

Second B.Pharmacy Exam.2009  
(Four Year Integrated Course)

Prospectus No.09145

संत गाडगे बाबा अमरावती विद्यापीठ

**SANT GADGE BABA AMRAVATI UNIVERSITY**

**(FACULTY OF MEDICINE)**

**PROSPECTUS**

OF

THE SECOND EXAMINATION FOR THE DEGREE OF

BACHELOR OF PHARMACY, 2009.

(FOUR YEAR INTEGRATED COURSE)



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**Syllabus Prescribed for**  
**B.Pharm Second Year**  
**Physical Pharmacy**  
**Theory (75 Hours)**

**II.T.1**

1. **Intermolecular forces and states of matter** : Binding forces between molecules : States of matter, gaseous, liquid and solid state, amorphous and crystalline states of solids; polymorphism; latent heat and vapor pressure, sublimation-critical point, phase equilibria and phase rule.
2. **Thermodynamics** : Laws of thermodynamics and their applications in Pharmacy.
3. **Solubility and distribution phenomena** : Solubility definitions, expressions, solvent solute interactions, polar solvents-non polar solvents-semipolar solvents, solubility of gases in liquids, effect of pressure- temperature-salting out-chemical reactions of solubility calculations, solubility of liquids in liquids, ideal and real solutions, complete and partial miscibility, influence of foreign substances-three component systems, dielectric constant and solubility, solubility of solids in liquids, solubility of salts in water-solubility of slightly soluble and weak electrolytes, calculating solubility of weak electrolytes as influenced by pH. Influence of co-solvents on the solubility of drugs, combined effect of pH and solvents, distribution of solutes between immiscible solvents, effect of ionic dissociation and molecular association on partition extraction, preservation action of weak acids in emulsion, distribution co-efficient.
4. **Diffusion and dissolution** : Steady state of diffusion, procedures and apparatus used, diffusion and drug release, diffusion principles in biological systems, vapour sorption and Transmission. Thermodynamics of diffusion.
5. **Kinetics and drug stability** : Rates and orders of reaction, influence of temperature and other factors, on reaction rates. Decomposition and stabilization of medicinal agents. Accelerated stability analysis.
6. **Surface and interfacial phenomenon** : Surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, complex films, adsorption at solid liquid-interfaces, surface activity, surface active agents, HLB classification, solubilization-micelle formation, determination of critical micelle concentration, detergency, and wetting agents. Contact angle, flocculating agents, deflocculating agents, foaming agents, anti-foaming agents. Medicinal and pharmaceutical applications.

7. **Colloids and macromolecular systems** : Introduction and types, optical, kinetic and electrical properties of colloids, Stabilization of colloids, gels-structure, properties and applications in Pharmacy.
8. **Coarse dispersions 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, emulsions-types-theories-physical stability, preservation of emulsions, rheological properties of emulsions, phase equilibria and emulsion formulation. Semisolid dispersions.
9. **Micromeritics** : Introduction and pharmaceutical importance, particle size and distribution, particle shape, particle volume, particle number, surface area, methods for determining particle size, particle volume measurement, specific surface, methods for determining surface area, Derived properties of powders-porosity-packing-arrangement-densities, bulkyness-flow properties of powders, angle of repose, factors affecting flow of powders.
10. **Rheology** : Fundamentals of rheology, type of flow, quantitative measurement of flow, mechanical models to illustrate flow on viscoelasticity, thixotrophy, measurement of thixotrophy, thixotrophy in formulation, rheology of disperse system, pharmaceutical application of rheology. Methods of viscosity measurements.
11. **Complexation** : Classifications, methods of preparation and analysis, crystalline structure of complexes, thermodynamic treatment of stability constants, protein binding.

**Recommended Books :**

- 1) Remington's Pharmaceutical Sciences.
- 2) Elements of Physical Chemistry - Glasstone & Lewis
- 3) Theory & Practice of Industrial Pharmacy - Lachman, Libermann & Kanig.
- 4) Physical Pharmacy by Martin - Swarbrick & A. Cammarata
- 5) Bentley's Text Book of Pharmaceutics by Rewilins.
- 6) Tutorial Pharmacy - Cooper & Gunn.

**II.P.1**

**Physical Pharmacy**  
**Practical (75 Hours)**

1. Studies on polymorphs, their identification and properties.

2. Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
3. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
4. Determination of surface/interfacial tension, HLB value and critical micelle concentration of surfactants.
5. Study of rheological properties of various types of systems using different viscometers.
6. Studies of different types of colloids and their properties.
7. Preparation of various types of suspensions and determination of their Sedimentation parameters.
8. Stability studies of emulsions.
9. Studies on different types of complexes and determination of their stability constants.
10. Determination of half-life, rate constant and order of reaction.
11. Accelerated stability testing, shelf-life determination and expiration dating of pharmaceuticals.
12. Experiments involving tonicity adjustments.

#### Reference Books :

- 1) Physical Pharmacy by Martin - Swarbrick & A.Cammarata
- 2) Practical Physical Pharmacy by Dr.U.B.Hadkar, T.N.Vasudevan, K.S.Laddha,
- 3) Practical Pharmaceutical Technology by - Engene Parrot.

#### II.T.2 Pharmaceutical Unit Operations Theory (75 Hours)

1. **Flow of fluids :** Introduction, Manometers, Reynolds Number, Viscosity, its units and measurements, Bernoulli's theorem, fluid head, friction loss, enlargement and contraction losses. Flow meters.
2. **Transportation of fluid :** Pipes, its standard, strength, fittings, joints flanges, valves, pumps. Transportation of gases, ejectors, compressors, fans, blowers.
3. **Flow of heat :** Conduction, convection, and radiation. Heat flow through a cylinder. Surface co-efficient; boiling liquids, condensing vapors. Black body, heaters, heat interchanges, heat insulation.
4. **Corrosion :** Corrosion and its prevention.

5. **Evaporation :** Different types of evaporators, condensers, traps, entrapment, separators, evaporator capacity, Heat and material balance, Dahring's rule, factors influencing heat transfer co-efficient. Rate of scale formation. Principle and operation of a multiple effect evaporator.
6. **Distillation :** Vapor-liquid equilibrium, boiling point diagram, Roul't's law, Henery's law, constant boiling mixture, equilibrium diagram, equilibrium distillation, differential distillation, rectification, fractionating column, heat and material balance, factors influencing plate efficiency.
7. **Extraction :** Extractors, flow sheet of extraction plant, liquid-liquid extraction, extraction towers, solid-liquid extractors, counter current multistage extractors.
8. **Filtration :** Filters, classification of filters, different types of filtering equipment Factors affecting rate of filtration. Theory of filtration, limitations of filters, filter aids, centrifuges, sterile filters.
9. **Mixing :** Theory of mixing of liquids with liquids, gas with liquids, solids with solids, types of mixing.
10. **Crystallization :** Crystal forms, theory of crystallization, rate of crystal growth, classification of crystallizers.
11. **Size reduction :** Theory of size reduction : Size reduction equipment.
12. **Size separation :** Screen, standards of screen, screen analysis, types of screening equipment. Size separation by setting, classification and sedimentation.
13. **Conveying :** Conveyors, belt & parametric elevation.
14. **Drying :** Classificatuion of dryers, theory of drying. Factors affecting drying. Equipment used in drying- Freeze Dryer.
15. **Humidity :** Humidity chart and its use. Instruments used in determing humidity. Humidification - Theory, equipment used for humidification. Dehumidification - application and equipment. Refrigeration and air conditioning.

#### Recommended Books :

- 1] Introduction to chemical Engineering by Badger & Banchemo.
- 2] Unit operations of Chemical Engineering - McCabe & Smith.
- 3] Unit operations by Brown.
- 4] Hand book of Chemical Engineering - Perry
- 5] Unit operation in Pharmacy - D.Ganderton
- 6] Theory and practice of Industrial Pharmacy - Leon Lachman
- 7] Tutorial Pharmacy - Cooper & Gunn

## II.T.3

## Pharmaceutical Analysis-I

## Theory (50 Hours)

- Introduction** : Significance of quantitative analysis in quality control, different techniques of analysis, computation of analytical results, significant figures, concept of error, precision and accuracy, standard deviation, calibration of analytical equipments, fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards.
- Acid Base titrations** : Acid base concepts, relative strength of acids and bases, Ionization, law of mass action, common ion effect, ionic product of water, pH, Henderson-Hasselbach equation, neutralization curves, acid-base indicators and their choice and mixed indicators. Application to I.P. product. Assay of Aspirin powder, Boric acid powder, ephedrine and Benzoic acid powder.
- Oxidation Reduction titrations** : Theory and pharmaceutical applications, strength and equivalent weights of oxidizing and reducing agents, measurement of electrode potential, oxidation-reduction curves, redox indicators. Titrations involving potassium permanganate, ceric ammonium sulphate, potassium iodate, potassium bromate, titanous chloride, sodium 2,6-dichlorophenol - indophenol, Iodimetry and Iodometry. Application to I.P. product Ascorbic acid tab, Ferrous fumarate tab and ferrous sulphate powder.
- Precipitation titrations** : Principles of precipitation titrations; Titrations involving-mercuric nitrate, ammonium or potassium thiocyanate, argentometric titrations, adsorption indicators. Application to products as potassium chloride and sodium chloride injection.
- Gravimetric analysis** : Basic concepts, precipitation techniques, co-precipitation, post-precipitation, various steps involved in gravimetric analysis and their pharmaceutical applications. Sodium sulphate, assay of aluminium in alum by oxime reagent.
- Non-aqueous titrations** : Theoretical considerations, scope, limitations, titration of weak acids, weak bases, indicators and precautions. Application to IP product, assay of mebenzadole powder, atenolol of powder, Non floxacillin powder.
- Complexometric Titrations** : Complexation and chelation, Werner's Co-ordination number, stability of complexes, titrants, titration curves, types of complexometric titrations, methods of end point detection. Application of IP product. Assay of Zinc sulphate powder, calcium gluconate powder & calcium gluconate injection.

- Miscellaneous methods of analysis as** : Diazotization titration, Kjeldahl method of nitrogen estimation, oxygen flask combustion, gasometry.

## Reference Books :

- Practical Pharmaceutical Chemistry Part-I and Part-II by Beckelt and Stanlake.
- Vogel Text Book of Practical Organic Chemistry
- Vogeli Text Book of inorganic chemistry.
- Instrumental methods of Analysis by Willard, Dean, Merritt and Settle - Wordsworth Publication Co.
- Instrumental methods of Analysis by Ewing.
- Higuchi and Brochmann - Hanssen - Pharmaceutical Analysis.
- Indian Pharmacopoeia
- British Pharmacopoeia.
- U.S.P.

## II.P.2

## Pharmaceutical Analysis-I

## Practical (75 Hours)

- Standardization of analytical weights and calibration of volumetric apparatus.
- Acid-base Titrations** : Preparation and standardization of acids and bases; Some exercises related with determination of acids and bases separately or in mixture form, some official assay procedures e.g. boric acid should also be covered.
- Oxidation reduction titrations** : Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate etc. Some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, titanous chloride, sodium 2,6-dichlorophenol, indophenol and ceric ammonium sulphate.
- Precipitation titrations** : Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate. Titrations according to Mohr's, Volhard's and Fajan's methods.
- Gravimetric analysis** : Preparation of Gooch crucible for filtration and use of sintered glass crucible; Determination of water of hydration; Some exercises related to gravimetric analysis should be covered.

6. Preparation and standardization of perchloric acid and sodium/potassium/lethium methoxide. Estimation of some drugs based on it
7. Preparation and Standardization of EDTA and some assays on it.

## Reference Books :

- 1) Practical Pharmaceutical Chemistry, Part-I by Becket & Stenlake
- 2) Indian Pharmacopoeia
- 3) Practical Inorganic Chemistry by Vogel.

#### II.T.4                      **Pharmaceutical Chemistry-III** **(Heterocyclic & Natural Products)** **Theory (75 Hours)**

1. **Heterocyclic Compounds** : Chemistry, preparation and properties of some important mono-heterocyclics containing 3,4,5 and 6 atoms with one or two heteroatoms like N,O, S and fused systems like indole, benzimidazole, quinoline, isoquinoline, acridine, phenothiazine.
2. **Chemistry of** : Lipids, carbohydrates, amino acids and proteins and nucleic acids.
3. **Concepts of stereo isomerism** taking examples of natural products.
4. **Classification, chemistry and pharmacological activity** of medicinally important monoterpenes, sesquiterpenes, diterpenes and triterpenoids.
5. **Carotenoids** : Beta-carotenoids, alpha-carotenoids, vitamin A, xanthophylls of medicinal importance.
6. **Glycosides** : Chemistry of digitoxin, digoxin, hecogenin, sennosides, diosgenin and sarasapogenin.
7. **Alkaloids** : Classification and general methods of structural elucidation excluding individual structure, elucidation, chemistry and pharmacological activity of atropine and related compounds, quinine, reserpine, morphine, papaverine, ephedrine, ergot and vinca alkaloids.
8. **Chemistry** of medicinally important lignins and quassanoids, flavonoids, purines and xanthines.
9. **A brief account of chemistry and medicinal uses of** : Taxol and derivatives, podophyllotoxin and derivatives, coumarin, artemisinin.

**Books Recommended :**

- 1) R.T.Morrison and R.N.Boyd, "Organic Chemistry"
- 2) I.L.Finar, Organic Chemistry Vol. I & II, ELBS London.
- 3) Logowaski and Katritzki, Heterocyclic Chemistry.
- 4) K.B.G. Torsell, Natural Product Chemistry, John Wiley and Sons N.Y.
- 5) Wilson and Gisvold's T.B. of Organic, Medicinal and Pharmaceutical Chemistry, Lippincott Co.

#### II.P.3                      **Pharmaceutical Chemistry-III** **(Heterocyclic and Natural Products)** **Practical (75 Hours)**

1. Five exercises in synthesis involving various heterocyclic ring system.
2. Demonstration on molecular modelling of primary, secondary and tertiary structures of proteins, molecular modelling on double helical structure of nucleic acid showing hydrogen bonding.
3. Analysis of oils and fats as given in I.P.
4. Estimation of functional groups as hydroxyl, amino and carbonyl.

**Reference Books :**

- 1) Vogels textbooks of Practical Organic Chemistry.
- 2) Practical Organic Chemistry by Mann and B.C.Saunders.
- 3) Qualitative analysis in Organic Chemistry by Prof.V.V.Nadkarni and Dr.P.S.Fernandes.

#### II.T.5                      **Biochemistry** **Theory (50 Hours)**

1. Biochemical organisation of the cell and transport processes across cell membrane.
2. **Bioenergetics** : Introduction, concept of free energy, role of high energy nucleotide phosphates, production of ATP and its biological significance.
3. **Enzymes** : Nomenclature, enzyme kinetics and its mechanism of action, mechanism of inhibition, isozymes, enzymes and isozymes in clinical diagnosis.
4. **Co-enzymes** : Vitamins as co-enzymes and their biological significance, metals as coenzymes.
5. **Carbohydrate metabolism** : Glycolysis, fermentation, glucogenesis, glycogenolysis, glycogen formation, metabolism

of galactose and galactosemia, pentose phosphate pathway, uronic acid pathway, citric acid cycle-significance, abnormalities of carbohydrate metabolism.

6. **Lipid metabolism :** Oxidation of fatty acids (Beta, Alpha, Omega oxidations), Ketone bodies and their significance, Biosynthesis of saturated and unsaturated fatty acids, phospholipids, sphingolipids, control of lipid metabolism, essential fatty acids, biosynthesis of eicosanoids (prostaglandins, prostacyclines, thromboxanes and leukotrienes), Abnormalities of lipid metabolism.
7. Biological oxidation and its biochemical importance.
8. Nitrogen and sulphur cycle.
9. **Metabolism of ammonia and nitrogen containing monomers :** Nitrogen balance, biosynthesis and catabolism of amino acids, assimilation of ammonia; Urea cycle; metabolic disorders of urea cycle, metabolism of sulphur containing amino acids; porphyrin biosynthesis, formation of bile pigments, porphyrias, hyperbilirubemia.
10. Nucleic acid metabolism, Purine and pyrimidine metabolism, disorders of purine metabolism, purine and pyrimidine biosynthesis, purine pyrimidine nucleotides interconversion, inhibition of nucleotide biosynthesis. Biosynthesis of DNA and RNA, Abnormalities of nucleic acid metabolism, genetic disorders.
11. Genetic code, protein synthesis, inhibition of protein synthesis.
12. Regulation of gene expression.
13. Brief account of genetic engineering and polymerase chain reaction.

**Reference Books :**

1. A review of Physiological Chemistry by Harold Harper.
2. Biochemistry by A.Lenningers.
3. Principles of Biochemistry by A Lenninger.
4. Text Book of Biochemistry by Dagainawala
5. Hand Book of Biochemistry by Siddiqui
6. Outlines of Biochemistry by Cohn & R.K.Stumpf.

**Biochemistry**

**Practical (75 Hours)**

- II.P.4**
1. Preparation of standard buffers (citrate, phosphate and carbonate) and measurement of pH.
  2. Study of amino acids by paper chromatography.
  3. The determination of glucose by means of the glucometer.
  4. Estimation of SGOT, SGPT in the serum.
  5. Estimation of cholesterol, creatinine, urea and uric acid in biological fluids.
  6. Estimation of phospholipids in serum.
  7. Estimation of serum alkaline phosphatase and acid phosphatase levels.
  8. Estimation of bilirubin contents in the blood.
  9. Estimation of serum Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup> levels.
  10. Estimation Vit.C by iodophenol method.
  11. Determination of Amylase activity.
  12. Isolation of casein from milk.

**Reference Books :**

1. Experimental Biochemistry by J.M.Clarke & R.L.Switzer.
2. An introduction to Practical Biochemistry by Plummer tata.

**II.T.6**

**Pharmacology-I**

**Theory (75 Hours)**

1. **a) General and basic principles of Pharmacology :** Definition, scope and various branches of pharmacology, historical development of pharmacological thought with special reference to development of pharmacology in India, Routes of drug administration.
- b) Pharmacokinetics :** Mechanisms of principles of absorption, distribution, biotransformation and excretion of drugs.
- c) Pharmacodynamics :** Principles of drugs action, molecular mechanism of drug action, concept of receptors, theories of drug receptor interaction, agonist, partial agonist, antagonist, synergism, various types of antagonism, brief description of cellular signaling systems, factors modifying drug action, tolerance and tachyphylaxis.

2. a) **Pharmacology of drugs acting on autonomic nervous system :** Organisation and function of autonomic nervous system, autonomic transmission, cotransmission.
- b) **Cholinergic system and drugs :** Cholinergic transmission, cholinergic receptors, parasymphomimetic agents, anticholine sterases and anticholinergic drugs.
- c) **Adrenergic system and drugs :** adrenergic transmission, biosynthesis, storage, release, re-uptake and metabolism of endogeneous catecholamines, adrenergic receptors, adrenergic drugs, alpha & beta adreno receptors blockers, adrenergic neuron blockers.
- d) **Drugs acting on autonomic ganglia :** Ganglionic transmission, ganglionic stimulants, ganglion blocking agents. Neuromuscular blocking agents.
3. a) **Drugs acting on central nervous system :** Synaptic transmission in central nervous system.
- b) **General anesthetics :** Theories of anesthesia, stages of anesthesia, inhalation anesthetics, intravenous anesthetics, pre-anaesthetic medication.
- c) **Sedative-hypnotics :** Barbiturates, benzodiazepines and non-barbiturate hypnotics. Antiepileptic drugs and antiparkinsonian drugs.
- d) **Drugs used in mental illness :** antipsychotic agents, antianxiety drugs, antidepressants, antimaniac drugs, hallucinogens.
- e) **Opioid analgesics and antagonists :**  
Non-opioid analgesics and non steroidal anti-inflammatory agents and other drugs for arthritis, drugs used in gout.
- f) **Central nervous system stimulants and cerebroactive drugs.**
4. Drug abuse and its management.
5. **Autacoids and related drugs :** Histamine, 5-Hydroxytryptamine and their antagonist, Plasma kinins and angiotensin, Pentagastrin, substance P, and cholecystokinin Eicosanoids.
6. **Local Anesthetics**
7. **Hormones and related drugs :** Introduction to endocrine pharmacology, pituitary hormones oxytocic and tocolytic agents, thyroid hormones and anti thyroid agents, hormones of pancreas and hypoglycaemic agents, adrenal corticosteroids and corticosteroid antagonists, gonadal hormones and their inhibitors, oral contraceptives, drugs regulating calcium homeostasis.

**Reference Books :**

1. Pharmacological basis of Therapeutics by Goodman and Gilman.
2. Modern Pharmacology by C.R.Craig and R.E.Stitzel.
3. Pharmacology and Therapeutics by Grollman.
4. Pharmacology and Therapeutics by Satoskar R.S. and Bhandarkar.
5. Lewis Pharmacology by Crossland.
6. Pharmacology by Rang & Dale.
7. Essentials of Pharmacotherapeutics by F.S.K.Barar.

**II.P.5****Pharmacology-I  
Practical (75 Hours)**

1. **Introduction to experimental pharmacology :** Introduction to commonly used instruments used in experimental pharmacology, laboratory animals, anaesthetics employed to anaesthetise laboratory animals, physiological solutions, drug solution and use of molar solutions. Stunning, Pitting and euthanasia. Care and handling of laboratory animals.
2. **ADME studies :** Study of various routes of administration i.e. intravenous, intramuscular, subcutaneous and intragastric administration. Blood sample collection from experimental animals. Study of various routes of administration on sleeping time.
3. **Pharmacology of receptors :** Dose-response relationships, synergism and antagonism.
4. **Pharmacological techniques :** Common evaluation techniques of analgesics, anticonvulsants, local anaesthetics, drugs affecting muscle rigidity and ciliary movements.

**Reference Books :**

1. H.B. of Experimental Pharmacology by S.K.Kulkarni
2. Experiments in Pharmacy & Pharmacology - Vol.-II by G.K.Grover.
3. Fundamentals of experimental Pharmacology by M.N.Ghosh.

**II.T.7****Basic Electronics and Computer Applications  
Theory (50 Hours)**

1. **Basic Electronics :** Semiconductors, p-n junction diode, LED, Photodiode and its uses. Rectifiers (half wave, full wave/with filters), Transistors, configurations, transistors, amplifiers. Introduction to integrated circuits, photo cells and photomultiplier tubes.

2. **Computers :** History of computers, simple model of computer and its working, parts of computers. CPU, memory, input/output devices, computer languages and their hierarchy machine language, assembly language, high level language, comparison of high level and low level languages especially C, Pascal, FORTRAN etc., Introduction to microcomputers, concepts of operating systems. Elements of DOS, UNIX etc. introduction of computer networks, spread sheets especially LOTUS 1-2-3, Concepts of data base and data base managements system : Objectives of data base management system, advantages and disadvantages of data base management system, examples of DBMS package (DBASE III)
3. **Flow charting and algorithm development :** Definition and properties of algorithm, Flow chart symbols and their use, Examples of efficient algorithm and flow-chart, Conversion of algorithm/flow chart to high level language.
4. **Introduction to Computer Programming :** BASIC language : BASIC character set, constants variables, expresion, Statements and system commands in BASIC, Entering and editing BASIC program, control structures, repetation statements (loops), nested loop, definite and indefinite loops, selection statements, array functions and subroutines. Concepts of files : Programme files and data files, Sequential files and random access files. Elementary BASIC programmes to numeric & string processing.
5. Computer applications in pharmaceutical and clinical studies.

**Reference Books :**

- 1) Computer today (3rd edition) by donald landers.
- 2) Computer Applications in Pharmacy by William and Fassett.
- 3) Computer Medicine by S.Rose.

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Also refer additional recommended book list, enclosed at the end of syllabus.

**ADDITIONAL BOOKS RECOMMENDED**

**IT IS UNDER STOOD THAT THE TEACHER WOULD FOLLOW AND RECOMMEND LATEST EDITION OF THE BOOK, HENCE THE SPECIFIC EDITION AND YEARS OF PUBLICATION ARE OMITTED.**

1. **Pharmaceutics (including Pharmaceutical Microbiology and Pharmaceutical Biotechnology)**
  - 01) A Owunwonne, Handbook of Radiopharmaceuticals, Narosa Publishing House, New Delhi.
  - 02) A Pecile and A Resigno Pharmacokinetics, Plenum Press, NY.
  - 03) Aiba Suichi, Humphrey and Millis, Biochemical Engineering, University of Tokyo Press.
  - 04) Allwodd M C and Fell J T, Textbook of Hospital Pharmacy, Blackwell Scientific Publications, Oxford.
  - 05) Ansel H.C., Introduction to Pharmaceutical Dosage Forms, K M Varghese & Co., Bombay.
  - 06) Aulton M E Pharmaceutics - The Science of Dosage Form Design, ELBS/Churchill Livingstone.
  - 07) Avis K E, Lachman L and Lieberman H A, Marcel Dekker Inc. Pharmaceutical Dosage Forms; Parenteral Medications, Vols. 1 & 2, NY.
  - 08) Badger W L and Banchemo J T, Introduction to Chemical Engineering McGraw Hill International Book C o . . , London.
  - 09) Banker G S and Rhode C T Modern Pharmaceutics, Marcel Dekker Inc., NY.
  - 10) Bean H S, Beckett A H, and Carless A H Advances in Pharmaceutical Sciences, Vol 1-4 Academic Press, London.
  - 11) Bergey's Manual of Determinative bacteriology.
  - 12) Bharati H K, Drugs and Pharmacy Laws in India, Sadhana Mandir, Indore.
  - 13) Bolton Sanford, Pharmaceutical Statistics, Marcel Dekker Inc NY.
  - 14) British National Formulary, No.25 Pub jointly by British Medical Association and Royal Pharmaceutical Society of Great Britain.
  - 15) British Pharmacopoeia, Her Majesty's Stationery Office, University Press, Cambridge.
  - 16) Brock T D, Madigen M T Biology of Micro-organism Prentice Hall, New Jersey USA.
  - 17) Carter S J, Cooper and Gunn's Dispensing for Pharmaceutical Students, CBS Publishers, Delhi.

- 18) Carter S J, Cooper and Gunn's Tutorial Pharmacy CBS Publishers, Delhi.
- 19) Carstensen J T, Drug Stability, Marcel Dekker Inc. NY.
- 20) Chittion HM and Witcofski RL, Nuclear Pharmacy, Lea and Febiger, Philadelphia.
- 21) Connors K A, Amidon G L and Stella V J, Chemical Stability of Pharmaceuticals, John Wiley & Sons NY.
- 22) Davis, Dulbetco, Eisen Microbiology.
- 23) Dittert LW Sprowl's American Pharmacy, J & B Lippincott Co, Philadelphia.
- 24) C G Brown, Unit operations (Indian Ed) Asia Publishing House, Bombay.
- 25) Giladi M & Perrier D, Pharmacokinetics, marcel Dekker Inc NY.
- 26) Remington's, the science and Practice of Pharmacy, Mack Publishing Co. Easton, Pennsylvania.
- 27) Hassan Willman E, Hospital Pharmacy, Lea & Febiger, Philadelphia.
- 28) Hoover J.E. Dispensing of Medication, ed Mack Publishing Co., Easton PA.
- 29) Hugo and Russel, Pharmaceutical Microbiology; Blackwell Scientific Publication, Oxford.
- 30) Jellinek JS, Formulation and Function of Cosmetics, John Wiley & Sons, NY.
- 31) Jain N K A Text Book of Forensic Pharmacy, Vallabh Prakashan, Delhi.
- 32) Juliano R L, Drug Delivery Systems, Oxford University Press, Oxford.
- 33) KacChensney J C Packaging of Cosmetics and Toiletries, Newness - Butterworth, London.
- 34) Kielslich K, Ed Biotechnology Vol 6a, Verleg Chemie, Switzerland.
- 35) Lachman L, Lieberman H A and Kanig J L, The Theory and Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia.
- 36) Lea & Fibiger, "Milo Gibaldi, Biopharmaceutics & Clinical Pharmacokinetics", Philadelphia.
- 37) Lea & Fibiger, Pharmaceutical Dosage, Forms and Drug Delivery Systems, Philadelphia.
- 38) Lewin Benjamin, Gene V Microbiology.
- 39) Liberman H A, Rieger M M and Banker G S, "Pharmaceutical Dosage Forms; Dispensing Systems", Vols.1 & 2, Marcel Dekker Inc., NY.

- 40) Liberman H A, Lachman L & Schwartz J B Pharmaceutical Dosage Forms : Tablets.", Vols.1-3, Marcel Dekker Inc., NY.
- 41) Loftus B T and Nash Robert, Pharmaceutical Process Validation, Marcel Dekker Inc., NY.
- 42) MaCabe W L and Smith J C, Unit Operations of Chemical Engineering McGraw Hill International Book Co., London.
- 43) Martin A N, Arthur Cammarata, James Swarbrick, Physical Pharmacy, K M Verghese & Co., Bombay.
- 44) Martin E.W. Dispensing of Medication, Mack Publishing Co., Eastern PA.
- 45) Martindale : The Extra Pharmacopoeia, ed J E F Reynolds, The Pharmaceutical Press, London.
- 46) Merchant H.S and Qadry J.S, Text Book of Hospital Pharmacy, B.S. Shah Prakashan, Ahmedabad.
- 47) Mittal B.M. A Text Book of Forensic Pharmacy, National Book Depot, Calcutta.
- 48) Notari R E, Biopharmaceutics and Pharmacokinetics - an Introduction Marcel Dekker Inc NY.
- 49) Parry R H & Chilton C H Chemical Engineers Handbook, McGraw Kogakusha Ltd.
- 50) Pepler, Microbial Technology, Vol I & II.
- 51) Pharmacopoeia of India, published by the Controller of Publications, Delhi, 1st ed - 1966 - 1985 4th ed-1996.
- 52) Prescott L M, Jarely G P, Klein D A, Microbiology, WmC Borown Publishers, Oxford.
- 53) Prescott and Dunn, Industrial Microbiology, McGraw Hill Book Company Inc.
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