

**Swami Ramanand Teerth Marathwada University
Nanded.**

FACULTY OF SCIENCE

SYLLABUS

**B.Sc. (BIOPHYSICS)
SECOND YEAR (MCQ Pattern)**

SEMESTER III & IV

[Syllabus progressively effective from June 2012 onwards]

**B.Sc. Biophysics Second Year Syllabus
(2012-13)
Semester III & IV**

Paper Code	Course Title	Semester	Teaching WL/Week	Marks		
				External	Internal	Total
BP VI	Membrane Biophysics	III	3 Hrs	40	10	50
BP VII	Molecular Biology	III	3 Hrs	40	10	50
BP VIII	Physiological Biophysics	IV	3 Hrs	40	10	50
BP IX	Molecular Enzymology	IV	3 Hrs	40	10	50
BPLAB X	Practical Course (Annual Pattern)	Based on Theory Paper-VI & VII	4 Hrs	50	---	50
BPLAB XI	Practical Course (Annual Pattern)	Based on Theory Paper-VIII & IX	4 Hrs	50	---	50
Grand Total						300

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B. Sc. Second year Semester III Syllabus [Biophysics]

Paper BP-VI : Membrane Biophysics

[Total Marks: 50] (40Ext.+10 Int.) [Exam Duration: 1 hrs] [Total Workload:45 hrs]

Unit I: Membrane structure and Models:

Membrane architecture, Lipid vesicles and planar Bilayer membrane, Membrane permeability, Membrane Channels, transmembrane helices, hydrophobic Plot, Membrane Asymmetry, Membrane fluidity, Functional reconstitution of membranes. Models of membrane fusion: bilayer fusion, viral fusion, cellular fusion, cell-cell fusion, fusion in mitochondria, Lipid bilayer and early models, Fluids mosaic model, Evidence from model system and biomembranes.

Unit II: Physical Properties of membrane:

Elastic properties, Elastic constants, Charge-induced microstructures and domain. Hysteresis of domain formation. Lateral phase separation. Critical concentrations fluctuation, selective lipid protein interactions, Membrane melting.

Unit III: Membrane transport:

Transport system with non-electrolytes and electrolytes. Transport with chemical reaction system: Primary and secondary active transport. Transports of molecules by simple and facilitated diffusion Transport by flux coupling. Transport by phosphotransferase system, Transport by vesicle formation

Electron Transport & Oxidative phosphorylation: Reduction potentials and free energy changes in redox reaction, organization of electron transport chain, chemiosmotic coupling, proton gradient drive and synthesis of ATP, P/O ratio for oxidative phosphorylation, Cytosolic NADH electron feeding into electron transfer

Unit IV: Membrane potentials Cell surface charge, Resting membrane potential, Action potential, properties of action potential, Nernst equation, Hodgkin-Huxley equation, Membrane impedance and capacitance, Transmembrane potential, Zeta, Stern and total electrochemical potential.

Books Recommended:

1. Molecular & Cellular Biology, D Roberties,
2. Biophysical Aspects of Transmembrane signaling, Sandor D (2005), Springer
3. Biophysics, Vasant Pattabhi, Gautam (2002), Narosa

4. Biomembrane structure and Function, Chapman D.
5. Introduction to Biological Membrane, Jain R K
6. Biophysics, Hopp, Lohman, Mark and Ziegler
7. Advances in Biophysics, Vol 18, 15
8. Molecular and Cellular Biophysics, Meyer B Jackson (2006), Cambridge)
9. Text Book of Physiology, Guyton & Hall, 11th Ed. 2006

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B. Sc. second year Semester III Syllabus [Biophysics]

Paper BP-VII: Molecular Biology

[Total Marks: 50] (40Ext.+10 Int.) [Exam Duration: 1 hrs] [Total Workload:45 hrs]

Unit 1 - Introduction to molecular biology

The Central Dogma, DNA Structure and Chemistry, The Molecular Nature of Genes & Organization, Gene Function, Protein-DNA Interactions (prokaryote and eukaryote), DNA Topology and the Nucleosome, Introduction to bacterial genetics. DNA Replication: The Replication Fork, Origins and Telomeres, Enzymes of DNA synthesis, DNA Repair, DNA Recombination.

Unit II- Transcriptional Machinery

, RNA Structure, RNA Types, genetic code, Eukaryotic RNA Polymerases and Their Promoters, reverse transcriptase, General Transcription Factors and Transcription. Activators in Eukaryotes Messenger RNA Processing: Splicing, Capping and Polyadenylation, Ribozymes, and Regulatory RNA Phage, Bacterial & Eukaryotic transcriptional Control.

Unit – III Ribosomal RNA and Transfer RNA

The Mechanism of Translation: Initiation, Elongation and Termination, Post Translational processing, Translational Control, Posttranslational modifications. Control of genetic expression, Lac, Trp, Ara, His, operons, regulation of protein synthesis.

Unit – IV Basic principles of rDNA technology

restriction enzymes, and its applications in medicine, agriculture, and in the production of commercially important proteins.

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B. Sc. Second year Semester IV Syllabus [Biophysics]
Paper BP-VIII: Physiological Biophysics
[Total Marks: 50] (40Ext +10 Int.) [Exam Duration: 1 hrs] [Total Workload: 45 hrs]

Unit I-Endocrine, Digestive & Excretory systems

Digestive system – oesophagus, stomach and small and large intestine and liver. Process of digestion.

Excretory system – structure of kidney, ureter, urinary bladder urethra, functions of kidney, formation of urine and its composition.

Unit II- Cardiovascular & Respiratory system

Circulatory system. Heart as a pump, cardiac cycle, Composition of blood and lymph, blood vessels. Structure of arteries, veins and capillaries, Haemodynamic principles.

Respiratory system – Respiratory tract, lungs. Process of respiration. Transport and exchange of oxygen and carbon dioxide in body.

Unit III- Nervous system & Sense organs

Central nervous system., brain and spinal cord. Functions of cerebrum, cerebellum and medulla oblongata, Peripheral nervous system, Structure of neuron, Neuroglia. Myelinated and unmyelinated nerve fibers. Polarisation and depolarisation of the cell, Conduction velocity of nerve impulse in relation to various factors, Properties of nerve fibers –excitability, conductivity, all-or none law, accommodation, adaptation, summation, refractory period, Concept of chronaxie and rheobase. Synapses- types & structure, synaptic potentials, synaptic transmission of the impulse, neurotransmitters. Motor unit. Injury to peripheral nerves- degeneration and regeneration-brief idea. The neuromuscular junctions – structure, events in transmission, end-plate potential. Sense organs -Physiology of Vision, audition, olfaction, taste, tactile sensation

Unit IV-

Endocrine glands – Role of hypothalamus, functions of pituitary, thyroid, adrenal glands, parathyroid and gonads.

Reproductive Systems-Structure & physiology, concepts of IVF, IUI, sperm analysis

Books Recommended:

1. Booback. J R (Ed), “Best and Taylor’s Physiological basis of Medical Practice”, The Williams & Wilkins Co.
2. Howell- Fulton, “Physiology and Biophysics”, T.C. Iwch & H.D. Palton, W.B. Saunders Co. 23
3. Berne. R.M & Levy. M.N (Eds), “Physiology”, The C.V. Mosby Co. St. Louis, Toronto.
4. Hamilton. W.F, “ Hand Book of Physiology”, Section 2, Circulation Vol II, American Physiological Society.

5. Arthur .C. Guyton & John.E.Hall, “Text Book of Medical Physiology”, W. B.Saunders Co.
6. Widmaier, Raff & Strang, “Vander’s Physiology- The mechanism of body Function. Mc Graw- Hill.

Reference Books:-

1. Principles of Biochemistry by A.L. Lehninger, D.L. Nelson and M.M. Cox, CBS Publishers, New Delhi, 1993.
2. Biochemistry by L. Stryer, W.H. Freeman and Co., Newyork 1997.
3. Conformation of Carbohydrates by V.S.R. Rao, P.K. Qasba, P.V. Balaji and R. Chandrasekaran, Harwood Academic Publishers, 1998.
4. Steno Chemistry of Carbohydrates J.F. Stoddart , Wiley Interscience 1971.
5. Complex Carbohydrates their Chemistry by N. Sharon, Biosynthesis and Functions, Addison-Wesley, London, 1975.
6. Bio active carbohydrates in Chemistry, Biochemistry and Biology by J.F.Kennedy and C.A.White, Ellis Harwood, New York, 1983.
7. Principles of Protein Structure by G. Schulz and R.H. Schirmer, Springer -Verlag, 1984.
8. Introduction to Protein Structure by C. Branden and J. Tooze, Gar land Publishing, 1991.
9. Proteins Structure and Molecular Properties Thomas E. Creighton, W.H. freeman and Company, New York, 1993.
10. Principles of Nucleic acid Structure, W. Saenger, Springer verlag, 1984.
11. Biophysics by W. Hoppe. et. al., Springer - Verlag, 1989.
12. Biophysics by Vasantha Pattabhi and N. Gautham, Narosa Publishmg House, New Delhi,2002.
13. Essentials of Biophysics by P. Narayanan, New Age International (P) Ltd. Publishers, New Delhi, 2000.

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B. Sc. Second year Semester IV Syllabus [Biophysics]

Paper BP-IX: Molecular Enzymology

[Total Marks: 50] (40Ext +10 Int.) [Exam Duration: 1 hrs] [Total Workload: 45 hrs]

Unit 1:Introduction to Enzymes

General and unique features of enzyme, nomenclature and classification of enzymes, Enzyme commission code, Catalysis,Acid-base catalysis and covalent catalysis, characteristics and mechanism of enzyme action, lock & key hypothesis, induced fit hypothesis, Active site structure, Enzyme specificity & selectivity, Co-enzymes and cofactors, Role of various cofactors in enzyme catalysis, Measurement of enzyme activity and its expression as Enzyme units, specific activity, katal, Intracellular localization of enzymes,

Unit 2: Kinetics of enzyme

A.J. Braun's hypothesis, Michaelis-Menton equation, steady state hypothesis, V_{max} , K_m & turnover number and their significance. Line Weaver-Burk plots and its limitation. Eddie-Hofstee plot, Woolf-Hanes plot, Factors affecting enzyme activity-pH, temperature, pressure,.

Unit 3: Enzyme Inhibitions

Nature of enzyme inhibitors and activators, Reversible, irreversible, competitive, non-competitive, uncompetitive and mixed types of inhibition, Metalloenzymes, Metal ions as enzyme inhibitors and activators.

Unit 4: Use of Enzymes

Extraction and purification of enzymes by using various techniques. Tests for purification and characterization. Immobilization of enzymes, Industrial and clinical applications of enzymes. Use of enzymes in food, Feed, dairy, leather, textile and drug industries. Enzyme electrodes

Books Recommended:

1. Principles of Biochemistry - L. Stryer (W.H. Freeman & Co.)
2. Principles of Biochemistry - A.L. Lehninger, D.W. Nelson & M.M. Cox (Macmillan)
3. Biochemistry - D. Voet & J.G. Voet (John Willey)
4. Harper's Illustrated Biochemistry - R.K. Murray et al. (McGraw Hill)
5. Outline of Biochemistry - Conn & Stump (John Willey & Sons)
6. Protein Science - A.M. Lesk (Oxford Univ. Press)
7. DNA Structure & Function - R.R. Sinden (Academic Press)
8. The Enzyme - Dixon & Webb
9. Enzymes: The Machines of Life-
10. Enzyme Kinetics - Ronald Breslow
11. Understanding Enzymes - Palmer

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B. Sc. SECOND YEAR PRACTICAL COURSE Syllabus [Biophysics]

Paper BPLAB X: Practicals Based on BP-VI & BP-VII

[Total Marks: 50] [Exam Duration: 4 hrs] [Total Workload 60 hrs]

Membrane Biophysics Practicals (Practicals based on BP-VI)

1. Study of membrane fluidity.
2. Effect of hypertonic/ hypotonic/isotonic on RBC membrane.
3. Purification of substances by dialysis
4. Study of volume regulation of erythrocyte and osmotic fragility.
5. Ionophore effect on erythrocyte.
6. Osmolarity: Determination of osmotic pressure of salts.

7. Verification of Fick's law of diffusion.
8. Study of phase transition of membrane phospholipids.
9. To study of membrane potential using fluorescence spectroscopy.

Molecular Biology Practicals(Practicals based on BP-VII)

1. UV spectra of DNA
2. Isolation of chromosomal DNA from *E.coli*.
3. Isolation of plasmid DNA from transformed *E.coli*
4. Characterization of isolated DNAs by agarose gel electrophoresis.
5. Extractions of nucleic acids from gels.
6. Artificial transformation of *E.coli* by plasmid DNA.
7. Study of bacterial conjugation.
8. SDS-PAGE of protein.

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B. Sc. SECOND YEAR PRACTICAL COURSE Syllabus [Biophysics]
Paper BPLAB XI: Practicals Based on BP-VIII & BP-IX
[Total Marks: 50] [Exam Duration:4 hrs] [Total Workload 60 hrs]

Physiological Biophysics Practicals (Practical's based on BP-VIII)

1. Study of Neubauer's Counting Chamber.
2. Red blood cell count/ μl of blood
3. White blood cell count/ μl of blood
4. Haemoglobin content estimation
5. Differential count of White blood cells
6. Determination of ESR
7. Determination of Clotting time
8. Determination of Bleeding time
9. Determination of Blood groups
10. Determination of fragility of erythrocytes
11. Oscilloscope Experiments
12. Spirometry- Measurement of vital capacity, tidal volume, different timed volumes, peak flow rate.
13. Anatomical study of different body systems by using virtual CD Rom/ DVDs(Educational Software).
14. Research laboratory / Clinical laboratory visits to observe neurophysiology and Cardiovascular experiments and instrumentation.
15. Blood pressure measurement
16. Pulse measurement

17. Interpretation of kymograph records

Molecular Enzymology Practicals (Practicals based on BP-IX)

1. Kinetic characteristics of alkaline phosphatase: (i) Progress curve; (ii) pH optima; (iii) temperature optima (iv) K_m and V_{max} ; (v) specific activity.
2. Effect of Mg^{2+} ion on the activity of alkaline phosphatase
3. Effect of metal ion on the activity of alkaline phosphatase
4. Kinetic & Clinical Assay of lactate dehydrogenase (LDH).
5. Kinetic Assay of α -amylase.
6. Kinetics Assay of invertase.
7. Immobilization of enzyme
8. Preparation of enzyme crystals & their microscopic analysis

ANNEXURE: - Recommended Books and Journals.

1. Ackerman E.A. Ellis, L.E.E. & Williams L.E. (1979), Biophysical Science, Prentice-Hall Inc.
2. Barrow. C. (1974), Physical Chemistry For Life Sciences, McGraw-Hill.
3. Berns M.W. (1982), Cells, Holt Sounders International Editors.
4. Bloomfield V.A. and Harrington R.E. (1975), Biophysical chemistry, W.A.Freeman and CO.
5. Cantor C.R. and Schimmel P.R. (1980), Biophysical chemistry, W.A.Fremman and Co.
6. Casey E.J. (1967), Biophysics, concepts and mechanisms. Affiliated East west press.
7. De Robertis E.D.P. and De Robertis E.M.P. (1981), Essentials of cell and molecular Biology, Holt sounders International Editions.
8. Dugas H. and Penney C. (1981), Bioorganic chemistry, Springer-Verlag.
9. Haschemyer R.N. and Haschemyer A.E.B.V. (1973), Proteins, John willey and sons.
10. Hughes W. (1979), Aspects of Biophysics, John willey and sons.
11. Lehninger A. (1981), Biochemistry, Butter Worth Publication.
12. Pesce A.J., Rosen C.G and Pasty T.L., Fluorescence Spectroscopy: An introduction for Biology and Medicine, Marcel Dekkar.
13. Pullman B. (1978), Molecular Association in Biology, Academic Press.
14. Saenge W. (1984), Principles of Nucleic acid structure, Springer-Verlag.
15. Schule G.E. and schirmer R.H. (1984), Principles of protein structure, Springer-Verlag.
16. Setlow R.B. and pollard E.L. (1962), Molecular Biophysics, Pergamon Press.
17. Sheelk P. and Birch D.E. (1983), Cell Biology Structure, Biochemistry and function, John willey and sons.

18. Spragg S.E. (1980), Physical Behavior of macromolecules with biological functions, John Willey and Sons.
19. Stanford J.R. (1975), Foundation of Biophysics Academic Press.
20. Stryer L. (1981), Biochemistry, W.A. Freeman and Co.
21. Szekely M. (1984), From DNA to protein, Macmillan.
22. Volkenstein M.V. (1977), Molecular Biophysics, Mir Publication.
23. Basar E. (1976), Biophysical and physiological system Analysis, Addison-Wesley.
24. Guyton A.C. (1981), Textbook of Medical Physiology, Saunders Co.
25. Geoffrey L. Zubay, William W. Parson, Dennis E. Vance. (1995), Principles of Biochemistry, Wm.c.Brown Publishers.
26. Sambrook and Russell (2001), Molecular cloning (A laboratory Manual) Cold Spring Harbor Laboratory Press.
27. Henry B. Bull (1971), An Introduction to physical biochemistry, F.A. Devis Co.
28. Gerald Karp (1996), Cell and Molecular biology concepts and experiments, John Willey and Sons, Inc.
29. Loewy Sickevitz, Menninger, Gallant (1991), Cell structure and function, Saunders College Pub.
30. Jean Brachet (1985), Molecular cytology, Academic Press.
31. Hans Netter (1969), Theoretical Biochemistry, Oliver and Boyd, Springer-Verlag Press.
32. Carl Branden and John Tooze (1991), Introduction to protein structure, Garland Publishing, Inc.
33. David Freifelder (1987), Molecular Biology, Narosa Publishing House.
34. Thomas E. Creighton (1994), Proteins: Structure and Molecular properties, W. A. Freeman and Co.
35. M. Satake, Y. Hayashi, M.S. Sethi & S.A. Iqbal (1997), Biophysical chemistry, Discovery Publishing House.
36. C. Edward Gasque (1992), A manual of lab. Experience in Cell biology, Universal Stall.
37. F. Heinmets (1970), Quantitative Cellular Biology, Marcal Dekker, Inc.
38. Daniel L. Hartl (1995), Essential genetics, Jones and Barlett Publishers.
39. Bernard R. Glick and Jack J. Pasternak: (1994), Molecular Biotechnology Principles and Applications of Recombinant DNA.
40. Clarence H. Suelter (1985), A practical guide to enzymology, John Willey and Sons.
41. Robert K. Scopes (1994), Protein Purification Principles and practice, Narosa Pub. House.
42. Stanley R. Maloy (1983), Experimental techniques in bacterial genetics, John and Bartlett Pub.
43. V. A. Bernstam (1997), V.YA. Alexandrov: Cells, Molecule and temperature, Springer-Verlag.

44. H. H. Perkampus (1992), UV-VIS Spectroscopy and Its applications, Springer-Verlag.
45. Felix Franks (1985), Biophysics and Biochemistry at low temperature, Cambridge Univ Press.
100. Bernard Pullman (1978), Proteins in physicochemical Biology, Academic Press
101. R. Glaser, D. Gingell (1990), Biophysics of the cell surfaces, Springer-verlag.
102. J. B. C. Findlay and W. H. Evans (1987), Biological Membranes a practical approach, ORL press.
103. Darnell, Lodish, Baltimore (1986), Molecular cell biology, W.H. Freeman Press.
104. P. W. Arora, P.K. Malhan (2002), Biostatistics, Himalayas pub. House, Mumbai.
105. Vijaya D. Joshi (1995), Prep. Manuals for Physiology, B.I. Churchill living stone Pvt. ltd.
106. R. N. Roy (1998), Viva and Practical Physiology, Biochemistry and Biophysics, Books and allied Pvt. Ltd.
107. P. S. S. Surnder Rao and J. Richard (1996), An introduction to Biostatistics, Prentice Hall of India.
108. C. STAN TSAL (2002), An introduction to computational biochemistry John Willey and sons Inc.
109. Manisha Dixit (2000), Internet an Introduction, Tata McGraw-Hill.
110. Timontry J. O'Leary, Linda I. O'Leary (1999), Microsoft windows 98, Tata McGraw Hill.
111. Timothy J. O'Leary, Linda I. O' Leary (2000), Microsoft office-2000, Tata McGraw Hill.
112. Pitter Norton's (1999), Introduction to Computers, Tata McGraw Hill.
113. S.M. Khopkar (1984), Basic Concepts of Analytical chemistry, Willey eastern lit.
114. Campbell R.C. (1974), Statistics for biologist, Cambridge University Press.
115. Bliss C. I.K. (1967), Statistics in biology vol. 1 Mac-Graw Hill.
116. Wardlaw, A.C (1985), Practical Statistics for Experimental biologist.
117. Bailey, (2000), Statistical Method in biology.
118. Daniel Wayne W., Biostatistics (A foundations for analysis in health sciences).
119. Khan, Fundamental of Biostatistics.
120. Lachin, Biostatistical Method.
121. Friefelder D, Physical Biochemistry, W. H. Freeman and co.
122. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
123. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
124. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
125. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco

126. David Sheehan, Physical Biochemistry: Principles and Applications, 2nd Edition, John Wiley, 2009.
127. Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, 2005.
128. Physical Biochemistry, David Freifelder, Applications to Biochemistry and Molecular Biology, 2nd Edition, W.H. freeman and Company, 2005.
130. K.E. Van Holde, W.C. Jhonson and P. Shing Ho, Principles of Physical Biochemistry, 2nd Edition, Prentice-Hall Inc, 1998
131. Hoppe et. al., Biophysics, Translation of 2nd German Edition, Springer Verlag,1983
132. D.A. Skoog et. al ,Principles of Instrumental Analysis,, 5th Edition, Saunders College Publishing, 1998.
133. Vasantha Pattabhi, N. Gautham Biophysics 2nd Edition, 2010Alpha Science Intl Ltd.
134. C.R. Cantor and P.R. Schimmel, Biophysical Chemistry (Parts 1 and 3). W.H. Freeman, 1980.
135. G. Schuiz and R.H. Shrimmer, Principles of protein structure. Springer Verlag,1984.
136. D. Holem and H. Peck – Analytical Biochemistry. Longman, 1983
137. T.G. Cooper – The Tools of Biochemistry. Wiley Intersciences, 1997
138. S.K. Sawhney and R. Singh ,Introductory Practical Biochemistry , 2nd Edition,Alpha Science International, 2005
139. Keith Wilson , John Walker, John M. Walker Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, 2000.
140. Puri B. R. ,Sharma L.R. & Pathania M.S. Principles of Physical Chemistry,S.N. Chand & Co.
141. Gabler R., Electrical Interactions in Molecular Biophysics Academic Press
142. Stanford J.R. Foundations of Biophysics Academic Press London
143. Volkenstein M. V. Biophysics Mir Publishers
145. Hallet F.R.,Speight P.A.,Stinson R.H.Introductory Biophysics Chapman & Hall
- 146.Sybesma C. An Introduction to Biophysics Academic Press
- 147.Hilgard H.C. & Biggin H.C. Physics for Applied Biologist Edward Arnold London
- 148.Jayraman J. laboratory manual in Biochemistry Wiley Eastern Ltd. New Delhi
- 149.Ruthmann A. Methods in cell Research G.Bell & Sons ltd London
- 150.Chatwal G.R. Biophysics Edited by Madhu Arora, Himalaya Publishing House Nagpur
- 151 Mohan P. Arora, Biomolecules ,Himalaya Publishing House ,Nagpur
152. Mohan P.Arora ,Biohysics, Himalaya Publishing House, Nagpur
153. Dr.R.N.Roy, A Text Book of Biophysics, New Central Book Publishing Agency
154. Dr.R.N.Roy,Viva & Practical Physiology, Biochemistry & Biophysics, Books and allied (P) Ltd Calcutta

155.Kudesia V.P., Sawhney S.S. Instrumental Methods of Chemical Analysis, Pragati Prakashan Meerut

156.Chatwal G.R. Anand S.K. Instrumental Methods of Chemical AnalysisHimalaya Publishing House ,Nagpur

157.Subramanian M. A. Biophysics –Principles & Techniques MJP publishersChennai

158.Nath, Upadhya, Upadhya Biophysical Chemistry Himalaya Publishing House

JOURNALS: - Recent advances Pertaining to various sections are generally reported in the following journals/magazines; Students are encouraged to keep themselves abreast of the subject from them.

Nature, Science, Scientific American, Current Science, Resonance. Etc.

Most Important Note :- The use of internet surfing for exploring the Latest Information should be compulsory to enrich the knowledge.