unit-I

1. Scope of anatomy & physiology, definition of various terms used in Anatomy.
Structure of cell, functions of its components.
Elementary tissues of human body: epithelium, connective, muscular and nervous.
Structure and functions of skeleton & joints: classification, movement and disorders of joints.
2. **Skeletal muscles:** name, position and functions of various muscle: Neuromuscular junction: Physiology of muscle contraction.

Unit-II

- Blood:** Composition and functions of blood elements, blood group and coagulation of blood.
Lymph nodes: Their position, name and functions. Lymph: Its composition and functions.
3. **Cardiovascular system:** Structure and functioning of Heart: Heart sounds, cardiac cycle various blood vessels: Arteries supplying to different parts and veins collecting blood from different parts. Blood pressure and its regulation.

Unit-III

4. **Digestive system:** Gross Anatomy and functions of various parts of alimentary canal including pancreas and liver. Composition and functions of various juices used in digestion. Role of vitamins in body.
Respiratory system: Anatomy of various parts of respiratory system. Physiology and regulation of respiration.

Unit-IV

- Urinary system:** Various parts of urinary system. Structure and functions of Kidney. Physiology of urine formation.
5. **Nervous system:** Brain and spinal cord: Structure and functions of different parts. Reflex action. Physiology of nerve impulse transmission. Nerves: Cranial and spinal nerves: Anatomy and physiology of Autonomic nervous system. Neurotransmitters: Name, their release and physiological role
Reproductive system: Male and female reproductive organs: their position and functions.

Unit-V

6. **Endocrinal glands:** Names, position and functions. Physiological role of hormones secreted by various glands viz. Adrenal, Thyroid, Parathyroid, Pituitary, Pancreas, Thymus, Ovary and testis.
Elementary knowledge of sense organs for taste, smell, vision and hearing. Skin: structure and functions.
7. **Health education:** Concept of health and disease, Definition, Dimensions and determinants of health, indicators of health, balanced diet, First aid treatment of shock and snake bite. Family Planning, Immunization schedule, concept of prevention of diseases, modes of intervention, Common infectious diseases and their prevention.

B.Ph. 112P	Human Anatomy, Physiology and Health Education	75 Hrs
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1. To record pulse, B.P., heart rate and temperature.
2. To estimate haemoglobin Content and oxygen Carrying capacity of blood sample.
3. To count RBC in blood sample.
4. To count total WBC in blood sample.
5. To prepare slide for differential leucocyte count.
6. To find out erythrocyte sedimentation rate.
7. To find out bleeding time and clotting time.
8. To study digestive system with the help of model and chart.
9. To study liver with the help of model and chart
10. To study urinary system with the help of model and chart.

11. To study kidney with the help of model and chart.
12. To study Heart with the help of model and chart.
13. To study respiratory system with the help of model and chart..
14. To study Brain with the help of model and chart.
15. To study Eye with the help of model and chart.
16. To study Ear with the help of model and chart.
17. To study spleen with the help of model and chart.
18. To study male reproductive system with the help of model and chart.
19. To study female reproductive system with the help of model and chart.
20. To study Arterial system with the help of model and chart.
21. To study venous system with the help of model and chart.
22. To study Bones of limbs chart.
23. To study vertebral column chart.
24. To study bones of skull.
25. To study Bones of ribs.
26. To study various histological slides.
27. To record respiratory parameters in an individual by using spirometer.
28. Physiological experiments on (muscle nerve preparation).

B.Ph. 113T	Pharmaceutical Jurisprudence	50 Hrs
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Unit-I

1. Origin, development, scope, objectives and nature of pharmaceutical legislation in India. Evolution of the "Concept of Pharmacy" as an integral part of the health care system. Principles and significance of professional ethics. Critical study of the code of pharmaceutical ethics drafted by Pharmacy Council of India. Pharmaceutical education - A brief review.

Pharmacy Act, 1948 – The general study of the Pharmacy Act with special reference to Education Regulations, working of State and Central Councils, constitutions and functions of these councils, registration procedures under the Act.

Unit-II

2. The Drugs and Cosmetics Act, 1940 & Rules 1945 – General study of the Drugs and Cosmetics Act and the Rules there under. Definitions and salient features related to retail and wholesale distribution of drugs. The powers of inspectors, the sampling procedures and the procedure and formalities in obtaining licences under the rule. Facilities to be provided for running a Pharmacy effectively. General study of the schedules with special reference to schedules C, C₁, F, G, J, H, P and X and salient features of labeling and storage conditions of drugs.

AICTE Act, 1987 - A brief study.

Unit-III

3. An elaborate study of the following (as amended to date)
 - (a) Drugs (Price Control) Order
 - (b) Medicinal and Toilet Preparations (Excise Duties) Act, 1955
 - (c) Poisons Act 1919
 - (d) Patents Act 1970

Narcotic Drugs and Psychotropic Substances Act, 1985 – A brief study of the Act with special reference to its objectives, offences and punishment.

Unit-IV

4. A brief study of the following with special reference to the main provisions (as amended to date)
 - (a) Medical Termination of Pregnancy Act, 1970 & Rules 1975
 - (b) Prevention of Cruelty to Animals Act, 1960
 - (c) Essential Commodities Act

The Drugs and Magic Remedies (Objectionable Advertisement) Act, 1954 – General study of the Act, objectives, special reference to be laid on advertisements, magic remedies and objectionable and permitted advertisement and diseases which cannot be claimed to be cured.

Unit-V

5. A brief study of the following with special reference to the main provisions
 - (a) States Shops and Establishments Act & Rules.
 - (a) Factories Act, 1948
 - (b) Minimum Wages Act, 1948

Drugs & Pharmaceutical Industry – A brief review.

B.Ph. 114T	Pharmacy Practice	50 Hrs
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Unit-I

1. **Introduction:** Trade, industry and commerce, functions and subdivision of commerce.
Forms of business organizations.
Drug house management: Selection of location of drug store, layout and legal requirements, chain store.
2. **Material management:** Importance and objectives of purchasing, selection of suppliers, credit information, tenders, contracts and price determination and legal requirements thereto.
Storage: General principles, codification, handling of drug store and other hospital supplies.
Inventory control: Objectives and importance, modern techniques like ABC, VED analysis, the lead time, inventory carrying cost, safety stock, minimum and maximum stock levels, economic order quantity, scrap and surplus disposal.

Unit-II

3. **Sales promotion:** Salesmanship, qualities of salesman, literature detailing, advertising and window display.
Recruitment, selection, orientation, training, evaluation and compensation of the Pharmacist.
4. Channels of distribution, buying, selling, transportation, storage, wholesale, retail, departmental store, multiple shop, mail order business with special reference to Indian marketing environment.

Unit-III

5. Banking and finance service and functions of bank, finance planning and sources of finance.
Cost accounting: Cost ascertainment, various elements of cost sheet preparation, statement of cost.

Unit-IV

6. **Accountancy:** Introduction to the accounting concepts and conventions, double entry book keeping, different kinds of accounts, recording of transactions-journal, cash book, ledger, trial balance, profit and loss account, balance sheet, computation of various ratios and analysis of financial statements.

Unit-V

7. **Budgeting:** Meaning importance and types of budgets. Elementary knowledge of preparing sales, cash, production and flexible budgets.

B.Pharm Second Year

B.Ph. 201T	Pharmaceutical Organic Chemistry	75 Hrs
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Unit-I

- Stereochemistry:** Isomerism, stereoisomerisms, optical activity, enantiomers, diastereomers, meso compounds, chirality, racemic modification & its resolution, configuration (R&S, D&L, d&l), sequence rules, conformational isomers.
Rotation about C-C single bond, conformation due to rotation, Vander waals repulsion, stereochemical reaction (selective & specific), syn and anti addition and elimination.

Unit-II

- Reactions:** Definition, reaction, mechanism, applications of all the following reactions - S_N1 & S_N2 reactions, E1 & E2, reactions, electrophilic & free radical addition reactions, markonikov rule and antimarkonikov rule.

Unit-III

- Reactions:** Definition, reaction, mechanism, applications of all the following reactions – aldol and claisen condensations, Wittig reaction, wolf-kishner reduction, clemmensen reduction, cannizaro and crossed cannizaro reaction, perkin condensation, Grignard synthesis, wurtz reaction, Williamson ether synthesis, fischer esterification, Diels alder reaction.
- Aromatic Compounds:** Structure of benzene and its derivatives, aromaticity, resonance theory, stability of benzene ring and huckle rule.

Unit-IV

- Aliphatic compounds:** Structure, nomenclature, preparation, physical properties and chemical reactions of aliphatic compounds: dienes, α , β - unsaturated carbonyl compounds, cycloalkanes. Aliphatic and aromatic alcohols, ethers, esters, carboxylic acids, aldehydes and ketones, phenols and amines.

Unit-V

- Reactions:** Electrophilic aromatic substitution, nucleophilic acyl substitution, friedal crafts alkylation and acylation, kolbe's synthesis, reimer tieman reaction, hoffmann reaction, Diazotization reaction and coupling reactions of amines.
- Poly nuclear hydrocarbons:** Structure, nomenclature, preparation and reactions $\alpha\phi$ -naphthalene, anthracene and phenanthrene.

B.Ph. 202P	Pharmaceutical Organic Chemistry	75 Hrs
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- Basic Laboratory Techniques
- To find out melting and boiling point of given samples.
- To carry out elemental detection in given organic samples.
- To carry out identification reactions of known functional groups.
- To identify unknown organic compounds and submit their derivatives.

B.Ph. 203T	Chemistry of Natural Drugs	75 Hrs
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Unit-I

- Heterocyclic Compounds (Single and fused rings):** Structure, nomenclature, preparations, chemical reactions of pyrrole, furan, thiophene, imidazole, pyrazole, pyridine, piperazine, pyrimidine, purine, indole, benzimidazole, quinoline, isoquinoline (important medicinal derivatives under each class should be discussed)

Unit-II

- Carbohydrates:** Structure, detailed chemistry, properties and reactions of mono, di and poly saccharides and qualitative analysis of carbohydrate.
- Cardiac Glycosides** Source, chemistry, biogenesis and pharmacological activity of digitoxin, digoxin, diosgenins, strophanthidin and sennosides.

Unit-III

- Lipids:** Classification & composition of fats and oils, properties, determination and significance of acetyl value, acid value, saponification and iodine value.
- Amino acids, Peptides and proteins:** Structure, classification, properties & reactions of amino acids, nomenclature of peptide and protein, solid phase peptide synthesis, classifications of proteins and levels of protein structure and protein denaturation.

Unit-IV

- Nucleic acids:** Nucleosides & nucleotides structure of RNA and DNA and biological importance of nucleic acids.

- 7. Terpenoids & Terpenes:** Sources, classification and structural elucidation and pharmacological activity of menthol, camphor, citral.
- 8. Antibiotics:** Source, chemistry and therapeutic activity of natural penicillins, streptomycins and tetracyclines.

Unit-V

- 9. Alkaloids:** Source, general classifications, chemistry and structural elucidation and pharmacological activity of atropine, quinine, reserpine, morphine, papavarine, ephedrine, ergot and vinca alkaloids.
- 10. Lignans and Flavonoids:** Chemistry and biogenesis of medicinally important lignans and flavonoids.
- 11. Vitamins:** Source, chemistry and uses of vitamins of plant origin.

B.Ph. 204P	Chemistry of Natural Drugs	75 Hrs
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- Synthesis of heterocyclic compounds like coumerine, furan derivatives, barbiturate and other related heterocyclic compounds.
- Qualitative analysis of natural products like carbohydrates, proteins, fats, alkaloids, glycosides.
- Analysis of fats and oils (acid value, iodine value, acetyl value, ester value, saponification value).

B.Ph. 205T	Physical Pharmacy	50 Hrs
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Unit-I

- 1. Matter, properties of matter:** State of matter, change in the state of matter, latent heats and vapor pressure, sublimation-critical point, eutectic mixtures, gases, aerosols-inhalers, relative humidity, liquid. Complexes, liquid crystals, glassy state, solids-crystalline, amorphous and polymorphism. Thermal analysis(DSC,DTA,TGA)
- 2. Behaviour of Gases:** Kinetic theory of gases, deviation from behaviours and explanation.
- 3. Kinetics and drug stability:** General considerations and concepts, half – life determination, influence of temperature, light, solvent, catalytic species and other factors, accelerated stability study, expiration dating.
- 4. Diffusion and Dissolution:** Diffusion, dialysis, ultra-filtration, fick 's first law of diffusion, fick's second law of diffusion, dissolution rate, powder dissolution-hixson crowell cube root law, drug release from polymer and granular matrices, diffusion of drug through GIT membrane, pH partition hypothesis

Unit-II

- 5. Dispersion systems:** Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy; Suspensions and emulsions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations, Donnan membrane equilibrium; Emulsions-types, theories, physical stability.

Unit-III

- 6. Complexation:** Classification of complexes, methods of preparation and analysis, applications.
- 7. Buffers:** Buffers equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. Henderson Hesselbalch equation, influence of solvents on the solubility of drugs, combined effect of pH and solvents, preservation, action of weak acids, distribution of solutes between immiscible solvents, effect of ionic dissociation and molecular association on partition co-efficient & drug action.

Unit-IV

- 8. Surface and interfacial phenomenon:** Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid-gas and solid-liquid interfaces, complex films, electrical properties of interface.
- 9. Viscosity and rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant and plastic flow; thixotropy in formulation, determination of viscosity; capillary, falling ball, rotational viscometers.

Unit-V

- 10. Micromeritic and powder rheology:** Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.
- 11. Solubility & distribution phenomenon:** Solubility, factors affecting solubility, expression of solubility, dissolution rate, solvent-solute interaction, polar and non-polar solvents, solubility of gases in liquid, liquid in liquid, effect of pressure, temperature, salting-out, chemical reasons, solubility calculations, ideal and real solution, colligative properties and mol. wt. determinations, miscibility, influence of foreign substances, dielectric constant and solubility, solubility of solid in liquids, ideal and non ideal solutions, solution and association in solution, solubility of slightly soluble and electrolytes.

B.Ph. 206P	Physical Pharmacy	75 Hrs
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- Determination of latent heat, vapor pressure, critical point.
- Studies on polymorphs, their identification and properties.
- Determination of particle size, distribution and surface area using various methods of particle size analysis.
- Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
- Determination of surface/ interfacial tension, HLB value and critical micellar concentration of surfactants.
- Study of rheological properties of various types of systems using different viscometers.
- Study of different types of colloids and their properties.
- Preparation of various types of suspensions and determination of their sedimentation parameters.
- Preparation and stability studies of emulsions.
- Studies on different types of complexes and determination of their stability constants.
- Determination of half-life, rate constant and order of reaction.
- Study of influence of various factors on the rate of reaction.
- Accelerated stability testing, shelf-life determination and expiration dating of pharmaceuticals.
- Preparation of pharmaceutical buffers and determination of buffer capacity.
- Experiments involving tonicity adjustments.
- Determination of the heat of solution, heat of hydration and heat of neutralization.
- Determination of rate constant of simple reaction.
- Determination of partition coefficient.
- Determination of solubility.

B.Ph. 207T	Pharmaceutical Engineering, Unit Operations and Engineering Drawing	75 Hrs
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Unit-I

- Unit Operations:** Introduction, basic laws.
- Material of construction:** General study of composition, corrosion, resistance, Properties and applications of the materials of construction with special reference to glass, plastics and metals, corrosion.
- Material Handling Systems:**
 - Liquid handling – Different types of pumps.
 - Gas handling – Various types of fans, blowers and compressors.
 - Solid handling – Different types of conveyers.

Unit-II

- Fluid Flow:** Types of flow, Reynolds number, Bernoulli's theorem, energy losses, basic equation of fluid flow, valves, measurement of flow.
- Filtration and centrifugation:** Theory of filtration, factors affecting filtration, filter aids, filter media, industrial filters including filter leaf, filter press, rotary filter, edge filter. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimenters.
- Size reduction, size separation, drying, compression and compaction.

Unit-III

- Dehumidification and humidity control:** Basic concepts and definition, wet bulb and adiabatic saturation temperatures, Psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipments for dehumidification operations.
- Refrigeration and air conditioning:** Principal and applications of refrigeration and air conditioning.
- Heat Transfer:** Applications, modes of heat transfer, Fourier's law, film coefficients, Boltzmann's law, heat exchangers and heat interchangers.

Unit-IV

- Evaporation:** Theory, factors affecting evaporation, efficiency of evaporators, natural circulation types – evaporating pans and stills, short tube evaporators, forced circulation type – long tube evaporators, wiped film evaporators, evaporation under reduced pressure.
- Distillation:** Theory and applications, simple distillation, flash distillation, fractional distillation, steam distillation, molecular distillation, azeotrope distillation, distillation under reduced pressure. Preparation of purified water IP and WFI IP, construction and working of the still used for the same.
- Mixing:** Theory of mixing, solid-solid mixing, solid-liquid and liquid-liquid mixing, mixing of semisolids, equipments used in mixing.

Unit-V

- Crystallization:** Theory of crystallization, characteristics of crystals like-purity, size, shape, geometry, habit, forms size and factors affecting them, solubility curves and calculation of yields, study of various types of crystallizers – agitated batch crystallizer, Swenson walker crystallizer, krystal crystallizer, vacuum crystallizer, caking of crystals and its prevention.
- Industrial Hazards and Safety Precautions:** Mechanical, chemical, electrical, fire and dust hazards and accident records.
- Automated process control systems:** Introduction to automatic process system and elements of automatic process control, measurement of variables like temperature, pressure level and vacuum.

B.Ph. 208P	Pharmaceutical Engineering, Unit Operations and Engineering Drawing	75 Hrs
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1. Measurement of flow of fluids and their pressure, determination of Reynold's number and calculation of frictional losses.
2. Evaluation of filter media, determination of rate of filtration and study of factors affecting filtration.
3. Experiments to demonstrate applications of centrifugation.
4. Thermometers and psychrometric charts, determination of humidity – use of dry bulb and wet bulb.
5. Determination of overall heat transfer coefficient.
6. Experiment to study the influence of various parameters on rate of evaporation.
7. Experiments based on steam, extractive and azeotropic distillation.
8. Determination of rate of drying, free moisture content and bound moisture content.
9. Experiments to illustrate principles of size reduction and size separation, laws governing energy and power requirements of size reduction.
10. Experiments to illustrate solid-solid mixing, determination of mixing efficiency using different types of mixers.
11. Basic engineering drawing practice; drawing of simple pharmaceutical machinery parts – bolts, nuts, riveted fronts, screws, worm screws as per specification.

B.Ph. 209T	Pharmacology – I and Pathophysiology	50 Hrs
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Unit-I

1. **General Pharmacology:** Introduction to pharmacology, sources of drugs, dosage forms. Routes of administration, mechanism of drug action, dynamic of drug absorption, distribution, metabolism and excretion. Theories of receptors, dose response relationship, affinity constants.
2. Factors affecting dose and effect of a drug. Adverse drug reactions, drug interactions. Drug evaluation.

Unit-II

3. Autocoids:
 - a. Histamine, 5HT and their antagonists.
 - b. Prostaglandins, Thromboxanes and Leukotrienes, Platelet activating factors.
 - c. Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin and substance P.
 - d. Nitric oxide.
 - e. Free radicals.
4. Endocrine system:
 - a. Hypothalamic hormone and Pituitary hormones.
 - b. Thyroid and anti thyroid drugs, Parathormone, Calcitonin.
 - c. Corticosteroids.
 - d. Gonadal hormones (sex hormones) and their antagonists.
 - e. Drugs affecting calcium balance.
 - f. Insulin, oral hypoglycaemic agents and glucagons.
 - g. Oxytocic drugs and uterine relaxants.

Unit-III

5. **Drugs acting on Peripheral nervous system:**
 - a. Skeletal muscle relaxants.
 - b. Local anaesthetics.
6. **Drugs acting on central nervous system:**
 - a. General anaesthetics.
 - b. Alcohol.
 - c. Narcotic and Non-narcotic analgesics.
 - d. Antiepileptics.
 - e. Sedatives and hypnotics.

Unit-IV

7.
 - a. C.N.S. stimulants and cognitive enhancers.
 - b. Antiparkinson drugs.
 - c. Psychopharmacological drugs (antipsychotics, antianxiety, anti-depressants)
 - d. Drugs used in gout and rheumatoid arthritis.
8. Pathophysiology of following diseases: Rheumatoid arthritis, gout, epilepsy, psychosis, depression, mania.

Unit-V

9. **Pathophysiology of following common diseases:** Basic principle of cell injury and adaptation: Causes of cellular injury, pathogenesis, morphology of cell injury. Intercellular alterations in lipids, proteins and carbohydrates, cellular adaptation, atrophy and hypertrophy.

Basic mechanism involved in the process of inflammation and repair: Alterations in vascular permeability and blood flow, migration of WBCs, acute and chronic inflammation, mediators of inflammation, brief outline of the process of repair.

B.Ph. 210T	Computer Applications	50 Hrs
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Unit-I

1. Data, Need of Data Processing, Information & its Need, Levels of information, Quality of information, Comparison of manual & electronic storage of data.
Introduction to computer: Brief history of development of computers, computer system concept, computer system characteristics, capabilities and limitations, Applications in general and pharmacy in particular.
Elements of computer systems: The architecture of a computer system, CPU – ALU, CU, Memory – Primary and Secondary, Input/Output and Storage Devices - Keyboard, Magnetic Tape, Magnetic Disk, Monitor, Printer, Floppy Disk, Hard Disk.
2. Peripheral devices — mouse, OCR, OMR, MICR, scanner, monitor, Printers – impact and non-impact printers – DMP, daisy wheel, line and drum printers, ink-jet and laser printers, plotters. Types of computers – Analog, Digital, Hybrid, General, Special, Purpose, Micro, Mini, Mainframe, Super, Personal computer (PCs) – Configuration, Pentium and Newer PCs specifications and main characteristics, types of PCs – Desktop, Laptop, Notebook, Palmtop, Workstations etc. – their characteristics.

Unit-II

3. Software, Types of Software – System Software, Application Software, Introduction to operating systems MS-DOS, Windows, Linux etc. Concept of programming, programming languages. Types of computer languages, Machine, Assembly, high level language. Examples & areas of use of various high level language & their features. Language translators : Comparative study, assembler, compiler, Interpreter.
Introduction to networking, concept of LAN and WAN. Internet Technology : Concept, e-mail services, browsers, search engines, WWW, HTML, Introduction to e-commerce, advantages & growth.

Unit-III

4. Windows 95/98: Windows concepts, Features, Windows Structure, Desktop, Taskbar, Start menu, My Computer, Recycle Bin, Windows Accessories – Calculator, Notepad, Paint, Wordpad, Character Map, Windows Explorer, Entertainment, Managing Hardware & Software, System Tools, Communication, Sharing Information between programs. Word Processing : MS-Word — Features, Creating, Saving and Opening Documents in Word, Interface, Toolbars, Ruler, Menus, Keyboard Shortcut, Editing, Previewing, Printing & Formatting a Document, Advanced Features of MS Word, Find & Replace, Using Thesaurus, Using Auto – Multiple Functions, Mail Merge, Handling Graphics, Tables & Charts, Converting a word document into various formats like – Text, Rich Text format etc.

Unit-IV

5. Electronic Spread Sheet– MS–Excel — Worksheet basics, creating worksheet, entering data into worksheet, heading information, data, text, dates, alphanumeric, values, saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and menus, Keyboard shortcuts, Working with single and multiple workbook, working with formulae & cell referencing, Auto sum, Coping formulae, Absolute & relative addressing, Working with ranges, formatting of worksheet, Previewing & Printing worksheet, Graphs and charts, Database, Creating and using macros, Multiple worksheets – concepts, creating and using.
6. Presentation Graphics (MS-PowerPoint) : introduction, various uses, creating and saving presentation, creating slides – different types of slides, different views of slides, editing and formatting slides, backgrounds, inserting pictures from files, presentation shows, animation, customization of slides.

Unit-V

7. Introduction to Databases with MS-Access: What is database, uses, hardware requirement, types, use of form, reports, query and simple code generation.
8. Introduction to internet: History, requirements, e-mail, search engines, websites and web servers, basics of html, scientific information retrieval using databases, search engines, pubmed, patent databases

B.Ph. 211P	Computer Applications	75 Hrs
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1. Study of Operating System – Windows.
 - (a) To test some of the basic systems operations on files/ folders.- create, rename, cut, copy, paste, delete.
 - (b) To use accessories available in Windows
2. Study of Different Software available in Windows.
 - (a) Exercises based on word-processing – creating documents, writing text in paragraph etc.
 - (b) Writing Informal letter, Formal letter, writing reports on current topics, writing news, writing article, creating brochure

3. Exercises based on electronic worksheet – creating sheet, entering data, applying formulae, functions on cells etc.
4. Application of absolute and relative referencing on data
5. Creating reports based on the experiments done in laboratories.
6. Searching of scientific information using database Pubmed, Searching of scientific information from patent databases, Searching of scientific information using search engines scholar.google.com and scirus.com
7. E-mail, creating of account, drafting, sending, attachments
8. Database creation, modification, searching of information, data input using forms, report creation, simple query process

B.Ph. 212T	Mathematics and Biostatistics	75 Hrs
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Unit-I

1. Sets, relations and functions equation of straight line. Calculus of finite differences Finite different, difference table finite difference operator and their properties.
2. Linear equation and matrices, solution of linear programming problems by graphical method and simplex method.

Unit-II

3. Transportations and assignment problems. Theory of games, queuing theory: One length, waiting time in Poisson que.

Unit-III

4. Differential calculus limits continuity and differentiability. Differentiation: Basic fundamental theorems on differentiation, differentiation of trigonometric and hyperbolic function (including inverse trigonometric and hyperbolic function), logarithmic differentiation. Partial differentiation.
5. Integral Calculus: Integration as inverse process of differentiation. Integration by substitution, integration by parts integration of algebraic functions.

Unit-IV

6. Differential equations: Formation, order and degree of a differential equation. Differential equation of first order and first degree, linear differential equation with constant coefficients. Homogeneous linear differential equations.
7. Laplas and inverse laplas transforms and their properties. Evaluation of laplas and inverse laplas transforms of simple functions (including higher transcendental functions) Application of laplas and its inverse to solve linear ordinary differential equation.

Unit-V

8. Bio-statistics: Tables and graphs 'Life tables' only, Linear correlation coefficient, Pearson's assumptions and causality; Regression of Y on X and X on Y, standard error estimate, Correlation coefficient: Linear and curvilinear correlation; Sampling: Non Probability and probability samples, Sampling distribution, confidence intervals, computing 99% and 95% fiducial limits from tables of areas and ordinates of normal curve. Probability rules, binomial experiments, 'Z' score computing 't' tests and analysis of variance. All calculation should be illustrated with examples from true laboratory pharmacological experimental models.

B.Pharm. Third year

B.Ph. 301T	Pharmaceutical Analysis	50 Hrs
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Unit-I

- 1. Pharmaceutical Analysis:** Types of analytical methods, different types of instrumental methods and the physical/chemical property used, data domains, criteria for analytical method selection, performance characteristics of instruments viz. precision, bias, sensitivity, LOD, LOQ, LOL, selectivity, calibration of instruments.
- 2. Non-aqueous Acid-base Titrations:** Non-aqueous acid – base chemistry, solvents for non-aqueous titrations, leveling solvents, indicators for non-aqueous titrations, determination of organic acid & base in non aqueous media, assay of phenobarbitone, benzocaine, dapsone, sodium amino salicylate, sulphamethoxazole, sulphathiazole etc.
- 3. Redox Titration:** Theory of redox reaction, balancing the redox reaction equation, types of indicators in redox titration, end-point determination in redox titration, iodometry, iodimetry, bromometry, Nernst equation, electrodes and their types, potentiometric method of end-point determination, assay of FeSO₄, H₂O₂, Iodine solution, chlorinated lime, copper sulphate.

Unit-II

- 4. Complexometric Titration:** Introduction, stability of complexes, factors influencing the stability of complexes, types of E.D.T.A. titrations, assay of calcium gluconate, magnesium sulphate, zinc sulphate.
- 5. Precipitation Titration:** Introduction, precipitation reactions, determination of endpoint in precipitation reactions. assay of sodium chloride injection, yellow mercuric oxide.

Unit-III

- 6. Gravimetric Analysis:** Introduction, precipitation methods, conditions of precipitation, filtration & washing of the precipitate, drying and ignition of the precipitate, assay of sodium sulphate, magnesium sulphate.
- 7. Diazotization Titration:** Introduction, theory of diazotization reaction, assay of sulfamethoxazole, benzocaine, dapsone, sodium amino salicylate.

The theoretical aspects, basic instruments & applications of the following analytical techniques should be discussed.

Unit-IV

- 8. Potentiometry and Conductometry**

Unit-V

- 9. Amperometry, coulometry and polarography**

B.Ph. 302P	Pharmaceutical Analysis	75 Hrs
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1. Calibration of weights and measures.
2. To prepare and standardize E.D.T.A. solution.
3. To estimate metal ions like calcium, magnesium, zinc and others.
4. To estimate mixture of cations.
5. To carry out the assay of calcium carbonate, magnesium sulphate, zinc sulphate and other cations by complexometric titrations.
6. To prepare and standardize acetous perchloric acid solution.
7. To estimate and perform assay of given organic bases.
8. To prepare and standardize sodium methoxide solution.
9. To estimate and perform assay of given organic acids.
10. To carry out the assay of sodium sulphate and magnesium sulphate by gravimetric analysis.
11. Acid -base and redox titration by using potentiometer.
12. Acid -base titration by using pH-meter.
13. Acid -base titration by using conductometer.
14. To carry out the estimation of given samples by using polarography.

B.Ph. 303T	Medicinal Chemistry-I	75 Hrs
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Unit-I

- 1. Principles of medicinal chemistry:** Physico-chemical aspects (solubility, partition coefficient, optical, geometrical and bioisosterism, ionization, hydrogen binding, chelation, redox-potential and surface activity) of drug molecule and biological action. Drug receptor interaction including transduction mechanism.
- 2. Drug metabolism:** General pathways of drug metabolism, sites of drug biotransformation, role of cytochrome P-450, oxidative reactions, reductive reactions, hydrolytic reactions, conjugation reactions, factor affecting drug metabolism.

Unit-II

3. **Prodrug and drug latention:** Basic concepts, prodrugs of functional groups, bioprecursor prodrugs, chemical delivery systems.
The following topics shall cover classification, nomenclature, S.A.R., synthesis, physicochemical properties, metabolism and therapeutic uses of drugs mentioned under each category. (Biochemical approaches in drug design wherever applicable should be discussed. A brief introduction of latest drugs under each category should also be discussed)
4. **Steroids:** Structure, nomenclature and conformational analysis, steroidal hormones – progesterone, osterone, testosterone, oral contraceptives, glucocorticoids-cortisone, hydrocortisone, betamethasone, prednisolone, steroidal glycosides-digoxin, digitoxin, ouabin.
5. **Vitamins:** Classification, detailed chemistry and biological importance of vitamin A, vitamin D, vitamin E, vitamin K, vitamin B-complex and ascorbic acid.

Unit-III

6. **Chemotherapeutic agents: Antimicrobial agents.**
- (i) **Antiseptics and disinfectants:** Chlorophene, hexachlorophene, povidone-iodine, chloramines-T, thiomersal, benzalkonium chloride, cetyl pyridinium chloride, gentian violet, chlorhexidine, chlorxylenol, chlorocresol.
- (ii) **Antibacterial:**
Sulphonamides: Sulphacetamide, sulphadiazine, sulphadimidine, sulphafurazole, sulphamethoxazole, sulphamethoxy pyridazine, succinyl sulphathiazole, phthalylsulphathiazole, sulphaguanidine, sulphisoxazole, sulfadoxine, salphasalazine.
Antibiotics: Beta-lactum antibiotics (penicillins and cephalosporines), aminoglycosides– streptomycin, gentamycin, tobramycin, amikacin, tetracyclines, macrolides– erythromycin, roxithromycin, azithromycin, quinolones – nalidixic acid, norfloxacin, ciprofloxacin, ofloxacin, sparfloxacin, levofloxacin, gemifloxacin and miscellaneous– chloramphenicol, clindamycin, polymyxin, vancomycin, bacitracin, cycloserine.
Antitubercular agents: Isoniazid, rifampicin, pyrazinamide, ethambutol, streptomycin, ethionamide, thiacetazone, PAS.
Antileprotic agents: Dapsone, clofazimine.
- (iii) **Antifungal agents:** Amphotericin-B, Flucytosine, ketoconazole, itraconazole, fluconazole, voriconazole, griseofulvin, clotrimazole, tolnaftate, naftifine, nystatin.

Unit-IV

- (iv) **Antiviral and anti-HIV agents:** Vidarabine, Acyclovir, cidofovir, famciclovir, foscarnet, ganciclovir, idoxuridine, amantadine, zanamivir, adefovir, interferons, lamivudine, zidovudine, didanosine, stavudine, nevirapine, saquinavir, amprenavir, HIV protease inhibitors.
7. **Chemotherapeutics agents: Parasitic infections**
- (i) **Antimalarials:** Quinine, chloroquine, amodiaquine, quinacrine, primaquine, pyrimethamine, proguanil, artemisinin, artemether, atovaquone.
- (ii) **Antiamoebic agents:** Diloxanide furoate, metronidazole, tinidazole, di-iodohydroxy quinoline, emetine.
- (iii) **Anthelmintics:** Thiabendazole, albendazole, benzimidazole, mebendazole, diethylcarbamazine, praziquantel, pyrantel pamoate, niclosamide, levamisol.

Unit-V

8. **Chemotherapeutics agents: Antineoplastics** – cytophosphamide, chlorambucil, melphalan, carmustine, altretamine, thiotepa, dacarbazine, procarbazine, cisplatin, methotrexate, 6-mercaptopurine, capecitabine, cytarabine, gemcitabine, 5-fluorouracil, vinblastine, vincristine, paclitaxel, camptothecin, dactinomycin, etoposide, L-asparaginase hydroxyurea, tamoxifen.
9. **Diagnostic agents:** Iodohippurate, diatrizoate, iopanoic acid, propylidone, rose bengal, fluorescein, etrapone, Evans blue.
10. **Immunomodulators:** Cyclosporine, tacrolimus, mycophenolate mofetil, azathioprine.

B.Ph. 304P	Medicinal Chemistry-I	75 Hrs
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- Separation and identification of organic mixtures containing not more than two compounds.
- Typical synthesis of drugs & drug intermediates using following types of reactions.
 - Chlorosulphonation – saccharin & sulfa drugs
 - Esterification.
 - Amination by reduction.
 - N-methylation and N-alkylation.
 - Mannich type reaction.

B.Ph. 305T	Pharmaceutical Microbiology and Biotechnology	75 Hrs
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Unit-I

1. **Introduction to microbiology:** History and scope, classification of microbes and their taxonomy – bacteria, fungi, protozoa, viruses, actinomycetes, rickettsias, spirochetes.
2. **Morphology, nutrition, identification, cultivation and isolation of:** Bacteria, fungi, protozoa and viruses. Growth of microorganisms in culture: batch, continuous and synchronous cultures.
3. Control of microbes by physical and chemical methods, evolution of anti-microbial chemical agents, sterilization, different methods, validation of sterilization processes, sterility testing of pharmaceutical products.

Unit-II

4. **Bacterial genetics:** Introduction, basic principles of molecular biology, extra chromosomal genetic elements, genotypic and phenotypic variations, mutation, transmission of genetic, material, genetic mechanisms of drug resistance in bacteria, transposable genetic elements and bacterial genetics applications.
5. **Enzyme immobilization:** Techniques of immobilization, and their applications in the industry, dynamics of enzymatic activity, factors affecting enzyme kinetics, study of enzymes such as hyaluronidase, penicillinase, streptokinase, streptodornase, amylases and proteases, immobilization of bacteria and plant cells.

Unit-III

6. **Immunology and immunological preparations:** Host-microbe interactions, the process of infection, natural resistance and nonspecific defense mechanisms, basic and theoretical aspects of immune response. Manufacturing and quality control of immunological products- Introduction, vaccines, in-vivo diagnostics, immune sera, human immunoglobuline including important bacterial and viral vaccines (highlights on its source material, processing, potency assay and safety tests).
7. Production & applications of Monoclonal antibodies.

Unit-IV

8. **Fermentation Technology:** Introduction, Fermenter: its design, control of different parameters, downstream process, production of lactic acid, alcohol, penicillin and vitamin B₁₂.

Unit-V

9. **Pharmaceutical biotechnology:**
Nucleic acids, the genetic code and protein synthesis: (a) Synthesis of DNA-polymerization of nucleotides into DNA – Basic chemical structure, replication and its role in protein synthesis. (b) Synthesis of proteins – the three roles of RNA in Translation, (mRNA, tRNA and rRNA). Genetic engineering and its application in pharmaceutical biotechnology. Recombination DNA techniques.
10. Microbial assays of antibiotics and vitamins

B.Ph. 306P	Pharmaceutical Microbiology and Biotechnology	75 Hrs
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1. Experiments devised to prepare various types of culture media,
2. Sub culturing of common aerobic and anaerobic bacteria, fungi and yeast,
3. Various staining methods,
4. Various methods of isolation and identification of microbes,
5. Sterilization techniques and their validation,
6. Evaluation of antiseptics and disinfectants,
7. Testing the sterility of pharmaceutical products as per I.P. requirements,
8. Microbial assay of antibiotics and vitamins etc.
9. Preparation and standardization of immobilized preparations,
10. Fermentative production of antibiotics,
11. Immobilization of enzymes.
12. Standardisation of inoculum and estimation of MIC by serial dilution.

B.Ph. 307T	Pharmaceutical Formulation	50 Hrs
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Unit-I

1. **Aseptic technique:**
Sources of contamination and methods of prevention, design of aseptic area, laminar flow bench services and maintenance.
Sterility testing of pharmaceuticals.
2. **Parenteral products:** Preformulation factors, routes of administration, WFI, pyrogenicity, non-aqueous vehicles, isotonicity and methods of its adjustment.
Formulation details, containers and closures and selection.

Prefilling treatment, washing of containers and closures, preparation of solutions and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophilization and preparation of sterile powders, equipment for large-scale manufacture and evaluation of parenteral products.

Unit-II

3. **Tablets:** Formulation of different types of tablets, granulation technology on large-scale by various techniques, physics of tablet making, theory of compression, heckle plot, different types of tablet compression machinery and equipments employed, evaluation of tablets.
Coating of tablets: Types of coating, film forming materials, formulation of coating solution, equipments for coating, coating process, evaluation of coated tablets.

Unit-III

4. **Capsules:** Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsules, size of capsules, method of capsule filling, soft gelatin capsule, capsule shell and capsule contents, importance of base adsorption and minim/gm factors in soft capsules, quality control, stability testing and storage of capsule dosage forms.
5. **Microencapsulation:** Types of microcapsules, importance of microencapsulation in Pharmacy, microencapsulation by phase separation, coacervation, multi orifice, spray drying, spray congealing, polymerization, complex emulsion, air suspension technique, coating pan and other technique, evaluation of microcapsules.

Unit-IV

6. **Surgical products:** Definition, primary wound dressings, absorbents, surgical cotton, surgical gauzes, etc., bandages, adhesive tapes, protective cellulosic haemostatics, official dressings, absorbable and nonabsorbable sutures, ligatures & catgut. Medical prosthetics and organ replacement materials.

Unit-V

7. **Packaging of pharmaceutical products:** Packaging components, types, specifications and methods of evaluation, stability aspects of packaging. Packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing.

B.Ph. 308P	Pharmaceutical Formulation	75 Hrs
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- Experiments to illustrate preparation, stabilization, physical and biological evaluation of pharmaceutical products like powders, capsules, tablets, parenteral, microcapsules, surgical dressings etc.
- Evaluation of materials used in pharmaceutical packaging.

B.Ph. 309T	Hospital & Community Pharmacy	50 Hrs
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HOSPITAL PHARMACY

Unit-I

- Organization and Structure:** Organization of a hospital, organization & personnel of hospital pharmacy, responsibilities of a hospital pharmacist, pharmacy procedural manual, Budget preparation and Implementation, Pharmacy and Therapeutic Committee, Hospital Formulary and its contents, preparation and revision of hospital formulary.
- Drugs Store Management and Inventory Control:**
 - Organization of drugs store, Types of materials stocked, storage conditions
 - Purchase and inventory control principles, purchase procedures, purchase order, procurement and stocking.
 - Quality control of drugs in hospitals.

Unit-II

- Drug distribution Systems in Hospitals:**
 - Dispensing of drugs to out-patients.
 - Dispensing of drugs to in-patients.
 - Dispensing of controlled drugs.
 - Pre-packaging and labeling.
 - Drug charges and charging policy.
 - Central Sterile Supply Unit and their Management.
- Surgical supplies and health accessories**

Unit-III

- Nuclear Pharmacy:** Introduction to Radio-pharmaceuticals, radio-active half life, Units of radio-activity Production of radio-pharmaceuticals, methods of isotopic tagging, preparation of radio-isotopes in laboratory using radiation dosimetry, radio-isotope generators, Permissible radiation dose level, Radiation hazards and their prevention, specifications for radio-active laboratory.

COMMUNITY PHARMACY**Unit-IV**

6. **Retail and whole sale drugs store:** Organization and structure of retail and whole sale drug store, types of drug stores and design, maintenance of drug store, dispensing of proprietary products, maintenance of records of retail and wholesale.
7. **Records and Reports:** Prescription filling, drug profile, patient medication profile, annual report.

Unit-V

8. **Patient counseling and Patient Compliance:** Role of pharmacist in community health care and education.
9. **Drugs Information Services:** Sources of Information on drugs, disease, treatment schedules, procurement of information, computerized services (e.g. MEDLINE, MEDLAR etc.), retrieval of information, medication error, safe use of medicine, drug Information center, pharmacist as a information specialist.

B.Ph. 310T	Pharmacology II and Pathophysiology	75 Hrs
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Unit-I

1. **Drugs acting on Autonomic nervous system:** General consideration of ANS, Neurotransmitters, cholinergic receptors, Cholinergic and Anticholinergic drugs, Neuromuscular blockers. Adrenoceptors, Adrenergic drugs and adrenergic blockers. Drugs acting on autonomic ganglion.

Unit-II

2. Cardiovascular system:
 - a. Cardiac glycosides and drugs for congestive heart failure.
 - b. Antihypertensive drug.
 - c. Antianginal and vasodilator drugs, including calcium channel blockers.
 - d. Antiarrhythmic drug.
 - e. Antihyperlipidemic drug.
 - f. Drugs used in the therapy of shock.

Unit-III

3. Haemopoetic system:
 - a. Hematinics.
 - b. Anticoagulants, vitamin K and haemostatic agent.
 - c. Fibrinolytic and anti platelet drugs.
 - d. Blood and plasma volume expanders.
4. Urinary system:
 - a. Water, electrolytes and acid-base balance of body.
 - b. Diuretics and Antidiuretics

Unit-IV

5. Respiratory system:
 - a. Anti asthmatic drugs
 - a. Antitussives, Mucolytics and expectorants, respiratory stimulants.
6. Gastrointestinal Tract:
 - a. Antacids and other anti ulcer drugs.
 - b. Laxatives and Antidiarrhoeal drugs.
 - c. Appetite stimulants and suppressants.
 - d. Emetics, anti emetics and prokinetic drugs.
 - e. Carminative, digestants, enzymes and mucolytics.

Unit-V

7. **Pathophysiology of following diseases:** Hypertension, angina, congestive heart failure, atherosclerosis, myocardial infarction, diabetes, peptic ulcer, asthma, ulcerative colitis, hepatic disorders, acute and chronic renal failure, tuberculosis, urinary tract infections, sexually transmitted diseases, anemias and common types of neoplasms. (wherever applicable the molecular basis should be discussed).

Bioassay: Principle and methods of bioassay. Some official bioassay of important drugs.

B.Ph. 311P	Pharmacology II and Pathophysiology	75 Hrs
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1. Study of various animals used in experimental pharmacology.
2. Study of various anesthetic agents used in experimental pharmacology and procedures to anaesthetize the animals.
3. Study of various instruments used in experimental pharmacology.
4. Preparation of different physiological salt solution used in experimental pharmacology.
5. Study of different routes of drug administration in animals.
6. Study of method of drug dilution.
7. Study of effect of mydriatics and miotics by using rabbit eye.

8. Study of surface anesthesia in rabbit eye.
9. Study of the effect of various routes of drug administration on the responses of the drug.
10. Demonstration of *in vitro* organ bath experiments (including mounting of isolated tissue in organ tube).
11. Demonstration of the effect of various drugs and ions on isolated frog's heart and perfused frog heart (using software system).
12. Identification of the nature of unknown agent using guinea pig ileum.
13. Study of the dose response curve and to find out the pD_2 value of acetylcholine and histamine on various tissues.
14. Study of effect of hepatic microsomal enzyme inhibitors on metabolism of drugs.
15. Recording of spontaneous activity and muscle relaxant activity of drugs.
16. Effects of spasmogens and spasmolytics.

B.Ph. 312T	Pharmacognosy I	75 Hrs
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Unit-I

Systematic study of biological source, cultivation, collection, processing, of the following:

1. **Resins:** Study of drugs containing resins and resin combination like colophony, podophyllum, jalap, cannabis, capsicum, myrrh, asafoetida, balsam of tolu, balsam of peru, benzoin, turmeric, ginger.
Tannins: Study of tannins and tannin containing drugs like gambir, black catechu, gall and myrobalan.
2. **Volatile oils:** General methods of obtaining volatile oils from plants, study of volatile oils of mentha, coriander, cinnamon, cassia, lemon peel, orange peel, lemon grass, citronella, caraway, dill, spearmint, clove, fennel, nutmeg, eucalyptus, chenopodium, cardamom, valerian, musk, palmarosa, gaultheria, sandal wood.

Unit-II

3. Phytochemical Screening:
 - (a) Preparation of extracts.
 - (b) Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts.
4. Fibers: Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass-wool, polyester and asbestos. Pharmaceutical aids: Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin and natural colors.

Unit-III

5. Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups of drugs containing glycosides:
 - (a) Saponins: Liquorice, ginseng, dioscorea, sarsaparilla, and senega.
 - (b) Cardioactive sterols: Digitalis, squill, strophanthus and thevetia.
 - (c) Anthraquinone cathartics: Aloe, senna, rhubarb and cascara.
 - (d) Others: Psoralea, ammi majus, ammi visnaga, gentian, saffron, chirata, quassia.

Unit-IV

6. Studies of traditional drugs, common vernacular names, botanical sources, morphology, and chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulation of following indigenous drugs:
Amla, kantkari, satavari, tylophora, bhilawa, kalijiri, bach, rasna, punarnava, chitrak, apamarg, gokhru, shankhapushpi, brahmi, adusa, arjuna, ashoka, methi, lahsun, palash, guggal, gymnema, shilajit, nagarmotha and neem.

Unit-V

7. The holistic concept of drug administration in traditional systems of medicine. Introduction to ayurvedic preparations like arishtas, asvas, gutikas, tailas, churnas, lehyas and bhasmas.

B.Ph. 313P	Pharmacognosy I	75 Hrs
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- 1 Identification of crude drugs mentioned in theory.
- 2 Study of fibers and pharmaceutical aids.
- 3 Microscopic studies of seven-selected crude drugs and their powders mentioned under the category of volatile oils in theory and their chemical tests .
- 4 General chemical tests for alkaloids, glycosides, steroids, flavonoids and tannins.
- 5 Microscopic study of some important glycoside containing crude drugs as outlined above. Study of powdered drugs.
- 6 Standardization of some traditional drug formulations.

B.Pharm Final year

B.Ph. 401T	Instrumental Analysis	50 Hrs
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Unit-I

1. **Chromatography:** Theoretical consideration, application in drug analysis and quality control of the following analytical techniques: column chromatography, GC, HPLC.

Unit-II

2. Theoretical consideration and application in drug analysis and quality control of the following analytical techniques: TLC, HPTLC, paper chromatography.

Unit-III

The theoretical aspects, basic instruments, interpretation of spectra (for UV, IR, NMR, and mass spectroscopy), and applications of the following analytical techniques should be discussed:

3. **Absorption spectroscopy:**
 - I. Ultraviolet and visible spectrophotometry
 - II. Infrared spectroscopy
 - III. Atomic absorption spectroscopy.
4. Nuclear magnetic resonance spectroscopy including ^{13}C -NMR

Unit-IV

5. Mass spectroscopy
6. Emission spectroscopy
 - I. Flame photometry
 - II. Fluorimetry
 - III. X-ray diffraction

Unit-V

7. **Quality assurance:**
 - I. GLP, ISO 9000, TQM, quality review and quality documentation.
 - II. Regulatory control, regulatory drug analysis and interpretation of analytical data.
 - III. Validation, quality audit, quality of equipment, validation of equipment and validation of analytical procedures.

B.Ph. 402P	Instrumental Analysis	75 Hrs
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1. Experiments involving separation of drugs by different analytical techniques.
2. Experiments involving chromatographical analysis of some pharmaceutical products for (e.g. amino acids, alkaloids, proteins, sulpha drugs, terpenes, etc.)
3. Quantitative estimation of at least ten formulations containing single drug or more than one drug, using instrumental techniques.
4. Estimation of Na^+ , K^+ , Ca^{++} and iron, using flame photometry.
5. I.R. of samples with different functional groups (-COOH, -COOR, -CONHR, -C=C-NH₂, -NHR, -OH etc.)
6. Workshop to interpret the structure spectral of simple organic compounds using UV, IR, NMR, and MS.

B.Ph. 403T	Medicinal Chemistry-II	75 Hrs
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Unit-I

1. **Principles of drug design:** QSAR methods, quantum, mechanics, computer aided drug design (CADD) and molecular modeling.
The following topics shall cover classification, nomenclature, S.A.R., synthesis, physicochemical properties, metabolism and therapeutic uses of drugs mentioned under each category. (Biochemical approaches in drug design wherever applicable should be discussed. A brief introduction of latest drugs under each category shall also be discussed).

Unit-II

2. **Drugs acting on autonomic nervous system:**
 - (i) **Cholinergic and anticholinesterases:** Acetylcholine, methacholine, carbachol, bethanechol, pilocarpine, muscarine, edrophonium, physostigmine, neostigmine, rivastigmine, parathion, diazinon, malathion.
 - (ii) **Anticholinergics:** Atropine, scopolamine, pirenzepine, tolterodine.
 - (iii) **Adrenergics:** Epinephrine, nor-epinephrine, salbutamol, dopamine, dobutamine, terbutaline, tyramine, albuterol, amphetamine, ephedrine, isoprenaline, naphazoline, oxymetazoline.
 - (iv) **Agents acting at the neuromuscular junction and autonomic ganglia:** Atracurium, tubocurarine, decamethonium, succinylcholine, nicotine, hexamethonium, mecamlamine.

3. **Drugs acting on peripheral nervous system:**

- (i) **Skeletal muscle relaxants:** Mephenesin, methocarbamol, carisoprodol, metaxalone, chlorzoxazone, orphenadrine
- (ii) **Local anaesthetics:** Cocaine, benzocaine, procaine, tetracaine, lidocaine, articaine, bupivacaine, etidocaine, ropivacaine, dibucaine, dyclorine, pramoxine.

Unit-III4. **Drugs acting on central nervous system:**

- (i) **General anaesthetics:** Isoflurane, sevoflurane, nitrous oxide, thiopental, ketamine, etomidate, propofol.
- (ii) **Sedative and hypnotics:** Alprazolam, chlordiazepoxide, clonazepam, diazepam, lorazepam, nitrazepam, oxazepam, midazolam, zolpidem, phenobarbitone, pentobarbitone, meprobamate.
- (iii) **Antidepressants:** Amitriptyline, doxepine, desipramine, citalopram, fluoxetine, sertraline, bupropion, phenelzine, pargyline, meclizamide.
- (iv) **Antipsychotics:** Chlorpromazine, fluphenazine, trifluoperazine, thiothixene, clozapine, haloperidol, loxapine, pimozide, ziprasidone, risperidone.
- (v) **Antiepileptics:** Phenytoin, carbamazepine, ethosuximide, lamotrigine, valproic acid, gabapentin, lamotrigine, zonisamide.
- (vi) **Antiparkinsonian drugs:** Levodopa, carbidopa, bromocriptine, pergolide, trihexyphenidyl.
- (vii) **Opioid analgesics:** Morphine, heroin, codeine, naloxone, nalorphine, meperidine, fentanyl, methadone, dextro-propoxyphene, dextromethorphan, pentazocine.
- (viii) **Non-steroidal anti-inflammatory drugs:** Aspirin, paracetamol, indomethacin, mefenamic acid, tolmetin, diclofenac, ibuprofen, ketoprofen, phenylbutazone, analgin, piroxicam, nimesulide, valdecoxib, etoricoxib, aceclofenac.
- (ix) **CNS stimulants:** Strychnine, picrotoxin, nikethamide, bemegride, caffeine, theophylline.

Unit-IV5. **Drugs acting on cardiovascular system:**

- (i) **Antihypertensive agents:** Reserpine, guanethidine, diazoxide, hydralazine, minoxidil, methyl dopa, prazosin, clonidine, pargyline, propranolol, phenoxybenzamine, atenolol, captopril, enalapril, lisinopril, nifedipine, amlodipine, diltiazem, verapamil.
 - (ii) **Antiarrhythmic agents:** Quinidine, di-isopyramide, procainamide, moxilitene, amiodarone, flecainide.
 - (iii) **Antianginal agents:** Glyceryl trinitrate, amyl nitrate, isosorbide dinitrate.
 - (iv) **Antiatherosclerotic agents:** Atorvastatin, simvastatin, colestipol, clofibrate, gemfibrozil.
6. **Drugs acting on kidney: Diuretics –** Mannitol, furesamide, bumetanide, ethacrynic acid, chlorthiazide, hydrochlorthiazide, chlorthalidone, acetazolamide, amiloride, triamterene, spironolactone.

Unit-V7. **Hormones and related drugs:**

- (i) **Hypoglycaemic agents:** Insulin, tolbutamide, chlorpropamide, phenformin, metformin, glyburide, glipizide, repaglinide, pioglitazone.
- (ii) **Thyroid hormone and antithyroid drugs:** Thyroxine, propylthiouracil, methimazole, carbimazole.

8. **Autocoids and related drugs:**

- (i) **Antihistaminics:** Diphenhydramine, dimenhydrinate, doxylamine, mepyramine, tripellamine, pheniramine, chlorpheniramine, dexchlorpheniramine, triprolidine, promethazine, methdilazine, antazoline, cyprohepatadine, azatidine, astemizole, cetirizine, fexofenadine.
- (ii) **Eicosinoids:** Prostaglandins: misoprostol, rioprostil, dinoprostone, carboprost tromethamine, alprostadil, metenprost.

9. **Drugs acting on gastrointestinal tract:**

- (i) **Antilucer drugs:** Cimetidine, ranitidine, famotidine, loratidine, roxatidine, omeprazole, lansoprazole, pantoprazole, rabeprazole.
- (ii) **Antidiarrhoeal drugs:** Loperamide, diphenoxylate, racecadotril.
- (iii) **Emetics and antiemetics:** Emetine, apomorphine, ondansetron, metoclopramide, cyclizine, promethazine, domperidone.

10. **Combinatorial chemistry:** Introduction, supports, linkers, solution-phase combinatorial chemistry, pooling strategies, detection, purification, analysis, high-throughput screening, chemical diversity and library design.

B.Ph. 404P	Medicinal Chemistry-II	75 Hrs
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Typical synthesis of drugs & drug intermediates by use of the following types of reactions and establishing pharmacopoeial standards of the drugs synthesized.

- (i) Benzoin condensation
- (ii) Benzilic acid rearrangement
- (iii) Friedel Crafts alkylation and acylation
- (iv) Hoffmann – Bromamide reaction
- (v) Perkin condensation
- (vi) Grignard reaction
- (vii) Claisen condensation

- (viii) MVP reduction,
- (ix) Catalytic hydrogenation
- (x) Skraup synthesis.

B.Ph. 405T	Dosage Form Design and Cosmeticology	50 Hrs
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Unit-I

1. **Preformulation studies:** Study of physical properties of drugs like physical form, particle size, shape, density, wetting and dielectric constant, solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability.

Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization etc. and their influence on formulation and stability of products.

Study of pro-drugs in solving problems related to stability, bioavailability and elegance of formulations.

Unit-II

2. Design, development and process validation methods for pharmaceutical operations involved in the production of pharmaceutical products with special reference to tablets and solutions.

Stabilization & stability testing protocol for various pharmaceutical products with special reference to tablets and solutions.

Unit-III

3. Performance evaluation methods:
In-vitro dissolution studies for solid dosage forms; methods, interpretation of dissolution data.
In-vivo methods of evaluation and statistical treatment.
4. GMP and quality assurance, quality audit.

Unit-IV

5. **Cosmeticology and cosmetic preparation:** Fundamentals of cosmetic science, structure and function of skin and hair. Formulation preparation and packaging of cosmetic for skin, hair, dentifrices and manicure preparation lipsticks, eyelashes, baby care products etc.

Unit-V

6. **Novel Drug Delivery Systems:** Basic concept, merits and demerits, design, development, production & evaluation of following delivery systems- sustained & controlled release dosage forms (with special reference to tablets, capsules and oral liquids), nanoparticles, liposomes, resealed erythrocytes, microspheres, microcapsules, fast dissolving dosage forms.

B.Ph. 406P	Dosage form Design and Cosmeticology	75 Hrs
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1. Preformulation studies including drug-excipient compatibility studies, effect of stabilizers, preservatives etc. in dosage form design.
2. Experiments demonstrating improvement in bioavailability through prodrug concept.
3. Stability evaluation of various dosage forms and their expiration dating.
4. Dissolution testing and data evaluation for oral solid dosage forms.
5. In-vivo bioavailability evaluation from plasma drug concentration and urinary excretion curves.
6. Design, development and evaluation of controlled release formulation.
7. Formulation of various types of cosmetics for skin, hair, dentifrices and manicure preparations.

B.Ph. 407T	Biopharmaceutics and Pharmacokinetics	50 Hrs
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BIOPHARMACEUTICS**Unit-I**

1. **Introduction to Biopharmaceutics**
2. **Delivery of drugs:** Routes of administration, transport of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion, pinocytosis, etc.).
3. **Absorption of drugs:** Factors influencing absorption such as physicochemical factors, biopharmaceutical factors, manufacturing processing factors, pharmacokinetic factors
4. **Distribution of Drugs:** Tissue permeability, physiological barriers, volume of distribution.

Unit-II

5. **Termination of drug action:** Biotransformation of drugs, protein binding of drugs, excretion of drugs, Concept of clearance – Renal clearance, mechanism of renal clearance, clearance ratio, determination of

renal clearance, Non-renal routes of drug elimination (Extraction ratio, hepatic clearance, biliary excretion, extrahepatic circulation).

- Bioavailability and bioequivalence:** Measure of bioavailability, C_{max} , t_{max} , and area under the curve (AUC), Design of single dose bio-equivalence study and relevant statistics, Review of regulatory requirements for conduction of bioequivalent studies

PHARMACOKINETICS

Unit-III

- Introduction to Pharmacokinetics:** Rate, Rate constants and order of reactions (Zero order and first order kinetics)
- Concept of compartment modeling:** Introduction, compartment models- **Intravenous** administration, **Extravascular** administration

Unit-IV

- Non-linear Pharmacokinetics** with special reference to one compartment model after I V drug administration, Michaelis Menten Equation, determination of non - linearity (Saturation mechanism).

MISCELLANEOUS

- In vivo-In vitro* Correlation

Unit-V

- Mean residence time concept
- Statistical moments analysis
- Multiple dosing and steady state levels and their relationship with single dose administration.
- International regulation regarding bioavailability and bioequivalence studies

B.Ph. 408P	Biopharmaceutics and Pharmacokinetics	75 Hrs
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- Experiments designed for the estimation of various pharmacokinetic parameters with given data.
- Analysis of biological specifications for drug content and estimation of the pharmacokinetics parameters.
- In vitro evaluation of different dosage forms for drug release.
- Absorption studies in- vitro and in -situ.
- Statistical treatment of pharmaceutical data.
- Preparation of surgical dressings, sterile infusions, adhesive tapes and bandages.
- Experiments based on sterilization of various types of materials like surgical dressings, surgical equipments, glasswares, gowns, headgears, mask, gloves etc. used in Hospitals.
- Evaluation of cotton, bandages, dressings, tapes and infusion.
- Evaluation of containers and closures for parenteral use.
- Preparation of haemostat.
- Practicals designed on the use of computers in Drug Information Center, prescription filling, documentation of information on drug interaction.

B.Ph. 409T	Pharmacology – III and Clinical Pharmacy	75 Hrs
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Unit-I

- Chemotherapy:** General principles of chemotherapy
Antimicrobial drugs: Sulfonamides and cotrimoxazole, beta-lactam antibiotics, Cephalosporins, tetracyclines and chloromphenicol (broad spectrum antibiotics), quinolones, aminoglycoside antibiotics, macrolides and other antibacterial.

Unit-II

- Antifungal, Antiviral, Antimalarial, Antiamoebic and other antiprotozoal drugs, anthelmintics.

Unit-III

- Chemotherapy of urinary tract infections, cancer, tuberculosis, leprosy and sexually transmitted diseases and immunosuppressive agents.
- Complete pharmacology of following Local anti infective agents, sera, vaccines, diagnostic agents and vitamins. Gene-therapy.

Unit-IV

- Clinical Pharmacy:
 - Basic concepts of pharmacotherapy
 - Clinical pharmacokinetics and individualization of drug therapy
 - Drug delivery systems, their biopharmaceutical and therapeutic considerations.
 - Use of drugs in infants and in elderly patients
 - Use of drugs during pregnancy and lactation
 - Therapeutic Drug monitoring

- g. Concept of essential drugs & Rational drug Use.
- h. Drug induced diseases.
- i. Basics of drug interactions.
- j. Interpretation of clinical laboratory tests.

Unit-V

6. a. Principles of Toxicology: Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, salicylates, organo-phosphorous and atropine poisoning.
- b. Heavy metals and heavy metal antagonists.

B.Ph. 410P	Pharmacology – III and Clinical Pharmacy	75 Hrs
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1. Bioassay of gallamine (d-tobocurarine), mepyramine and atropine.
2. Study of non-competitive antagonism between acetyl choline and papaverine on guinea pig ileum.
3. Study of competitive antagonism between histamine and mepyramine and to find out the PA^2 value of mepyramine on guinea pig ileum.
4. Study of competitive antagonism between acetyl choline and atropine and to find out the PA^2 value of atropine on rat ileum.
5. Demonstration of dose response curve of oxytocin on rat uterus.
6. Demonstration of dose response curve using guinea pig tracheal chain.
7. Study of the anti secretory and anti ulcer activity using rat pylorus.
8. Evaluation of anti-inflammatory activity of drugs.
9. Evaluation of antipsychotic and hypnotic drugs.
10. Evaluation of anticonvulsant drugs.
11. Evaluation of local anaesthetic drugs
12. Evaluation of analgesic drugs.
13. Study of the effect of antihistaminics on histamine induced asthma.
15. Pyrogen testing.
16. Demonstration of effect of drugs on dog B.P. and respiration, intestine and spleen (using suitable software system).
17. Clinical Pharmacology: To determine the effect of certain clinically useful drug on human volunteers like :
 - a. Antihistaminics.
 - b. Anti anxiety and sedative drug.
 - c. Analgesics.
 - d. Beta blockers.

B.Ph. 411T	Pharmacognosy II	75 Hrs
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Unit-I

1. Systematic study of biological source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following alkaloid-containing drugs:
 - (a) Pyridine-piperidine: Tobacco, areca and lobelia.
 - (b) Tropane: Belladonna, hyoscyamus, datura, duboisia, coca and withania.
 - (c) Quinoline and isoquinoline: Cinchona, ipecac, opium.
 - (d) Indole: Ergot, rauwolfia, catharanthus, nux-vomica and physostigma.
 - (e) Imidazole: Pilocarpus
 - (f) Steroidal: Veratrum and kurchi
 - (g) Alkaloidal amine: Ephedra and colchicum.
 - (h) Glycoalkaloid: Solanum.
 - (i) Purines: Coffee, tea and cola.

Unit-II

2. Role of medicinal and aromatic plants in national economy. Biological sources, preparation, identification tests and uses of the following enzymes: Diastase, papain, pepsin, trypsin and pancreatin.
3. General techniques of biosynthetic studies and basic metabolic pathways. Brief introduction to biogenesis of secondary metabolites of pharmaceutical importance. Plant bitters and sweeteners. Introduction, classification and study of different chromatographic methods and their applications in evaluation of herbal drugs.

Unit-III

4. World-wide trade in medicinal plants and derived products with special reference to diosgenin (disocorea), taxol (Taxus sps) digitalis, tropane alkaloid containing Plants, Papain, Cinchona, Ipecac, Liquorice, Ginger, Aloe, Valerian, Rauwolfia, and Plants containing laxatives. . A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. Utilization and production of phytoconstituents such as quinine, calcium sennosides, podophyllotoxin, diosgenin, solasodine, and tropane alkaloids.

Unit-IV

- Utilization of aromatic plants and derived products with special reference to sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and eucalyptus oil. Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance. Application of plant tissue culture in pharmacognosy.

Unit-V

- Chemotaxonomy of medicinal plants. Marine pharmacognosy, novel medicinal agents from marine sources.
- Natural allergens and photosensitizing agents and fungal toxins. Herbs as health foods. Herbal cosmetics.

B.Ph. 412P	Pharmacognosy II	75 Hrs
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- Identification of crude drugs listed above.
- Microscopic study of characters of eight-selected drugs (Belladonna, datura, sinchona, rauwolfia, nux-vomica, withania, ephedra, ipecac, etc.) given in theory in entire and powdered form.
- Chemical evaluation of powdered drugs and enzymes.
- Chromatographic studies of some herbal constituents.
- Isolation of some selected phytoconstituents studied in theory (nicotine picrate, caffeine, ammonium glycyrrhizinate, calcium citrate etc.)
- Extraction of volatile oils and their chromatographic profiles.
- Some experiments in plant tissue culture (like preparation of various plant tissue culture media, Aseptic transfer, Role of growth regulators, Micro-propagation etc).

B.Ph. 413T	Pharmaceutical Industrial Management	50 Hrs
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Unit-I

- Management:** Meaning, Evolution - Scientific, administrative and human relation approach. Process of management: Planning, organizing, staffing, directing, coordinating and controlling – a preliminary idea of their concepts, processes and techniques. Functional areas of management: Production management, marketing management, personnel management, financial management - their meaning and functions. Entrepreneurship development.
- Economics:** Principles of economics with special reference to the laws of demand and supply, demand schedule, demand curves, labour welfare.

Unit-II

- Production management:** Nature and scope of production and operations management, strategic operations management A brief exposure of different aspects of production management- visible and invisible inputs, methodology of activities, performance evaluation techniques, process flow, process know how and maintenance management. Production planning and control, production processes - mass, job and project; plant location and lay out; work study (preliminary idea only). manufacturing and services operations, product and process design, process planning, plant utilities, production technology, materials handling, factory building, shop floor planning. Materials management, purchasing, purchasing policies, materials storing and inventory management.

Unit-III

- Market research:** Marketing research and information system Market demands- major concepts in the demand measurement, estimating current demands, geo-demographic analysis, estimating industry sales, market share and future demand.
- Pharmaceutical marketing:** Evolution of modern concept; market segmentation; concept of marketing mix; product planning; pricing, promotion; channels of distribution developing the marketing mix – product and service strategies, new product development and product life cycle strategies. Field sales management, sales organization, training of sales personnel, compensation of sales force, field sales planning control and risk, sales forecasting, sales budget and budgetary control, sales literature, catalogue and price list. Concepts and nature of advertising, advertising and marketing, effects of advertising, social effects of advertising, ethics, advertising process, media selection, messages, planning and budget.

Unit-IV

- Personnel management:** Marketing – objective and scope, developing marketing opportunities and strategies Recruitment and selection of employees, orientation and training, evaluation and compensation, retrenchment, lay off and discharge. General principles of insurance and inland and foreign trade, procedure of exporting and importing goods.

Unit-V

7. **Industrial psychology:** Transactional analysis - Meaning, ego status, types of transactions and life positions – a preliminary idea. Organization development- (preliminary idea). Motivation – Maslow's theory, approaches and styles of leadership (preliminary idea).

REFERENCE BOOKS (LATEST EDITION)**B.Pharm first year****Pharmaceutical Inorganic Chemistry (B.Ph. 101T & B.Ph.102P)**

1. Pharmacopoeia of India, Ministry of Health, Govt. of India, New Delhi.
2. Jeffery G.H., Bassett J., Mendham J., Denney R.C., Vogel's Text Book of Quantitative Chemical Analysis, E.L.B.S. London.
3. Beckett A.H. and Stenlake J.B., Practical Pharmaceutical Chemistry, Part-I, The Athlone Press University of London.
4. Connors K.A., A Text Book of Pharmaceutical Analysis, John Wiley & Sons.
5. Chatten L.G., Pharmaceutical Chemistry, Vol. I & II, Marshal Dekker, New York.
6. Block J., Roche E.B., Sonie T.O., Wilson C.O., Inorganic Pharmaceutical chemistry, Lea & Febiger, Philadelphia, PA.
7. Atherden L.M, Bentley and Driver's Text Book of Pharmaceutical Chemistry, Oxford University Press, London.
8. Jeffery G.H., Bassett J., Mendham J., Denney R.C., Vogel's text book of quantitative chemical analysis, E.L.B.S. London.
9. Brey W. S., Physical Chemistry and its Biological Applications, Academic press.
10. Disher L. A., Modern Inorganic Pharmaceutical Chemistry.
11. Suchla G., Vogel's Textbook of Micro and Semimicro Qualitative Inorganic Analysis, Orient Longman, Hyderabad.

Pharmaceutical Biochemistry and Clinical Pathology (B.Ph. 103T & B.Ph.104P)

1. Lehninger A. L., Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
2. Stryer L., Biochemistry, W H Freeman and Company, San Francisco.
3. Rama Rao. A.S.S.V; A Text book of Biochemistry; L. K. & S. Publishers, Visakhapatnam.
4. Conn E. E. and Stumpf P. K., Outlines of Biochemistry, John Wiley and Sons, New York.
5. Harrow B. and Mazur A., Textbook of Biochemistry, W. B. Saunders Co., Philadelphia.
6. Jayraman J., Laboratory Manual in Biochemistry, Wiley Eastern Limited, New Delhi.
7. Martin D. W., Mays P. A. and Redwell V. M., Harpers Biochemistry, Lange Medical Publications.
8. Mussay R. K., Granner D. K., Mayous P. A. and Rodwell Harpers Biochemistry, Prentice-Hall International, Inc.
9. Plumer D. T., An Introduction to Practical Biochemistry, Tata MacGraw Hill, New Delhi.
10. Deb A.C., Fundamentals of Biochemistry, New Central Book Agency Pvt. Ltd.
11. Varley H. Practical Clinical Biochemistry, CBS Publishers & Distributors.

Dispensing Pharmacy (B.Ph. 105T & B.Ph.106P)

1. Carter S. J., Cooper Gunn's Dispensing for Pharmaceutical Students, CBS Publishers, Delhi.
2. Remington's The Science and Practice of Pharmacy, Mack Publishing Co. Easton, Pennsylvania.
3. The British Pharmaceutical Codex, The Pharmaceutical Press, London, Convention, Mack Pub Co., Easton PA.
4. Hoover J.E., Dispensing of Medication, Mack Publishing Co., Easton, Pennsylvania.
5. Martin E. W., Dispensing of Medication, Mack Publishing Co., Easton PA,

Pharmaceutical Technology (B.Ph. 107T & B.Ph.108P)

1. Ansel H. C, Introduction to Pharmaceutical Dosage Forms, K M Varghese and, Bombay.
2. Aulton M. E., Pharmaceutics –The Science DosageForm Design, ELBS/Chuchill Livingstone.

Pharmaceutical Biology and introductory Pharmacognosy (B.Ph. 109T & B.Ph.110P)

1. Tyagi Y. D., Text Book of Botany, Universal Publication.
2. Dutta A. C., Text Book of Botany, Oxford University Press, Calcutta-700720.
3. Khetrapal & Kotpal, Invertebrates, Rastoghi Publication, Merrut.
4. Youngken H. S., Pharmaceutical Botany, The Balkishan Company, Toronto.
5. Kokate C. K., Practical Pharmacognosy, Vallabh Prakashan, Delhi.
6. Kokate C. K., Purohit A. P. and Gokhale S. B., Pharmacognosy, Nirali Prakashan, Pune.
7. Tylor V. E., Brady L. R. and Robbers J. E., Pharmacognosy 1981, Learned Febiger, Philadelphie, U. S. A.
8. Trease G. E. Pharmacognosy and Evans W. C., Baillers Tindall London.
9. Wallis T. E. Pharmacognosy, J. A. Churchill.

Human Anatomy, Physiology and Health Education (B.Ph. 111T & B.Ph.112P)

1. Derashari and Gandhi; Human Anatomy and physiology; B.S. Shah Prakashan.
2. C. Chatterjee; Human Physiology; Medical Allied Agency, Calcutta.
3. Goyal, Bhatt and Kumar; Basics of Health Education and Community Pharmacy; B.S. Shah Prakashan.
4. Warwick & Williman Longman; Gray's Anatomy.
5. Sahana's Text Book of Anatomy.
6. Willium and Wilkins, Baltimore Best and Taylor's Physiological Basis of Medical Practice.

7. Difore Lea SH and Febiger, Atlas of Normal Histology, Philadelphia.
8. Ganong WF, Review of Medical Physiology, Prentice Hall International.
9. Chourasia B.D.; Human Anatomy, Regional and Applied. Part I, II & III; CBS Publishers and Distributor, New Delhi.
10. Gyuton A.C., Half J.E.; Text Book of Medical Physiology; WB Sannders Company.
11. Subhash Shaliya; Human Physiology; CBS Publishers and Distributors.
12. Keel C.A., Neil E and Joels N.; Samson Wright's Applied Physiology; Oxford University Press.
13. MC Naught A.B. and Callander R, Churchill Livingstone; Illustrated Physiology.
14. N.S. Parmar; Health Education and Community Pharmacy; CBS Publishers.
15. Ranade V.G.; Text Book of Practical Physiology; Pune Vidyarthi Griha Prakashan, Pune.
16. Tortora G.J. and Anagnodokos N.P.; Principles for Anatomy and Physiology; Harper and Row Publishers N.Y.
17. Vander A.J. Shermati J.H. and Luciano D.S.; Human Physiology; Tata Mcgraw Hill Publishing Co. New Delhi.
18. R.K. Goyal; A Text Book of Experimental physiology; B.S. Shah Prakashan.

Pharmaceutical Jurisprudence (B.Ph. 113T)

1. Original laws published by Govt. of India.
2. Mithal B. M., Text book of forensic pharmacy, Vallabh Prakashan.
3. Hussain, Laws of Drugs in India.
4. Jain N. K., Text book of Forensic Pharmacy, Vallabh Prakashan, New Delhi.

Pharmacy Practice (B.Ph. 114T)

1. Remington Pharmaceutical Science.
2. Merchant S. H., Text Book of Retail Pharmacy Management.

B.Pharm second year**Pharmaceutical Organic Chemistry (B.Ph. 201T & B.Ph. 202P)**

1. Morrison R. T. & Boyd R. N., Organic Chemistry, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Finar I. L., Organic Chemistry, Vol-1, E.L.B.S. London.
3. Gupta R. D., A Text book of Analytical Chemistry
4. Mann F. G. & Saunders B.C., Practical Organic Chemistry, Longmans, Green and Co. Ltd., London.
5. Furniss B. S., et.al, Vogel's Textbook of "Practical Organic Chemistry, E.L.B.S., London.
6. Wingrove A. S. & Caret R. L.; Organic Chemistry, Harper & Row Publishers, New York.
7. Pine, Handrickon et.al, Organic Chemistry, McGrall Hill Book Co., N.Y.
8. Eliel L., Stereochemistry of Carbon Compounds, Tata McGrall Hill, Bombay.
9. Singh H. K. and Kapoor V. K., Basic and Pharmaceutical Practical Chemistry, Vallabh Prakashan, Delhi.
10. Finar I. L., Organic Chemistry, Vol. II., The Fundamentals and Principles, ELBS/Longman.
11. Textbook of Practical Organic Chemistry, The ELBS/Longman, Longman, London.
12. Jurs P. C. Computer Software Application in Chemistry, John Wiley & Sons, New York.
13. Roberts J. D. and Caserio M. C., Basic Principles of Organic Chemistry, W. A. Benjamin, Inc., New York.
14. Sykes P. A. Guidebook to Mechanisum in Organic Chemistry, Orient Longman, New Delhi.

Chemistry of Natural Drugs (B.Ph. 203T & B.Ph. 204P)

1. Morrison R.T. & Boyd R.N., Organic Chemistry, Prentice Hall India Pvt. Ltd., New Delhi.
2. Finar I.L., Organic Chemistry, Vol –II, E.L.B.S., London.
3. Mann F. G. & Saunders B. C., Practical Organic Chemistry, Longmans, Green and Co. Ltd., London.
4. Furniss B. S., et. al, Vogel's Textbook of "Practical Organic Chemistry, E.L.B.S., London.
5. Wingrove A.S. & Caret R.L.; Organic Chemistry, Harper & Row Publishers, New York.
6. Acheson R.N., An Introduction to the chemistry of Heterocyclic compounds, Interscience Publications, New York.
7. Gutsch, Chemistry of Carbonyl Compounds, Prentice Hall India Pvt. Ltd., New Delhi.
8. Remington Pharmaceutical Sciences.
9. Acheson R. N., An Introduction to the chemistry of Heterocyclic Compounds, Interscience Publishers, New York.
10. Finar I. L., Organic Chemistry, Vol. II., The Fundamentals and Principles, ELBS/Longman.
11. Textbook of Practical Organic Chemistry, The ELBS/Longman, Longman, London.
12. Jurs P. C. Computer Software Application in Chemistry, John Wiley & Sons, New York.
13. Roberts J. D. and Caserio M. C., Basic Principles of Organic Chemistry, W. A. Benjamin, Inc., New York.
14. Sykes P. A. Guidebook to Mechanisum in Organic Chemistry, Orient Longman, New Delhi.

Physical Pharmacy (B.Ph. 205T & B.Ph. 206)

1. Alfred Martin, Physical Pharmacy, B.I. Waverly Pvt. Ltd., New Delhi
2. Shotton E and Ridgaway K, Physical Pharmaceuticals Oxford University Press, London.
3. Carter S. J., Cooper and Gunn's Tutorial Pharmacy, CBS Publishers, Delhi.
4. CVS Subramanyam et al, Physical Pharmaceutics, Vallabh Prakashan.
5. Gennaro A.R., Remington: The Science and Practice of Pharmacy, Lippincot Williams and Wilkins
6. Allen L.V., Popovich W.G. & Ansel H.C., Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, Lippincott Williams and Wilkins.
7. Cheng-ju-Kim, Advanced Pharmaceutics Physicochemical Principles, CRC Press
8. Yalkowsky S.H., Techniques of Solubilization of Drugs, Marcel Dekker
9. Solubility and Related Properties, Marcel Dekker

Pharmaceutical Engineering, Unit Operations and Engineering Drawing (B.Ph. 207T & B.Ph. 208P)

1. Badger W.L. and Banchero J.T.; Introduction to chemical engineering, McGraw Hill International Book Co., London.
2. Parry R. H. & Chilton C. H., Chemical Engineers Handbook, McGraw Kogakusha Ltd.
3. Lachmen L., Lieberman H. A., The Theory and Practice of Industrial Pharmacy, Lee & Febiger, Philadelphia.
4. Carter S.J., Cooper and Gunn's Tutorial Pharmacy, CBS Publishers, Delhi
5. Brown C.G., Unit Operations (Indian Ed.) Asia Publishing House, Bombay.
6. McCabe W.L., Smith J.L., Unit Operations of Chemical Engineering, McGraw Hill International Book Co., London.
7. Bhatt, N.D., Machine Drawing.

Pharmacology – I and Pathophysiology (B.Ph. 209T & B.Ph. 210P)

1. Goyal R. K., Derasari & Gandhi's Elements of Pharmacology, B. S. Shah Prakashan.
2. Satoskar & Bhandarkar, Pharmacology & Pharmacotherapeutics I & II, Popular Prakashan, Bombay.
3. Applied Therapeutics: The clinical use of Drugs, applied Therapeutics, Inc.
4. Crossland J. and Thomsen J.H.; Essential of Pharmacology; Harper & Raw Publishers NY.
5. Barar F. S. K., Essentials of Therapeutics; Interprint New Delhi.
6. Craig C. R. & Stizel R. R., Modern Pharmacology, Little Brown and Company.
7. Davidson's Principles and Practice of Medicine, ELBS/Churchill Livingstone.

8. J.G.Hardman, L.E., Limbird, P.B.Molinoss, R.W.Rudden & A. G. Gil, Goodman & Gilmans, The Pharmacological basis of Therapeutics, Pergamon Press.
9. Tripathi, K.D., Essentials of Medical Pharmacology, Jaypee Brothers, New Delhi
10. Herindal E. T. & Hirschman J.L., Willams and Wilkins, Clinical Pharmacy and Therapeutics.
11. Katzung B. G., Basic and Clinical Pharmacology, Prentice Hall International.
12. Lawrence D.R. and Bennet P. N., Clinical Pharmacology; Churchill Livingstone.
13. Myeek M. J., Gertner S. B. & Perper M. M., Pharmacology Lippincatt's Illustrated Reviews, Lippincott Company, Philadelphia.
14. Paul L., Chapman and Hall, Principles of Pharmacology.
15. Dipiro, J.L.Elseuier, A Pathophysiological Approach: Pharmacotherapy.
16. Rang M.P., Dale M.M., Ritter J.M., Pharmacology, Churchill Livingstone.
17. Robinson S. L. and Kumar V.; Basic Pathology, W. B. Saunders Co.
18. Theoharides T. C., Pharmacology; Little Brown & Co.
19. B. C. Bose, Pharmacology
20. James crossland, Levi's Pharmacology
21. Ghosh, Pharmacology materia medica and therapeutics.
22. Sharma V.N., Essentials of Pharmacology.

Computer Applications (B.Ph. 211T & B.Ph. 212P)

1. Office 2000 Complete, BPB Publication
2. Sukhviri Singh :Fundamentals of computers , Khanna Publications .
3. Office 2000:No Experiments Required: BPB Publications .
4. G B Davis ,Complete Data Process ,Mc Graw Hill Publication.
5. Comdex Computer Course Kit ,BPB Publication.
6. Pradeep S.K., Computer Fundamentals, BPB, Delhi
7. Diana R., Microsoft Access, BPB, Delhi
8. Rajaraman R., Fundamentals of Computer, PHI.
9. Mukherjee, Fundamentals of Computers, PHI
10. Jain S., Adobe Pagemake Training Guide, BPB, Delhi
11. Wray P., BPB Computer Course, BPB, Delhi
12. Check M., Exploring Office XP, BPB, Delhi
13. Courter G., Mastering Excel 2002, BPB, Delhi
14. Gralla P., How the Internet Works, techmedia
15. Sybex, internet Complete, BPB, Delhi
16. Simplified Internet, BPB, Delhi
17. Crumblish C., The internet: No experience required, BPB, Delhi
18. Johnson S., Learning guide to the internet, BPB, Delhi
19. Mukhi V., Surf's UP, BPB, Delhi
20. Falk B., Internet basic reference A to Z, BPB, Delhi

Advanced Mathematics and Biostatistics (B.Ph. 213T & B.Ph. 214P)

1. Phillips David S., 'Basics Statistics for health science Student's, Freeman and company, San Francisco.
2. Ray & Sharma, 'Mathematical Statistics'.
3. Bansal, Agrawal and Bhargava, 'Differential Integral Calculus- I', Jaipur Publishing House.
4. Bansal, Agrawal and Bhargava, 'Integral Calculus', Jaipur Publishing House.
5. ,Bansal and Dhami, 'Differential equations – I', Jaipur Publishing House.
6. Gupta and Goyal, 'Laplace Transformation', Jaipur Publishing House.
7. Grewal, T. S., Introduction to Accountancy,
8. Jain S. P. and Narang N. L., Cost Accounting ,
9. Verma T. R., Auditing.
10. Maheshwari S. N., Management Accounting.
11. Saxena R. G., Principles and practice of auditing.
12. Pandey I. M., Financial management, Vikas Publishers.
13. Khan and Jain, Management Accounting, Tata Mc Graw Hill.
14. Matrices by G.C. Sharma.

B.Pharm third year**Pharmaceutical Analysis (B.Ph. 301T & B.Ph. 302P)**

1. Pharmacopoeia of India, Govt. of India, Ministry of Health, New Delhi.
2. Jeffery G.H., Bassett J., Mendham J., Denney R.C., Vogel's Text Book of Quantitative Chemical Analysis, E.L.B.S. London.
3. Beckett A.H. & Stenlake J.B., Practical Pharmaceutical Chemistry, Part-I & II, The Athlone Press University of London.
4. Connors K.A., A Text Book of Pharmaceutical Analysis, John Wiley & Sons, New York.
5. Chatter L.G., Pharmaceutical Chemistry, Vol. I & II, Marshal Dekker, New York.
6. Atherden L.M, Bentley and Driver's Text Book of Pharmaceutical Chemistry, Oxford University Press, London.
7. Kolthoff I. M. and Stenger V. A., Volumetric Analysis, Vol. II Titration Methods, Interscience Publishers, Inc., New York.
8. Kenevel A. M. and Digangi F. E., Jenkin's Quantitative Pharmaceutical Chemistry, Mc Graw Hill Book Co., New York.

Medicinal Chemistry-I (B.Ph. 303T & B.Ph. 304P)

1. Vogel's Textbook of Practical Organic Chemistry, ELBS.
2. Mann & Saunder's – Practical Organic Chemistry.
3. Wilson & Gisvold's, Testbook of Organic medicinal & Pharmaceutical chemistry; J. B. Lippincott Co.
4. W. O. Foye, Principles of medicinal chemistry.
5. M. E. Wolff, Burger's medicinal chemistry, John Wiley & Sons.
6. Remington's Pharmaceutical Sciences
7. Vogel's Textbook of Practical Organic Chemistry, ELBS.
8. Mann & Saunder's – Practical Organic Chemistry.

Pharmaceutical Microbiology and Biotechnology (B.Ph. 305T & B.Ph. 306P)

1. Peleczar M.J. Jr., Chan E.C.S., & Krieg N.R., Microbiology, Tata McGraw Hill, Publishing Co. Ltd., Delhi.
2. Frobisher M., Hindsall R.D., Crabtree K.T., & Goodheart C.R., Textbook of Microbiology.
3. Salle A. J., Fundamental Principles of bacteriology.
4. Hugo and Russel, Pharmaceutical Microbiology, Blackwell Scientific Publication, Oxford.
5. Rawlins E. A., Bentley's textbook of Pharmaceutics, ELBS Bacilliere Tindal.
6. Carter S. J., Cooper and Gunn's Tutorial Pharmacy, CBS Publishers, Delhi.
7. Remington's The Science and Practice of Pharmacy, Mack Publishing Co. Easton, Pemsybrania.
8. Vyas, Dixit, Pharmaceutical Biotechnology.
9. Jain S. K., Textbook of Biotechnology (Fundamentals of Cellular biology).
10. Casida, Industrial Microbiology.
11. Prescott and Dunn, Industrial Microbiology, McGraw Hill Book Co. Inc.
12. Standury P. F. & Whitaker A., Principles of Fermentation Technology, Pergamon Press, Oxford.
13. Ward O. P., Fermentation Technology, Principles, Processes and Products, Open University Press, Milton Keynes, UK.
14. Nagori B.P. & Issrani Roshan, Foundation in pharmaceutical biotechnology.

Pharmaceutical Formulation (B.Ph. 307T & B.Ph. 308P)

1. Lachmann L., Liberman H.A., & Kanig J.L., The Theory and Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia.
2. Remington's The Science and Practice of Pharmacy, Mack Publishing Co. Easton, Pemsybrania.
3. Pharmacopoeia of India, Published by the Controller of Publications, Delhi (Latest edition)
4. Rawlins E. A., Bentley's Textbook of Pharmaceutics, ELBS Bacilliere Tindal.

Hospital & Community Pharmacy (B.Ph. 309T)

- 1 Turbo S. and King R.E.; Sterile Dosage Forms; Lea and Febiger, Philadelphia.
- 2 Sykes G., Disinfection and Sterilization, II ed.
- 3 Pharmacopoeia of India; published by Controller of Publications Delhi, All editions.
- 4 Hassan W.E.; Hospital Pharmacy; Lea and Febiger, Philadelphia.
- 5 Remington's; The Science and Practice of Pharmacy; Mack Publishing Co., Easton, Pemsybrania.
- 6 Allwodd M.C. and Fell J. T.; Text book of Hospital Pharmacy; Blackwell Scientific Publication, Oxford.
- 7 A Owunwonue; Handbook of RadioPharmaceuticals; Narosa Publishing House, New Delhi.
- 8 Parmar, N.S., Health Education and Community Pharmacy, CBS Publishers and Distributors.
- 9 Merchant & Quadry, Hospital Pharmacy, B.S. Shah Prakashan, Ahmedabad.
- 10 Nand & Khar, Hospital Pharmacy, Birla Publication, New Delhi
- 11 Stephen M., Hospital Pharmacy, Pharmaceutical Press.

Pharmacology II and Pathophysiology (B.Ph. 310T & B.Ph. 311P)

- 1 Goyal R.K., Derasari & Gandhi's Elements of Pharmacology, B. S. Shah Prakashan.
- 2 Satoskar & Bhandarkar, Pharmacology & Pharmacotherapeutics I & II, Popular Prakashan, Bombay.

- 3 Applied Therapeutics: The clinical use of Drugs, applied Therapeutics, Inc.
- 4 Crossland J. and Thomsen J.H.; Essential of Pharmacology; Harper & Raw Publishers NY.
- 5 Barar F. S. K., Essentials of Therapeutics; Interprint New Delhi.
- 6 Craig C. R. & Stizel R. R., Modern Pharmacology, Little Brown and Company.
- 7 Davidson's Principles and Practice of Medicine, ELBS/Churchill Livingstone.
- 8 J.G.Hardman, L.E., Limbird, P.B.Molinoss, R.W.Rudden & A. G. Gil, Goodman & Gilmans, The Pharmacological basis of Therapeutics, Pergamon Press.
- 9 Herindal E. T. & Hirschman J.L., Willams and Wilkins, Clinical Pharmacy and Therapeutics.
- 10 Katzung B. G., Basic and Clinical Pharmacology, Prentice Hall International.
- 11 Lawrence D.R. and Bennet P. N., Clinical Pharmacology; Churchill Livingstone.
- 12 Myeek M. J., Gertner S. B. & Perper M. M., Pharmacology Lippincatt's Illustrated Reviews, Lippincott Company, Philadelphia.
- 13 Panl L., Chapmom and Hall, Principles of Pharmacology.
- 14 Dipiro, J.L.Elseuier, A Pathophysiological Approach: Phermacotherpay.
- 15 Rang M.P., Dale M.M., Riter J.M.,Pharmacology, Churchill Liningstone.
- 16 Robbinson S. L. and Kumar V.; Basic Pathology, W. B. Saunders Co.
- 17 Theoharides T. C., Pharmacology; Little Brown & Co.
- 18 Turner; Screening of drugs.
- 19 B. C. Bose, Pharmacology
- 20 James crossland, Levi's Pharmacology
- 21 Ghosh, Pharmacology materia medical and therapeutics.
- 22 Goyal R. K., Bhat R. and Burande M. K., Text Book of Clincal Pharmacy, Shah Publication.
- 23 Goyal R. K., Text Book of Experimental Pharmacology, Shah Publication.
- 24 Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
- 25 Kulkarni S. K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.
- 26 Sharma V.N., Essentials of Pharmacology.

Pharmacognosy I (B.Ph. 312T & B.Ph. 313P)

1. Trease G. E. and Evans W. C., Pharmacognosy, Bailliers Tindall, Eastbourne, U. K.
2. Tyler V. C., Brady L. R., and Robers J. E., Pharmacognosy, Lea and Febiger, Philadelphia.
3. Tyler V. E. Jr. and Schwarting A. E., Experimental Pharmacognosy, Burgess Pub. Co., Minneaplis, Minnesota.
4. Wallis T. E., Analytical Microscopy, J & A Churchill Limited, London.
5. Wallis T E., Text Book of Pharmacognosy, J & A Churchill Limited, London.
6. Welsch J. R., Fundamentals of Plant Genetics and Breeding, Wiley, New York.
7. Zafar R., Medicinal Plants of India, C.B.S. Publisher, New Delhi.

B.Pharm final year**Instrumental Analysis (B.Ph. 401T & B.Ph. 202P)**

1. Atal C.K. and Kapur B.M., Cultivation and Utilization of Medicinal Plants, RRL, Jammu.
2. Barz W., Reinhard E. and Zenk M.H., Plant Tissue Culture and its Biotechnological Application, Springer, Berlin.
3. Brain K.R. and Turner T.D., The Practical Evaluation of Phytopharmaceuticals, Wright- Sciencetchnica, Bristol.
4. Clarke E.C.G., Isolation and Identification of Drugs, The Pharmaceutical Press, London.
5. Export Potential of Selected Medicinal Plants, prepared by Basic Chemicals, Pharmaceuticals and Cosmetic Export Promotion Council, Bombay and Other Reports.
6. Peach K., and Tracey M.V., Modern Methods of Plant Analysis, 1-4, Narosa Publishing House, New Delhi.
7. Ross M. S. E. and Brain K. R., An Introduction to Phytopharmacy, Pitman Medical, Kent.
8. Staba E. J., Plant Tissue Culture as a Source of Biomedicinals, CRC Press, Florida.
9. Stahl E., Thin Layer Chromatography – A Laboratory Hand Book, Springerverlag, Berlin.
10. Swan T., Chemical Plant Taxonomy, Academic Press, London.
11. Swan T., Comparative Phytochemistry, Academic Press, London.
12. The Wealth of India, Raw Materials (all volumes) Council of Scientific and Industrial Research, New Delhi.
13. Instrumental Methods of Analysis by Scoog and West.
14. Pharmaceutical Analysis – Modern Methods, Part A and B by Munson James. W.

Medicinal Chemistry-II (B.Ph. 403T & B.Ph. 404P)

1. Pharmacopoeia of India, Govt. of India, Ministry of Health, New Delhi.
2. Jeffery G.H., Bassett J., Mendham J., Denney R.C., Vogel's Text Book of quantitative chemical analysis, E.L.B.S. London.
3. Beckett A.H. & Stenlake J.B., Practical pharmaceutical Chemistry, Part-II, The Athlone Press University of London.
4. Connors K.A., A text book of Pharamaceutical Analysis, John Wiley & Sons, New York.
5. Chatter L.G., Pharamaceutical Chemistry, Vol. I & II, Marshal Dekker, New York.
6. Atherden L.M, Bentley and Driver's Text Book of Pharmaceutical Chemistry, Oxford University Press, London
7. Willard, Instrumental analysis.
8. Ewing, Method of instrumental analysis.
9. Sharma B. K., Methods of Instrumental Analysis.
10. Chatwal and Anand, Instrumental methods of analysis.
11. D. C. Garatt, The quantitative analysis of drugs, champann and Hill Ltd., London.
12. Skoog, Instrumental Analysis.
13. Kolthoff I. M. and Stenger V. A., Volumetric Analysis, Vol II Titration Methods, Interscience Publishers, Inc., New York.
14. Kenevel A. M. and Digangi F. E., Jenkin's Quantitative Pharamaceutical Chemistry, Mc Graw Hill Book Co., New York.

Dosage Form Design and Cosmeticology (B.Ph. 405T & B.Ph. 406P)

1. Wilson & Gisvold's Textbook of Organic Medicinal & Pharmaceutical chemistry, J.B.Lippincott Co.
2. Foye W.O., Principles of Medicinal chemistry.
3. Wolff M.E., Burger's medicinal chemistry, John Wiley & Sons.
4. Remingtons Pharmaceutical sciences.
5. Vogel's Textbook of practical organic chemistry, ELBS.
6. Pharmacopoeia of India
7. British Pharmacopoeia
8. United States Pharmacopoeia
9. Mann & Saunders – Practical organic chemistry.
10. Atherden L. M., Bentley and Driver's Text book of Pharmaceutical Chemistry, Oxford University Press, London.
11. Chatten L. G. A Textbook of Pharmaceutical Chemistry, Vol I and II, Marcel Dekker, New York.
12. Exploring QSAR Vol; I Fundamentals and Applications in Vhemistry and Biology by C Hansh and A Leo Vol. II: Hydrophobic, Electronic and Steric constants by C. Hansh, A Leo and D. Hockman ACS Book Catalog.
13. Hansh C., Comprehensive Medicinal Chenistry, Vol. IV, Quantitative Drug Design, Pergamon Press, Oxford.
14. Landu B. N. Mandel H. G. and way E. L., Fundamentals of Drugs Metabolism and Disposition, William and Welkind Co. 428 E., Preston Street, Baltimore.
15. Martine Y. C., Quantitative Drug Design – A Critical Introduction (Medicinal Research Monograph, Vol. 8) Marcel Dekkers, inc. New York.
16. Nogrady T., Medicinal Chemistry – A Biochemical Approach Oxford University Press, New York, Oxford.
17. Pop and Perruns, Computer Aided Drug Design, Academic Press, NY.
18. Reynolds J. E. F., Martindale, The Extra Pharmacopoeia, The Pharmaceutical Press, London
19. Jellinek J. S., Formulation and Function of Cosmetics, John Wiley and sons, NY.
20. Mithal, Saha Hand book of cosmetics.

Biopharmaceutics and Pharmacokinetics (B.Ph. 407T & B.Ph. 408P)

1. Sharma P.P., How to Practice GMP, Vandana Publications, Delhi.
2. Aulton M.E., Pharmaceutics - The Science of Dosage Form Design, ELBS/ Churchill Livingstone.
3. Banker G.S. and Rhode C.T., Modern Pharmaceutics, Marcel Dekker Inc., NY.
4. Remington's The Science and Practice of Pharmacy, Mack Publishing Co. Easton, Pennsylvania.
5. Juliano R.L., Drug Delivery System, Oxford University Press, Oxford.
6. Lachman L, Lieberman HA and Kanig JL, The Theory and Practice of Industrial Pharmacy, Lee & Febiger, Philadelphia.
7. Liberman H.A., Rieger M. M. and Banker G 8, "Pharmaceutical Dosage Forms; Dispense System, Vols 1&2, Marcel Dekker Inc., NY.
8. Lieberman H.A, Lachman L & Schwartz J. B. Pharmaceutical Dosage Forms; Tablets, Vol. 1-3, Marcel Dekker Inc., NY.
9. Loftus B. T. and Nash Robert, Pharmaceutical Process validation, Marcel Dekker Inc., NY.
10. Pharmacopoeia of India, Published by the Controller of Publications, Delhi..
11. Robinson J. R. & Lee Vincent, Controlled Drug Delivery: Fundamentals & Applications, Marcel Dekker Inc., NY.
12. Wagner, J.G., Handbook of Basic Pharmacokinetics, CBS Publishers & Distributors
13. Gibaldi M., Biopharmaceutics and Pharmacokinetics, Marcel Dekker.
14. Ansel H.E., Introduction to Pharmaceutical Dosage Forms, B. I. Waverly Publications.
15. Shargel L., Biopharmaceutics and Clinical Pharmacokinetics, McGraw Hill.
16. Winter M.E., Basic Clinical Pharmacokinetics, Lipincott Williams & Wilkins
17. Schoenwald R.D., Pharmacokinetics in Drug Discovery and Development, CRC Press

Pharmacology – III and Clinical Pharmacy (B.Ph. 409T & B.Ph. 410P)

1. Rowland M. and Tozer T.N.; Clinical Pharma cokinetics, Lea & Feblger, NY.
2. Welling Peter G. and Tse Francis L.S.; Pharmacokinetics, Marcel Decker Inc. N.Y.
3. Winter M.E.; Basic Clinical Pharmacokinetics, Applied Therapeutics, Ine San Francisco.
4. Wagner J.G.; Pharmacokinetics for Pharmaceutical Scientist; Technomic Publishing A. G. Basel, Switzerland.
5. Wagner J.G.; Fundamentals of Pharmacokinetics; Drug intelligence publication, Hamilton.
6. Ritschel W. A.; Handbook of Basic Pharmacokinetics; Drug Intelligence Publication, Hamilton.
7. Motari R.E.; Biopharmaceutics and Pharmacokinetics an Introduction; Marcel Decker Inc. NY.
8. Gibaldi M.; Biopharmaceutics and Clinical Pharmacokinetics; Philadelphia.
9. Gibaldi M. and Perrier D.; Pharmacokinetics; Marcel Decker Inc. NY.
10. Pecile A. and Resigno A.; Pharmacokinetics; Plenum Press NY.

Pharmacognosy II (B.Ph. 411T & B.Ph. 412P)

1. Goyal R.K., Derasari & Gandhi's Elements of Pharmacology, B. S. Shah Prakashan.
2. Satoskar & Bhandarkar, Pharmacology & Pharmacotherapeutics I & II, Popular Prakashan, Bombay.
3. Applied Therapeutics: The clinical use of Drugs, applied Therapeutics, Inc.
4. Crossland J. and Thomsen J.H.; Essential of Pharmacology; Harper & Raw Publishers NY.
5. Barar F. S. K., Essentials of Therapeutics; Interprint New Delhi.
6. Craig C. R. & Stizel R. R., Modern Pharmacology, Little Brown and Company.
7. Davidson's Principles and Practice of Medicine, ELBS/Churchill Livingstone.
8. J.G.Hardman, L.E., Limbird, P.B.Molinoss, R.W.Rudden & A. G. Gil, Goodman & Gilmans, The Pharmacological basis of Therapeutics, Pergamon Press.
9. Herindal E. T. & Hirschman J.L., Willams and Wilkins, Clinical Pharmacy and Therapeutics.
10. Katzung B. G., Basic and Clinical Pharmacology, Prentice Hall International.
11. Lawrence D.R. and Bennet P. N., Clinical Pharmacology; Churchill Livingstone.
12. Myeek M. J., Gertner S. B. & Perper M. M., Pharmacology Lippincatt's Illustrated Reviews, Lippincott Company, Philadelphia.
13. Panl L., Chapmom and Hall, Principles of Pharmacology.
14. Dipiro, J.L.Elseuier, A Pathophysiological Approach: Phermacotherpay.
15. Rang M.P., Dale M.M., Riter J.M.,Pharmacology, Churchill Liningstone.
16. Robbinson S. L. and Kumar V.; Basic Pathology, W. B. Saunders Co.
17. Theoharides T. C., Pharmacology; Little Brown & Co.
18. Goyal R. K., Bhat R. and Burande M. K., Text Book of Clinical Pharmacy, Shah Publication.
19. Goyal R. K., Text Book of Experimental Pharmacology, Shah Publication.
20. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
21. Kulkarni S. K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.
22. Turner; Screening of drugs.
23. B. C. Bose, Pharmacology
24. James crossland, Levi's Pharmacology
25. Ghosh, Pharmacology materia medical and therapeutics.

Pharmaceutical Industrial Management (B.Ph. 413T)

1. Tripathi P. C. and Reddy P. N.: Management; Tata Mc Graw Hill.
2. Shukla M. C.: Business Organization and Management; S. Chand and Company.
3. Sherlaker S. A.: Business Organization and Management; Himalaya.
4. Filippo E. B.: Personnel Management; McGraw Hill.
5. Kotler Philip: Marketing Management; Prentice Hall of India.
6. Rao and Narayan: Organizational Behaviour; Konark Publishers.
7. Tripathi P. C.: Personnel Management; S. Chand and Company.
8. Memoria C. B.: Principle and Practice of Marketing in India.
9. K.Aswhathappa and K. Sridhara Bhat, Production and Operations Management, Himalaya Publishing House, New Delhi.
10. M. N. Mishra, Sales promotion and advertising management, Himalaya Publishing House, New Delhi.
11. Prassanna Chandra, Financial Management, Theory and practice Tata mcGraw-hill publishing company limited, New Delhi fourth edition.
12. H.P.S. Palwa, Bharat's Project financing (Policies, Procedure and Practice), Bharat law house, 4th edition.
13. T.M. Joseph, Environmental Management, Himalaya Publishing House, New Delhi.
14. K.Aswhathappa, Essentials of production management, Himalaya Publishing House, New Delhi.
15. S.A. Chunawala, Sales Management, Himalaya Publishing House, New Delhi.
16. S.A. Chunawala, Product Management, Himalaya Publishing House, New Delhi.
17. SVR Subbarao, Hand book of pharmaceutical marketing in India, Universal book corporation, Mumbai.
18. Peter F. Drucker, Management tasks, responsibilities, practices, Allied publishers limited, New Delhi.
19. Heinz Wehrich and Harold Koontz, Management, A global Perspective, McGraw-hill International edition.
20. Prasanna Chandra, Financial Management: Projects, Planning, analysis, selection, implementation & Review, Tata mcGraw-hill publishing company limited, New Delhi fourth edition.
21. Nikhilesh Dholkia, Rakesh Khurana, Labdhi Bhandari & Ashinandan K. Jain, Marketing Management cases and Concepts, Macmillan India Limited.
22. S.A. Sherlekar, K. Nirmala Prasad and S. J. Salvadore victor, Principles of Marketing, Himalaya Publishing House, New Delhi.
23. S.A.Chunawalla and K.C., Sethia, Foundation of advertising, Theory and practice, Himalaya Publishing House, New Delhi.
24. R.B.Smarta, Revitalizing the pharmaceutical business, innovative marketing approaches, Universal book corporation, Mumbai.
25. S.K. Bhattacharjee, Fundamentals of PERT / CPM and project management, Khanna Publisher.
26. D.Gopalkrishana, A study of managerial economics, Himalaya Publishing House, New Delhi.
27. Dr. M.M. Varma and R.K. Agarwal, managerial economics, King Books, Delhi.
28. A Nag, Macroeconomics for management studies, Universal Book corporation, Mumbai