

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

EVALUATION SCHEME & SYLLABUS



BACHELOR OF PHARMACY

ECOND SEMESTER

Course Code	Name of the Course	No. of Hours/ week	Internal Assessment				End Semester Exams		Total Marks	Credit Points
			Continuous Mode	Sessional Exams		Total	Marks	Duration		
				Marks	Duration					
BP201T	Human Anatomy and Physiology II – Theory	4	10	15	1 Hr	25	75	3 Hrs	100	4
BP202T	Pharmaceutical Organic Chemistry I – Theory	4	10	15	1 Hr	25	75	3 Hrs	100	4
BP203T	Biochemistry– Theory	4	10	15	1 Hr	25	75	3 Hrs	100	4
BP204T	Pathophysiology– Theory	4	10	15	1 Hr	25	75	3 Hrs	100	4
BP205T	Computer Applications in Pharmacy – Theory	3	25	50	2 Hrs	75	---	---	75	3
BP206T	Environmental Sciences – Theory	3	25	50	2 Hrs	75	---	---	75	3
BP207P	Human Anatomy and Physiology II – Practical	4	5	10	4 Hrs	15	35	4 Hrs	50	2
BP208P	Pharmaceutical Organic Chemistry I – Practical	4	5	10	4 Hrs	15	35	4 Hrs	50	2
BP209P	Biochemistry– Practical	4	5	10	4 Hrs	15	35	4 Hrs	50	2
BP210P	Computer Applications in Pharmacy – Practical	2	10	15	2 Hrs	25	---	---	25	1
Total		36	115	205	22 Hrs	320	405	24 Hrs	725	29

Semester II

BP201T. HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)

45 Hours

Course Content:

Unit-I

10 hours

Nervous system

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fiber, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity).

Unit II

06 hours

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

Energetics: Formation and role of ATP, Creatinine Phosphate and BMR.

Unit-III

10 hours

Respiratory system

Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration.

Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

Urinary system: Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

Unit-IV

10 hours

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

Unit-V

09 hours

Reproductive system: Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition.

Introduction to genetics: Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance.

BP207P. HUMAN ANATOMY AND PHYSIOLOGY-II (Practical)

4 Hours/week

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

Recommended Books (Latest Editions)

- Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York.
- Best and Taylor's Physiological Basis of Medical Practice by Best, Charles Herbert, Taylor, Norman Burke, John Bernard, 12th edition; William and Wilkins, Baltimore.
- Textbook of Medical Physiology by Arthur C, Guyton and John. E. Hall. Miamisburg, Ohio, U.S.A.
- Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
- Pharmacotherapy- A Pathophysiological Approach by Dipiro J.L., Elsevier, Amsterdam.
- Human Anatomy, Regional & Applied Part I, II & III by Chaurasia B.D, CBS Publishers & Distributors, New Delhi.
- Anatomy and Physiology in Health and Illness by Ross and Wilson, Churchill Livingstone, London.
- Essentials of Anatomy and Physiology by Seeley R.R., Stephens T.D. and Tate, P., McGraw-Hill, New York.
- Human Physiology, Volume 1 and 2 by Dr. C.C. Chatterjee, Academic Publishers Kolkata.

BP202T. PHARMACEUTICAL ORGANIC CHEMISTRY-I (Theory)

45 Hours

Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences.

Unit-I

07 Hours

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

Unit II

10 Hours

Alkanes*, Alkenes* and Conjugated dienes*

sp^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, sp^2 hybridization in alkenes.

E_1 and E_2 reactions – Kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeff's orientation and evidences. E_1 versus E_2 reactions, Factors affecting E_1 and E_2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti-Markownikoff's orientation.

Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement.

Unit III

10 Hours

Alkyl halides*

SN_1 and SN_2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN_1 versus SN_2 reactions, Factors affecting SN_1 and SN_2 reactions.

Structure and uses of ethyl chloride, chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.

Alcohols*- Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol.

Unit-IV**10 Hours****Carbonyl compounds* (Aldehydes and ketones)**

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

Unit-V**08 Hours**

Carboxylic acids*: Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids, amide and ester.

Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid.

Aliphatic amines*: Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine.

BP208P. PHARMACEUTICAL ORGANIC CHEMISTRY-I (Practical)

4 Hours / week

- A. Systematic qualitative analysis of unknown organic compounds like
1. Preliminary test: Color, odor, aliphatic/aromatic compounds, saturation and unsaturation, etc.
 2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test.
 3. Solubility test.
 4. Functional group test like Phenols, Amides/Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.
 5. Melting point/Boiling point of organic compounds.
 6. Identification of the unknown compound from the literature using melting point/boiling point.
 7. Preparation of the derivatives and confirmation of the unknown compound by melting point/boiling point.
 8. Minimum 5 unknown organic compounds to be analyzed systematically.
- B. Preparation of suitable solid derivatives from organic compounds.
- C. Construction of molecular models.

Recommended Books (Latest Editions)

- Organic Chemistry by Morrison R.T., Boyd R.N. and Bhattacharjee, S.K., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.
- Organic Chemistry by I.L. Finar, Volume-I, Pearson Education Ltd, New Delhi.
- Organic Chemistry by Bruice P.Y. and Prasad, K.J.R., Dorling Kindersley (India) Pvt. Ltd, New Delhi.
- A Guidebook to Mechanism in Organic Chemistry by Peter Sykes, Longman Group Ltd., Noida.
- Strategic Applications of Named Reactions in Organic Chemistry by Laszlo Kurti and Barbara Czako, Elsevier Academic Press.
- Reaction and Reaction Mechanism by Ahluwalia/Chatwal, Narosa Publishing House, New Delhi.
- Organic Chemistry by Jain M.K., Sohan Lal Nagin Chand & Co, New Delhi.
- Elementary Practical Organic Chemistry by Vogel A.I., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.
- Practical Organic Chemistry by Mann F.G, and Saunders, B.C., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education Ltd.), New Delhi.
- Advanced Practical Organic Chemistry by N.K. Vishnoi, Vikas Publishing House Pvt. Ltd., Noida.
- Introduction to Organic Laboratory Techniques by Pavia, Lampman and Kriz, Cengage Learning, Delhi.

BP203T. BIOCHEMISTRY (Theory)

45 Hours

Course Content:

Unit-I

08 Hours

Biomolecules: Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

Bioenergetics: Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.

Energy rich compounds; classification; biological significances of ATP and cyclic AMP.

Unit-II

10 Hours

Carbohydrate metabolism:

Glycolysis- Pathway, energetics and significance.

Gluconeogenesis- Pathway and its significance.

Citric acid cycle- Pathway, energetics and significance.

HMP shunt and its significance- Glucose-6-Phosphate dehydrogenase (G6PD) deficiency.

Glycogen metabolism Pathways and glycogen storage diseases (GSD).

Hormonal regulation of blood glucose level and Diabetes mellitus.

Biological oxidation:

Electron transport chain (ETC) and its mechanism.

Oxidative phosphorylation & its mechanism and substrate level phosphorylation.

Inhibitors ETC and oxidative phosphorylation/Uncouplers.

Unit-III

10 Hours

Lipid metabolism: β -Oxidation of saturated fatty acid (Palmitic acid). Formation and utilization of ketone bodies; ketoacidosis. De novo synthesis of fatty acids (Palmitic acid).

Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D.

Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.

Amino acid metabolism: General reactions of amino acid metabolism.

Transamination, deamination and decarboxylation, Urea cycle and its disorders.

Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, Alkaptonuria, Tyrosinemia).

Synthesis and significance of biological substances: 5-HT, melatonin, dopamine, noradrenaline, adrenaline.

Catabolism of heme; hyperbilirubinemia and jaundice.

Unit-IV**10 Hours****Nucleic acid metabolism and genetic information transfer**

Biosynthesis of purine and pyrimidine nucleotides.

Catabolism of purine nucleotides and Hyperuricemia and Gout disease.

Organization of mammalian genome.

Structure of DNA and RNA and their functions DNA replication (semi conservative model)

Transcription or RNA synthesis.

Genetic code, Translation or Protein synthesis and inhibitors.

07 Hours**Enzymes**

Introduction, properties, nomenclature and IUBMB classification of enzymes.

Enzyme kinetics (Michaelis-Menten plot, Line-Weaver Burke plot) Enzyme inhibitors with examples.

Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation.

Coenzymes: Structure and biochemical functions.

Therapeutic and diagnostic applications of enzymes and isoenzymes.

BP209P. BIOCHEMISTRY (Practical)

4 Hours / Week

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

Recommended Books (Latest Editions)

- Harper's Illustrated Biochemistry by Murray R.K. and Granner D.K., Lange Medical Publication.
- Lehninger Principles of Biochemistry by Nelson D.L. and Cox M.M., Macmillan Worth Publishers.
- Fundamentals of Biochemistry by Voet D., Voet J.G., Pratt C.W., John Wiley and Sons Inc.
- Lippincott's Illustrative Reviews: Biochemistry by Champe P.C., Harvey R.A., Ferrier D.R., Lippincott Williams and Wilkins.
- Principles and Techniques of Biochemistry and Molecular Biology- by Wilson K. and Walker J., Cambridge University Press.
- Bioorganic Chemistry: A Chemical Approach to Enzyme Action by Dugas H., Springer (India) Private Limited, New Delhi.
- Molecular Cell Biology by Lodish H., Berk A., Matsudaira P., Kaiser C.A., Krieger M. and Scott M.P., W. H. Freeman and Company, New York.
- Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition), McGraw Hill, New Delhi.
- Outline of Biochemistry by Conn E.E. and Stumph P.K., John Wiley & Sons, New York.

- Biochemistry by Stryer L. and Berg J.M., W.H. Freeman and Company, New York.
- Textbook of Biochemistry by Harrow B. and Mazur A., W.B. Saunders Co., Philadelphia.
- Practical Biochemistry by Harold Varley. CBS Publishers and Distributors. New Delhi.
- Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
- Laboratory Manual in Biochemistry by Jayaraman J., Wiley Eastern Limited.
- Practical Manual to Biochemistry by Singh S.P., CBS Publisher, New Delhi.
- Modern Experimental Biochemistry by Boyer R.F., Dorling Kindersley (India) Pvt. Ltd.
- Comprehensive Viva and Practical Biochemistry by Deb A.C., New Centre Book Agency (P.) Ltd. London.
- Pharmaceutical Biochemistry by Vyas S.P. and Kohli D.V., CBS Publishers & Distributors, New Delhi.

BP204T. PATHOPHYSIOLOGY (THEORY)

45Hours

Course content:

Unit-I

10 Hours

Basic principles of Cell injury and Adaptation:

Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage), Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance.

Basic mechanism involved in the process of inflammation and repair:

Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis.

Unit-II

10Hours

Cardiovascular System:

Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)

Respiratory system: Asthma, Chronic obstructive airways diseases.

Renal system: Acute and chronic renal failure.

Unit-III

10Hours

Hematological Diseases:

Iron deficiency, megaloblastic anemia (Vitamin B12 and folic acid), sickle cell anemia, thalassemia, hereditary acquired anemia, hemophilia.

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

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

Gastrointestinal system: Peptic Ulcer.

Unit-IV

8 Hours

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

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

Principles of cancer: classification, etiology and pathogenesis of cancer.

Unit-V**7 Hours****Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis, Urinary tract infections.**Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhoea.**Recommended Books (Latest Editions)**

- Robbins & Cotran Pathologic Basis of Disease by Vinay Kumar, Abul K. Abas, Jon C. Aster; South Asia edition; India; Elsevier.
- Text book of Pathology by Harsh Mohan; 6th edition; India; Jaypee Publications.
- Goodman Gilman's The Pharmacological Basis of Therapeutics by Laurence B, Bruce C., Bjorn K. 12th edition; McGraw-Hill, New York.
- Best and Taylor's Physiological Basis of Medical Practice by Best, Charles Herbert, Taylor, Norman Burke, John Bernard, 12th edition; United States; William and Wilkins, Baltimore.
- Davidson's Principles and Practice of Medicine by Nicki R. College, Brian R. Walker, Stuart H. Ralston, 21st edition; London; ELBS/Churchill Livingstone.
- Textbook of Medical Physiology by Guyton A, John. E Hall; 12th edition; WB Saunders Company.
- Pharmacotherapy by Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey, A Pathophysiological Approach; 9th edition; London; McGraw Hill Medical.
- Basic Pathology by V. Kumar, R. S. Cotran and S. L. Robbins, 6th edition; Philadelphia; WB Saunders Company.
- Clinical Pharmacy and Therapeutics by Roger Walker, Clive Edwards, 3rd edition; London; Churchill Livingstone Publication.

Recommended Journals

- The Journal of Pathology. ISSN: 1096-9896 (Online).
- The American Journal of Pathology. ISSN: 0002-9440.
- Pathology. 1465-3931 (Online).
- International Journal of Physiology, Pathophysiology and Pharmacology, ISSN: 1944-8171.
- Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

BP205T. COMPUTER APPLICATIONS IN PHARMACY (Theory)

30 Hours (2 Hours/Week)

Course content:

Unit-I

06 hours

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

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

Unit-II

06 hours

Web technologies: Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products.

Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database.

Unit-III

06 hours

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

Diagnostic system. Lab-diagnostic System, Patient Monitoring System, Pharma Information System.

Unit-IV

06 hours

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

Unit-V

06 hours

Computers as data analysis in Preclinical development:

Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS).

BP210P. COMPUTER APPLICATIONS IN PHARMACY (Practical)

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

Recommended books (Latest edition):

- Computer Application in Pharmacy by William E. Fassett, Lea and Febiger, South Washington Square, USA, (215) 922-1330.
- Computer Application in Pharmaceutical Research and Development by Sean Ekins, Wiley-Interscience, A John Willey and Sons, INC., Publication, USA.
- Bioinformatics (Concept, Skills and Applications) by S.C. Rastogi, CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi.
- Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath by Cary N. Prague – Wiley Dreamtech India (P) Ltd., New Delhi.

BP206T. ENVIRONMENTAL SCIENCES (Theory)

30 hours

Course content:

Unit-I

10hours

The multidisciplinary nature of environmental studies.

Natural Resources.

Renewable and non-renewable resources: Natural resources and associated problems

a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit-II

10hours

Ecosystems

Concept of an ecosystem.

Structure and function of an ecosystem.

Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit-III

10hours

Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books (Latest edition):

- Environmental Science by Singh, Y.K., New Age International Pvt. Publishers, Bangalore.
- Environmental Biology by Agarwal, K.C., 2001, Nidi Publ. Ltd. Bikaner.
- The Biodiversity of India by Bharucha Erach, Mapin Publishing Pvt. Ltd., Ahmedabad, India.
- Hazardous Waste Incineration by Brunner R.C., 1989, McGraw Hill Inc.
- Marine Pollution by Clark R.S., Clarendon Press Oxford.
- Environmental Encyclopedia, by Cunningham, W.P. Cooper, T.H., Gorhani, E. & Hepworth, M.T., Jaico Pub. House, Mumbai.
- Environmental Chemistry by De A.K., Wiley Eastern Ltd.
- Down of Earth, Centre for Science and Environment, Editor Sunita Narain.