Swami Ramanand Teerth Marathwada University Nanded.

FACULTY OF SCIENCE

SYLLABUS

B.Sc. (Biophysics)

First Year (CBCS Pattern)

SEMESTER I & II

[Syllabus With effective from 2016-17 onwards]

Swami Ramanand Teerth Marathwada University, Nanded.

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

B.Sc. Biophysics (UG) Program under Faculty of Science

(Affiliated Colleges)

(W.E.F. Academic Year 2016-17)

Name of the Faculty	Total credit	Average credits per semester
Science	**36**	**06**

Note:

- Assessment shall consist of Continuous assessment **(CA)** and End of Semester Examination **(ESE).**
- **Weightage:** 80% for ESE & 20% for CA.
- The Biophysics as optional in each of Semester consists of Two Theory Papers each of 50 marks **[40 External + 10 Internal]** and One Practical paper of 50 marks.
- This workload is inclusive of test, tutorial to be conducted as mandatory UG activities as part of internal assessment.
- **Paper- (Elective):** Transfer of Credit as per Student choice.

Distribution of Credits for B.Sc. Biophysics (CBCS Pattern)

(All Affiliated Colleges)

CBCS pattern for B.Sc. First Year

Sem.	Code & Paper Code	Section & Period /week	Title of the paper	External (ESE)	Internal (CA)	Credits
I	CCBP-I	A/03	Molecular Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	CCBP-II	B/03	Cellular Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
II	CCBP-III	A/03	Basic Biophysical Techniques	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	CCBP-IV	B/03	Biostatistics & Computer Fundamentals	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
Lab Course Work (Annual Practical)	CCBP-V	04	Practical's based on theory papers CCBP-I, II, III, IV	100 Marks	----------	04 (2+2)
	Total for B.Sc. I Year: Sem. I + Sem. II + Lab Course work (Annual)					12

The syllabus is based on six (3x2) theory periods and 4 practical periods per batch per week. Candidates should require to pass separately in theory and practical examination.

Marks distribution:

1) Theory exam (ESE): 40 marks (30 +10 for each paper)
2) Internal (CA) evaluation: 10 marks ((Attendance 5 Marks) & Tests/Assignments (5 Marks))

CBCS pattern B.Sc. Second Year

Sem.	Code & Paper Code	Section & Period /week	Title of the paper	External (ESE)	Internal (CA)	Credits
III	CCBP-VI	A/03	Membrane Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	CCBP-VII	B/03	Molecular Biology	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
IV	CCBP-VIII	A/03	Molecular Enzymology	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	CCBP-IX	B/03	Physiological Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
Lab Course Work (Annual Practical)	CCBP-X	03	Practical's based on theory papers CCBP-VI & VII	50 Marks	----------	02
Lab Course Work (Annual Practical)	CCBP-XI	03	Practical's based on theory papers CCBP-VIII & IX	50 Marks	----------	02
	Total for B.Sc. II Year: Sem. I + Sem. II + Lab Course work (Annual)					12

CBCS pattern B. Sc. Third Year

Sem.	Code & Paper Code	Section & Period/ week	Title of the paper	External (ESE)	Internal (CA)	Credits
V	DSEBP-XII	A/03	Immunology	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	DSEBP - XIII	B/03	Bioinformatics & Structural Biology	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	SEC-I			50 marks		02
VI	DSEBP - XIV	A/03	Radiation Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	DSEBP - XV	B/03	Medical Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	SEC-II			50 marks		02
Lab Course Work (Annual Practical)	CCBP-XVI	03	Practical's based on theory papers CCBP-XII & XIII	50 Marks	----------	02
Lab Course Work (Annual Practical)	CCBP-XVII	03	Practical's based on theory papers CCBP-XIV & XV	50 Marks	----------	02
	Total for B.Sc. III Year: Sem. I + Sem. II + Lab Course work (Annual)					16

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – I)

Semester Pattern Effective from-2016

Paper CCBP-I: Molecular Biophysics

[Total Marks: 50](40Ext.+10 Int.) *[Exam Duration: 2 hrs]* *[Total Workload:45 hrs]*

Unit 1: Atomic & Molecular structure

Structure of atom-Models & theories, Periodic table, Concept of bonding; valence of carbon; hybridizations of carbon; hybridizations of nitrogen & oxygen; molecular orbital theories, polar & non polar molecules; inductive effect;

Secondary bonding: weak interactions, hydrogen bonding; dipole-dipole & dipole-induced dipole interactions; London dispersion forces.

Bonds within molecules-Ionic, covalent, Hydrogen, Electrostatic, Disulphide & peptide bonds, Van-der Waals forces Bond lengths & Bond energies , Bond angles, Structural isomerism; optical isomerism & optical activity.

Unit 2 : Physico-chemical Foundations

Biophysics of Water: Physicochemical properties of water, Molecular structure, Nature of hydrophobic interactions, Water Structure.

Small-Molecule Solutes: Hydrophiles, Hydrophobes, Large Hydrophobic Solutes and Surfaces, Aqueous Environment of the Cell, State of water in bio- structures & its significance, Protein Hydration-Nonspecific Effects, The Hydration Shell.

Acid & Bases: Acid-Base theories, Mole concept, Molarity, Molality & Normality, Ampholyte, concept of pH,measurements of pH , Henderson–Hasselbatch equation , Titration curve & pK values, Buffers & Stability of their pH , numerical problems.

Redox potential : Oxidation –Reduction, examples of redox potential in biological system.

Unit 3 : Physical Foundations of Biophysics

Thermodynamics of Biological system: First and second laws of thermodynamics, activation energy. Biological systems as open, non-equilibrium systems,Concept of free energy, unavailable energy and entropy, heat content of food, bomb calorimetry, Enthalpy, Negative entropy as applicable to biological systems. thermodynamics of passive and active transport, glycolytic oscillations, biological clocks.

Bioenergetics: Concept of energy coupling in biological processors, Energy requirements in cell metabolism, structure and role of mitochondria, high energy phosphate bond, energy currency of cell, Biological oxidation, Electron-transport chain, Oxidative Phosphorylation including chemiosmotic hypothesis. Thermodynamic analysis of TCA cycle and oxidative phosphorylation.

Unit 4. Biomolecules as molecular alphabets of life

Nucleic acids: Purine and Pyrimidine bases, nucleosides, nucleotides, basic differences in structure and function of RNA and DNA

Amino acids & Proteins: Amino acid **general structure &** types, peptide bond,Structure of Proteins - primary, secondary, tertiany and quarternary ,

Carbohydrates : Structure and function of mono, di ,oligo and polysaccharides, Structure of D-glucose & D-fructose; formation of glucosides & the cyclic structure of D-glucose; Structure and conformation of diasacharides and polysaccharides- cellulose, amylopectin & glycogen,Chitin.

Lipids : Defination:Types of lipids; Triglycerides , fatty acids, Fats & oils ,Phospholopids, Glycolipids; lipoproteins, Structure, Function and Localization

Vitamins & hormones: Structure, classification & function.

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – I)

Semester Pattern Effective from-2016

Paper CCBP-II: Cellular Biophysics

[Total Marks: 50] (40Ext.+10 Int.) *[Exam Duration: 2 hrs]* *[Total Workload 45 hrs]*

Unit1:Cell Organization

Cell as the basic structural unit, Origin & organization of Prokaryotic and Eukaryotic cell, Cell size & shape, Fine structure of Prokaryotic & Eukaryotic cell organization Internal architecture of cells, cell organelles, compartment & assemblies membrane system, Ribosome, Polysomes, Lysosomes & Peroxisomes, Connection between cell & its environment, Extracellular Matrix.

Unit 2: Cell Cycle & Growth

The Cell Cycle, Interphase-G1,S,G2,M molecular events at different cell cycle phases, A cytoplasmic clock times, Growth Factors & Control of cell proliferation.
Mitosis & Cell division-Molecular mechanism , Events in mitosis, significance of mitosis, Meiosis & Sexual reproduction, Molecular mechanism of meiosis, significance of meiosis.

Unit 3.Cell differentiation & Cell-Cell Interactions

General characteristics of cell differentiation, Localization of cytoplasmic determinants, Molecular mechanism of cell differentiation, Morphological movements & the shaping of body plains, Cell memory, Concept of positional values.
Connection between the cell and its environment, Glycocalyx, Extracellular Matrix, collagen, Elastin, Fibronectin, Lamin, Integrins, Cell Junctions, Desmosomes, Gap junction, connexins, Tight Junctions, Plasmodesmata .

Unit 4: Basics of Cell Signaling

Cell Signaling, General principle of cell signaling, Paracrine, Autocrine, Endocrine &synaptic signaling, Heat Shock Proteins, G-Protein structure and role in signaling, Intracellular Cyclic AMP, Role Ca^{++} in cell signaling, CAM Kinases, (Calmodulin/Ca^{++} dependent protein kinases), Interaction between cyclic AMP & Ca^{++}. Synapse and synaptic vesicles, Role of Methylation in adaptation & bacterial chemotaxis.

Swami Ramanand Teerth Marathwada University, Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – II)

Semester Pattern Effective from-2016

Paper CCBP-III: Biostatistics and Computer Fundamentals

[Total Marks: 50] (40Ext.+10 Int.) *[Exam Duration: 2 hrs]* *[Total Workload 45 hrs]*

Unit 1 –Introductory Biostatistics

Statistics, Biostatistics and Biometry, Aims of Biostatistics, Applications of Biostatistics. Data Collection, Necessity of Sampling, Types of Sampling Data Processing ,Data Summarization, Classification of Data Methods of classification of Data, Difference s Between Classification and Tabulation, Formation of Frequency Distribution.

Tabular Representation of Data, Graphic Representation of Data,Line Diagram,Histogram,Frequency Polygon,Frequency Curve, Cumulative Frequency Curve or Ogive, Scatter or Dot Diagram,Bar Diagram, pie diagram, Pictogram And Cartogram.

Unit 2-Measures of Central Tendency, Dispersion, Correlation & regression

Average, Objectives of Averages, Characteristics of an Ideal Measure of Central Tendency Types of Averages, Mean, Median, Mode, Measures of Dispersion, Range, Standard Deviation, Standard Error.

Correlation, Types of Correlation, Measures of Simple Correlation, Regression, Simple Regression, Regression Equation,

Unit 3- Probability, Test of Hypothesis and Tests of Significance

Important Terms and Concepts, Sample point, Sample space, Trial and Event; Classical Definition of Probability, Frequency Definition of Probability, Rules of Probability (Addition Rule and Multiplication Rule) Random variable and Probability Distribution,Binomial Distribution, Poisson Distribution and Normal Distribution. Test of Significance, Computation of Test of Significance, Test for the mean of a Normal Population, chi-square test,`t' test, F-test and their significance, analysis of variance(ANOVA).

Unit 4: Computer Fundamentals

Computer system at a glance processor (CPU, ALU) Memory (ROM, RAM,) Storage, Input & Output devices, Computer peripherals, Binary code and binary system, Algorithms and Flow charts, Software & Hardware, Operating systems (Dos, Windows) Application software's (MS-office) Super computer, Mainframe computers, Mini computers, Micro computers,

Network concepts (LAN, WAN, MODEM,) and its topology. Internet protocols HTML, XML, WWW (World wide webs) Internet connectivity, search engines, biological databases.

Swami Ramanand Teerth Marathwada University, Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – II)

Semester Pattern Effective from-2016

Paper CCBP-IV: Basic Biophysical Techniques

[Total Marks: 50] (40Ext. +10 Int.) [Exam Duration: 2 hrs] [Total Workload 45 hrs]

Unit 1.Optical Techniques:

Light:Reflection ,Refraction, Diffraction, Interference phenomena,

Refractometry: Refraction of light and snell's law, refractive index , principle ,design, working and application of Abbe's refractometer,

Light microscopy: Simple ,compound optical microscope, Phase contrast and interference contrast microscope, Fluorescence and polarizing microscope: principle, design, resolution, numerical aperture, care and maintenance of microscopes, **Polarimetry**: Polarization of light, stereoisomers, optical activity and its measurement, specific rotation, molar rotation, optical activity of some biomolecules and its significance.

Unit 2.Hydrodyanamic Techniques :

Centrifugation:Concept of sedimentation Basic principles, Forces involved, RCF, Centrifugation techniques-Differential centrifugation, principle, design, types and applications of different Centrifuges.

Viscometry: General features of fluid flow. Origin of viscosity of gases and liquids, factors affecting viscosity:temperature dependence of viscosity diffusion of gases and solute in solution,

Fick's law, viscometric measurements, determination of coefficient of viscosity, Stokes law, Oswald's viscometer, relative, specific and intrinsic viscosity, applications of viscometry in bimolecular structure determination.

Unit 3. Physico-chemical & Electroanalytical techniques :

Chromatography : Adsorption, Partition, Partition Basic principles of Adsorption & Partition Chromatography, Principle Experimental set-up, Methodology & Applications of all types of Adsorption & Partition Chromatography methods-chromatography using paper, thin layer, Column (gel filtration, ion exchange, affinity), gas(GC,GLC) **Electrophoresis :** Principle, Electrophoretic mobility(EPM) estimation,

factors affecting EPM , Principle, Methodology & Applications of Electrophoresis techniques, paper, agarose gel, polyacrylamide gel (native and SDS) electrophoresis & isoelectric focusing, **Potentiometry** & voltametry,pH meter–principle, design, and working of pH meter, care & maintainance of pH electrodes.

Unit 4. Absorption & Fluorescence Spectroscopy:

Electromagnetic spectrum, properties of electromagnetic radiations, concept and types of spectroscopy, absorption spectrum, energy characteristics of spectrum, fundamental laws of photometry:Beer's law and its deviation ,concept of λ_{max}, chromophoric shifts, Photometric analysis,Principles of fluorescence, Colorimeter, spectrophotometer & Spectrofluoriphotometer-design,working,andApplication.

Swami Ramanand Teerth Marathwada University Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. First year Biophysics

Semester Pattern Effective from-2016

Practical Paper CCBP-V (Annual practical's based on CCBP-I, II, III, IV)

Practical Workload **Four periods per batch per week for 15 weeks**

[Total Marks: 100] [Total Workload 60 hrs] [Exam Duration: 4 hrs] [Credits: 04]

Practical's based Molecular Biophysics

1. Preparation of buffers (acetate, phosphate, citrate, borate buffers).Preparation of Normal, molar and standard solutions, serial dilutions
2. To study the principle of spectrophotometer. To verify the Lambert Beer's law.
3. To determine the beer's limit and measurement of molar and percent extinction coefficient.
4. To estimate the percent purities of dyes and inorganic compounds.
5. To establish the absorption spectrum and determine the absorption maxima of p-Nitro phenol.
6. To plot absorption spectrum of DNA and protein(BSA/Egg Albumin) and find λ_{max}
7. Estimation of ascorbic acid in lemon juice by titration with 2,6 DichlorophenolIndophenol
8. Estimation of Glycine or any other by formal titration method.
9. Estimation of Glucose by ortho-Toludine method
10. Estimation of DNA by DPA method
11. Estimation of RNA by Orcinal method.
12. Estimation of reducing sugars by Benedict's Method
13. To estimate proteins by Biuret assay, Folin's-Lowry method
14. Spot test for carbohydrates.
15. Qualitative tests for Glucose, Fructose, Ribose ,Maltose
16. Spot tests for Amino Acids.
17. Test for cholesterol.
18. To Isolate of Casein from milk
19. To isolate the Phospholipids from Egg Yolk
20. Estimation of protein from animal and plant sources.
21. Isolation of Starch from potato
22. Acid – Base titration using pH meter and Determine the pK values: - Strong acid Vs Strong base, Weak acid Vs Strong base, Mixture of Strong and Weak acid Vs Strong base..
23. To determine the pH titration curve of amino acids & calculate the pKa values.
24. To determine the pH titration curve of Proteins & calculate the pI values
25. To study the biomolecular structures by using ball & stick models
26. To construct the structures of biomolecules using balls & sticks.
27. To Study the simple molecular structures using DTMM or other basic molecular modeling software.

Practicals based on Cellular biophysics

1. To learn a) use of microscope b) principles of fixation and staining;
   To familarize with bright field, phase contrast, fluorescence & polarizing microscopes. and micrometry.

2. Microscopic observation of bacteria, microalgae, fungi, lichen and protists; Cell staining – Staining of Plant cell (onion epidermal cell), Animal cell (Squamous epithelial cell), Blood cell, Microbial cells (Bacteria & Yeast).
3. To study cell structure from onion leaf peels ; Shape and size of the cell–simple & differential staining
4. Cell division- Examination of various stages of mitosis and meiosis -mitosis (Onion root tip)& Meiosis (Tradescantia flower buds / grasshopper testes)
5. Polytene chromosome (chironomous larvae)
6. Separation of chloroplast & flower pigments by paper chromatography
7. Microbiological Techniques:
   1. Preparation of Media(Media preparation : Nutrient agar and Nutrient broth), Cotton Plugging and Sterilization, Pure culture and maintenance of culture, Dilution and pour plate techniques. Standard plate count, Gram staining, other staining methods
   2 .Bacterial growth curve- To raise the culture of E. coli and estimate the culture density by turbidity method. Draw a growth curve from the available data. determination of generation time

4.3 Study of different types of eggs; Study of egg of hen and vital staining of embryo;Culture of chick embryo fibroblast – Demonstration,Study of frog development, observation of frog embryo different developmental stages; Study of different types of sperms by smear preparation.

Practicals based on Biostatistics & Computer Fundamentals

1. Presentation of Statistical data by Histogram, Ogive curves, Pie diagram. frequency tables, graphs (5 assignments)
2. Measurement of central tendencies: - Arithmetic & Geometric mean, Mode and Median. (5 assignments)
3. To calculate the measures of dispersion.:(6 assignments) Mean deviation. Quartile deviation ,Standard deviation and Coefficient of variation.
4. Test of Significance. (6 assignments):Chi-Square test, t- test.
5. Calculating the Correlation coefficients.
6. Finding Regression coefficients and Regression lines
7. Basic operating procedures of computer.Basic commands – File creation, Copying and deleting in Linux and Windows
8. To create File, Folder, Directories. (2 assignments)
9 Familiarity with the Basic operations of MS-office. (7 assignments)
10 Familiarity with use of Internet, Search engines, Web sites, Surfing, Browsing websites such as NCBI,EMB,DBT,DDBJ, Ethics in Internet surfing, Downloading text and Graphics. (4 assignments)
11 Creating Email account, Using Email, Sending and Receiving mails.

Practicals based on Basic Biophysical techniques

1.Refractometry

(i)Use of Refractometer and determine RI of biofluids, biomolecular solutions
(ii)To obtain relation between concentration & Refractive Index for solutions of

proteins and sugars and estimation of specific refraction increment for proteins

(iii)Determine refractive index of a given liquid as a criterion for its purity (Benzene i.e. commercial benzene + A.R. acetone)

2.Polarimetry

(i)Use of polarimeter and determination of observed rotation α,specific rotation[α] and molar rotation [m'] for amino acids and sugars

(ii)Determination of the percentage composition of optically active solution.

3. Conductometry

(i)Determination of cell constant

(ii)Determination of specific and equivalent conductance of electrolyte (NaCl and HCl) and Bio-fluids

4.Absoption & Fluorescence Spectroscopy

(i) To study the principle of colorimeter and spectrophotometer and determine suitable filter for light absorption studies of inorganic salts. Verify Beer-Lambert law.Determine molar Extinction coefficient

(ii) To plot absorption spectrum of DNA and protein and find λ_{max}.

(iii)To study the effect of different solvents on UV absorption spectra of proteins

(iv)Study of spectral changes of proteins at different pH using Spectrophotometry

(v)Study of structural changes of proteins at different temperature using UVSpectrophotometry.

(vi)Differentiate single stranded DNA from double stranded DNA

(vii)Quantitative estimation of DNA/RNA using spectroscopy.

(viii)Fluorescence spectrum of protein and Nucleic acids

5.Viscometry

(i) Use of Ostwald viscometer. & Determination of coefficient of viscosity $\eta$of biofluids.

(ii) Determination of relative viscosity of a macromolecule (Protein & DNA) in native and altered state of the biomolecule.

6.Electrophoresis

Separation of Biomolecules (amino acids, proteins) by paper electrophoresis.

7. pH meter

(i) Use of pH meter and measuring the pH of the buffer solutions

(ii) Acid base titration of HCl vs. NaOH

(iii) To obtain pH titration curve for amino acids and estimate their pKvalue

(iv) Determination of ionization of a weak acid (CH3COOH)

8.Chromatography

(i)Separation of amino acids and sugars using paper and Thin layer chromatography. Estimate their Rf value

(ii)Fractionation of mixture of amino acids and sugars using Paper & TLC

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, Addition-Wesley.
24. Guyton A.C. (1981), Textbook of Medical Physiology, Sounders 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, Sounders 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. Pastermak: (1994), Molecular Biotechnology Principles and Applications of Recombinant DNA.
40. Clearance 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 University 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 Wayle 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.
1 De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
2 Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
3 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
a) David Sheehan, Physical Biochemistry: Principles and Applications, 2nd Edition, John Wiley, 2009.
b) Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, 2005.
c) 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. Shrimer, 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 Acdemic 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 Chapmann & 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 Analysis Himalaya Publishing House ,Nagpur
157.Subramanian M. A. Biophysics –Principles & Techniques MJP publishers Chennai
158.Nath, Upadhya, Upadhya Biophysical Chemistry Himalaya Publishing House ,Nagpur

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.

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

Swami Ramanand Teerth Marathwada University, Nanded.

FACULTY OF SCIENCE

SYLLABUS

B.Sc. (Biophysics)

SECOND YEAR (CBCS Pattern)

SEMESTER III & IV

[Syllabus effective from 2016-17 onward]

Member
Mr.V.A. Jadhav
Head, Dept. Of Biophysics,
D.B.College,Bhokar,Dist.Nanded.

Chairman
Dr. B.M. Kareppa,
Head, Dept. Of Biotechnology,
D.S.M.College, Parbhani, Dist.Parbhani.

B.Sc. Biophysics Second Year Syllabus (2016-17)
Semester III & IV

CBCS pattern B.Sc. Second Year

Sem.	Code & Paper Code	Section & Period/ week	Title of the paper	External (ESE)	Internal (CA)	Credits
III	CCBP-VI	A/03	Membrane Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	CCBP-VII	B/03	Molecular Biology	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	SEC-I			50 Marks	SEC-I 1) Electrophoresis in disease identification 2) Membrane disorders 3) Model of Biomolecules 4)Molecular machinery for central dogma	02
IV	CCBP-VIII	A/03	Physiological Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	CCBP-IX	B/03	Molecular Enzymology	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	SEC-II			50 Marks	SEC-II 1)Survey of Blood pressure variation 2)Analysis of hemoglobin percentage 3) Waveform with OScilloscope 4)Anatomical study of human body	
Lab Course Work (Annual Practical)	CCBP-X	03	Practical's based on theory papers CCBP-VI & VII	50 Marks	----------	02
Lab Course Work (Annual Practical)	CCBP-XI	03	Practical's based on theory papers CCBP-VIII & IX	50 Marks	----------	02
	Total for B.Sc. II Year: Sem. I + Sem. II + Lab Course work (Annual)					16

Note:

- Assessment shall consist of Continuous assessment **(CA)** and End of Semester Examination **(ESE).**
- **Weightage:** 80% for ESE & 20% for CA.
- The Biophysics as optional in each of Semester consists of Two Theory Papers each of 50 marks **[40 External + 10 Internal]** and One Practical paper of 50 marks.

- This workload is inclusive of test, tutorial to be conducted as mandatory UG activities as part of internal assessment.

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – III)

Paper CCBP-VI: Membrane Biophysics

Semester Pattern Effective from-2016

[Total Marks: 50](40Ext.+10 Int.) [Exam Duration: 2 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, hydropathy 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, Ionic transport during Action Potential,

properties of action potential, Nernst equation, Hodgkin-Huxley equation, Membrane impedance and capacitance, Transmembrane potential, total electrochemical potential.

Books Recommended:

2.1 Molecular & Cellular Biology, D Roberties,

2.2 Biophysical Aspects of Transmembrane signaling, Sandor D (2005), Springer

2.3 Biophysics, Vasant Pattabhi, Gautam (2002), Narosa

3.1 Biomembrane structure and Function, Chapman D.

3.2 Introduction to Biological Membrane, Jain R K

3.3 Biophysics, Hopp, Lohman, Mark and Ziegler

3.4 Advances in Biophysics, Vol 18, 15

3.5 Molecular and Cellular Biophysics, Meyer B Jackson (2006), Cambridge)

3.6 Text Book of Physiology, Guyton & Hall, 11th Ed. 2006

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – III)

Paper CCBP-VII: Molecular Biology

Semester Pattern Effective from-2016

[Total Marks: 50](40Ext.+10 Int.) [Exam Duration: 2 hrs] [Total Workload:45 hrs]

Unit 1 - Introduction to molecular biology

The Central Dogma, The Molecular Nature of Genes & Organization, Gene Function, DNA Structure and Chemistry, DNA Topology and the Nucleosome, Introduction to bacterial genetics. Protein-DNA Interactions (prokaryote and eukaryote),

DNA Replication: The Replication Fork, Origins and Telomeres, Enzymes of DNA synthesis, DNA Repair, DNA Recombination.

Unit II- Transcriptional Machinery

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

Unit III- Translation and regulation

The Mechanism of Translation: Initiation, Elongation and Termination, Post Translational processing, Translational Control, Posttranslational modifications.

Control of genetic expression: Lac & Trp operons, regulation of protein synthesis.

Unit – IV Basic principles of rDNA technology

Basic Steps involved in rDNA, Restriction enzymes, its applications in medicine, agriculture, and in the production of commercially important proteins.

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.

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – IV)

Paper CCBP-VIII: Physiological Biophysics

Semester Pattern Effective from-2016

[Total Marks: 50](40Ext.+10 Int.) *[Exam Duration: 2 hrs]* *[Total Workload:45 hrs]*

Unit I- Digestive & Excretory systems

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

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

Unit II- Cardivascular & Respiratory sytem

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, 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 & Reproductive systems

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 Boobeck. 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. Moshy Co. St. Louis,Toronto.

5. Hamilton.W.F, " Hand Book of Physiology", Section 2, Circulation Vol II,American Physiological Society.

6. Arthur .C. Guyton & John.E.Hall, "Text Book of Medical Physiology", W. B.Saunders Co.

7. Widmaier, Raff & Strang, "Vander's Physiology- The mechanism of body Function. Mc Graw- Hill.

Reference Books:-

3. Principles of Biochemistry by A.L. Lehninger, D.L. Nelson and M.M. Cox, CBS Publishers, New Delhi, 1993.

4. Biochemistry by L. Stryer, W.H. Freeman and Co., Newyork 1997.

5. Conformation of Carbohydrates by V.S.R. Rao, P.K. Qasba, P.V. Balaji and R. Chandrasekaran, Harwood Academic Publishers, 1998.

6. Steno Chemistry of Carbohydrates J.F. Stoddart , Wiley Interscience 1971.

7. Complex Carbohydrates their Chemistry by N. Sharon, Biosynthesis and Functions, Addison-Wesley, London, 1975.

8. Bio active carbohydrates in Chemistry, Biochemistry and Biology by J.F.Kennedy and C.A.White, Ellis Harwood, New York, 1983.

9. Principles of Protein Structure by G. Schulz and R.H. Schirmer, Springer - Verlag, 1984.

10. Introduction to Protein Structure by C. Branden and J. Tooze, Gar land Publishing, 1991.

11. 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.

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – IV)

Paper CCBP-IX: Molecular Enzymology

Semester Pattern Effective from-2016

[Total Marks: 50](40Ext.+10 Int.) *[Exam Duration: 2 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, Vmax , Km & turnover number and their significance. Line Weaver-Burk plots and its limitation. Eddie– Hofstee 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
10.Enzyme Kinetics-Ronald 11.Understanding Enzymes - Palmer

Swami Ramanand Teerth Marathwada University Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics Second year

Semester Pattern Effective from-2016

Practical Paper CCBP-X (Annual practical's based on CCBP-VI & VII)

[Total Marks: 50] *[Exam Duration: 4 hrs]* *[Credits: 02]*

Membrane Biophysics Practical's

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 Practical's

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.

Swami Ramanand Teerth Marathwada University Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Second year Biophysics

Semester Pattern Effective from-2016

Practical Paper CCBP-XI (Annual practical's based on CCBP-VIII & IX)

[Total Marks: 50] *[Exam Duration: 4 hrs]* *[Credits: 02]*

Physiological Biophysics Practical's

2.2 Study of Neubauer's Counting Chamber.
2.3 Red blood cell count/µl of blood
2.4 White blood cell count/ µl of blood
2.5 Haemoglobin content estimation
2.6 Differential count of White blood cells
2.7 Determination of ESR
2.8 Determination of Clotting time
2.9 Determination of Bleeding time
2.10 Determination of Blood groups
2.11 Determination of fragility of erythrocytes
2.12 Oscilloscope Experiments
2.13 Spirometry- Measurement of vital capacity, tidal volume, different timed volumes, peak flow rate.
2.14 Anatomical study of different body systems by using virtual CD Rom/ DVDs(Educational Software).
2.15 Research laboratory / Clinical laboratory visits to observe neurophysiology

Molecular Enzymology Practical's

1. Kinetic characteristics of alkaline phosphatase: (i) Progress curve; (ii) pH optima; (iii) temperature optima (iv) Km and Vmax ; (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 biologicalfunctions, 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, Addition-Wesley.
24. Guyton A.C. (1981), Textbook of Medical Physiology, Sounders 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, Sounders college pub.
30. Jean Brachet (1985), Molecular cytology, Academic press. 31. Hans Netter (1969), Theoretical Biochemistry, Oliver and Boyd, Springer-verlag Press.
44. Carl Branden and John Tooze (1991), Introduction to protein structure, Garland publishing,
Inc.
45. David Freifelder (1987), Molecular Biology, Narosa Publishing house.
46. Thomas E. Creighton (1994), Proteins: Structure and Molecular properties, W. A. Freeman and co.
47. M. Satake, Y.Hayashi, M.S. Sethi & S.A.Iqbal (1997), Biophysical chemistry, Discovery publishing house.
48. C.Edward Gasque (1992), A manual of lab. Experience in Cell biology, Universal stall.

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. Pastermak: (1994), Molecular BiotechnologyPrinciples and Applications of Recombinant DNA.
40. Clearance 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. 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.

141. S.M.Khopkar (1984), Basic Concepts of Analytical chemistry, Willey eastern lit. 114.Campbell R.C. (1974), Statistics for biologist, Cambridge University Press.

144. Bliss C. I.K. (1967), Statistics in biology vol. 1 Mac-Graw Hill.

145. Wardlaw, A.C (1985), Practical Statistics for Experimental biologist.

1.1 Bailey, (2000), Statistical Method in biology.

1.2 Daniel Wayle W., Biostatistics (A foundations for analysis in health sciences).

1.3 Khan, Fundamental of Biostatistics.

1.4 Lachin, Biostatistical Method.

1.5 Friefelder D, Physical Biochemistry, W. H. Freeman and co.

1.6 Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments.VI

Edition. John Wiley & Sons. Inc.

1.7 De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

1.8 Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates,MA.

1.9 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. Shrimer, 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 Acdemic 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

Chapmann & 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.

Swami Ramanand Teerth Marathwada University Nanded.

FACULTY OF SCIENCE

SYLLABUS

B.Sc. (Biophysics)

Third Year (CBCS Pattern)

SEMESTER V & VI

[Syllabus progressively effective from 2016-17 onwards]

Member
Mr.V.A. Jadhav
Head, Dept. Of Biophysics,
D.B.College,Bhokar,Dist.Nanded.

Chairman
Dr. B.M. Kareppa,
Head, Dept. Of Biotechnology,
D.S.M.College, Parbhani, Dist.Parbhani.

Swami Ramanand Teerth Marathwada University ,Nanded

Syllabus Pattern for B.Sc. Biophysics Third Year

Semester V & VI (2016-17 onwards)

Sem.	Code & Paper Code	Section & Period/ week	Title of the paper	External (ESE)	Internal (CA)	Credits
V	DSEBP-XII	A/03	Immunology	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	DSEBP - XIII	B/03	Bioinformatics & Structural Biology	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	SEC-I			50 Marks	SEC-I 1) Retrieval of sequences from database 2) Validation of blood group 3) Retrival of 3D structures 4) Disease identification by Ag-Ab interaction	02
VI	DSEBP - XIV	A/03	Radiation Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	DSEBP - XV	B/03	Medical Biophysics	40 Marks	10 Marks (Attendance: 5Marks & Tests/Assignments: 05 Marks))	02
	SEC-II			50 Marks	SEC-II 1)Visit to gamma chamber 2) Analysis the gamma mediated biomolecules 3)Analysis of phenotopical changes in gamma irradiated seeds 4) literature about radiation syndrome	02
Lab Course Work (Annual Practical)	CCBP-XVI	03	Practical's based on theory papers CCBP-XII & XIII	50 Marks	----------	02
Lab Course Work (Annual Practical)	CCBP-XVII	03	Practical's based on theory papers CCBP-XIV & XV	50 Marks	----------	02
	Total for B.Sc. III Year: Sem. I + Sem. II + Lab Course work (Annual)					16

Note:

- Assessment shall consist of Continuous assessment **(CA)** and End of Semester Examination **(ESE).**
- **Weightage:** 80% for ESE & 20% for CA.
- The Biophysics as optional in each of Semester consists of Two Theory Papers each of 50 marks **[40 External + 10 Internal]** and One Practical paper

of 50 marks.

- **Paper- (Elective):** Transfer of Credit as per Student choice.

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester–V)

Paper DSEBP-XII: Immunology

Semester Pattern Effective from-2016

[Total Marks: 50](40Ext.+10 Int.) *[Exam Duration: 2 hrs]* *[Total Workload:45 hrs]*

Unit 1: - Introduction to Immunology.

Concept and principles of immune system, origin of immune system in invertebrates and vertebrates, Innate immunity, Barriers of innate imunity,Anatomical,physiological and chemical barriers, Adaptive Immunity, active and passive immune system. Molecules, Cells and tissues of immune system,

Unit 2: - Cells and Organs of the Immune System:

The lymphatic system, Haematopoiesis, Haematopoietic growth factors, Primary lymphoid organs: Thymus, Bone marrow and Bursa of fabricius Secondary lymphoid organs: Thymus, , Lymphnodes, Spleen, tonsils ,Payer's patches ,Mucosa associated lymphoid tissues,B lymphocytes ,T-lymphocytes, NK cells, Granulocytes etc. The complement system.

Unit 3 : Antigen:Antibody & their interaction

Concepts of antigen, Antigenic determinant, Factors affecting Antigenicity,Exogegous & Endogenous antigen, Alloantigens, Immunogen and Immunogenicity, Hapten, Carrier effect, Cross reactivity.

Immunoglobulin, Structure of Immunoglobulin, Classes and subclasses of Immunoglobulins , function of different Immunoglobulins, Immunoglobulin diversity.

Physico-chemical basis of Ag- Ab interaction, Avidity, strength of binding between Ag and Ab and its measurement.

Unit 4 : - Immunotechniques.

Detection of Ag-Ab interaction: Precipitation, Agglutination and Complement fixation, Cytokines Concept of Monoclonal and polyclonal Antibodies, Immunization, Methods for purification of antibodies,Antibody assays : Precipitation reaction in gel and solutions Double, Single, Radial immunoprecipitation, Agglutination reactions, Prozone effect, Haemagglutination, Bacterial agglutination , Passive agglutination , Coomb's test, Complement fixation test, Immunoelectrophoresis,Immunofluoreoscence, Radioimmunoassay, ELISA.

REFERENCES :

1. Basic Immunology by Joshi and Osarano. Agrobotanical publishers Ltd. Bikaner
2. Elementary Microbiology Vol.I and II Dr. A.H Modi. Akta Prakashan. Nadiad.
3. Medical Microbiology. N.C.Dey and T.K. Dey. Allied agency, Culcutta.
4. A text book , of Immunology. C.V.Rao.,Narosa Publishing House,New Delhi.
5. Molecular biology by David Freidfelder, Narosa Publishing house, New Delhi.

6. Text book of Immunology by B.S.Nagoba and D.V.Vedpathak. BI publications, New Delhi.
7. Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, Orient Longman,

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester–V)

Paper DSEBP -XIII: Bioinformatics & Structural Biology

Semester Pattern Effective from-2016

[Total Marks: 50](40Ext.+10 Int.) *[Exam Duration: 2 hrs]* *[Total Workload:45 hrs]*

Unit 1: Bioinformatics I

Bioinformatics-Definition, aims and tasks of bioinformatics, applications of bioinformatics in pharmaceutical industry, intrinsic & extrinsic views in bioinformatics,**Data bases** – Major Bioinformatics Resources:, BTIS,EBI, ExPASy,; Nucleic acid sequence databases: NCBI ,EMBL, DDBJ; GenBank; Protein sequence databases: Uniprot-KB: SWISS-PROT, Structure classification database: CATH,SCOP, Protein-Protein interaction database: STRING ; Repositories for high throughput genomic sequences: EST, STS,GSS, etc ; Genome Databases at NCBI, EBI, SANGER ; 3D Structure Database - PDB, Chemical Structure database: Pubchem; Gene Expression database: GEO, SAGE., genomic resources (KEGG).

Genomics: DNA Sequence Analysis-Introduction, why analyze DNA , gene structure and DNA sequences, feature of DNA sequence analysis, expression profile of a cell, cDNA libraries, and ESTS, different approaches to EST analysis, **Micro-array** technology and its applications. Genome mapping – physical mapping, Genetic mapping, gene ontology, gene annotation.

Unit 2:Bioinformatics II

Phylogenetic Analysis-Phylogenetics, cladestics and ontology, building phylogenetic trees, distance based methods and character based methods, molecular approaches to phylogeny, phylogenetic analysis databases

Sequence Alignment-Algorithm, goals and type of alignment, Method for the comparison of two sequences viz., dot plot/ Dot matrix plots, algorithms. Pair wise database searching: FASTA, BLAST, multiple sequence alignment, Detecting Open Reading Frames, Mutation Matrices, Interpreting results.

Unit 3: Structural Biology

Levels of structures in Biological macromolecules, Building blocks of proteins, motifs of protein structures, alpha/beta structures ,Basic structural & conformational principles: Conformational analysis-Forces that determine Protein and Nucleic acid structure, rotation angles, hydrogen bonding, hydrophobic interactions and water structures; ionic interactions, disulphide bonds, Ramachandran plot, Folding and flexibility, Types of proteins and Interactions that govern protein folding, folding mechanisms, Prediction, engineering and design of protein structures. Supra-molecular interactions, Functional importance of Protein-protein and protein-nucleic acid interactions.

Unit 4: Structural Bioinformatics

Molecular Modeling : Predictive methods using DNA and Protein Sequences, Gene-prediction andProteins-prediction strategies, homology modeling, comparative modeling, threading, energy minimization ,bases prediction, molecular visualization, Molecularvisualization-protein

conformation and visualization tool (RASMOL),Structures of oligomeric proteins and study of interaction interfaces.

Drug Discovery and Pharmaco-informatics-
Discovering a drug, Drug discovery -role of bioinformatics in drug discovery target identificationand validation, identification the lead compounds, optimization of lead compounds, pharmacoinformatics, chemical libraries, search programming docking and prediction of drug quality. Bioinformatics companies.

REFERENCES:

Text Books:

2.4 Basic Bioinformatics by S. Ignacimuthu, S. J. Narosa Publishing House,2005.
2.5 Bioinformatics: Sequence and Genome analysis by David W. Mount, Cold Spring
2.6 Harbour Laboratory Press, 2001.

2.7 Protein structure, stability and folding (2001) K.P.Murphy Humana press.

2.8 Introduction to protein architechcture (2001) Arthur M.Lesk Oxford University Press.

2.9 Introduction to Macromolecular Crystallography (2003) McPherson John wiley Publications.

2.10 Introduction to Protein Structure, (1991) Carl Branden and John Tooze

2.11 Bioinformatics (2006) N.Gautham John Garland, Publication Inc Narosa publications.

2.12 Biophysics (2002) Vasantha Pattabhai and N.Gautham Narosa Publishers.

2.13 Physical Chemistry (2001):Tinoco, I., Jr., Sauer, K., Wang, J. C., & Puglisi, J. D.

2.14 Principles and Applications in Biological Sciences, 4th ed. Prentice Hall.

2.15 Introduction to Protein Architecture, by A.M. Lesk

2.16 Introduction to Protein Structure, by Branden and Tooze

Reference Books:

3.7 Introduction to Bioinformatics by S. Sundara Rajan and R. Balaji. HimalayaPublishing

3.8 Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D.

3.9 Baxevanis and B. F. Francis Ouellette, 2nd Edition, John Wiley & Sons, 2002.

3.10 Bioinformatics: Sequence, Structure and Databanks by Des Higgins and Willie Taylor.

3.11 Oxford University Press, 2000.

3.12 Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids by

3.13 Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Cambridge Univ P

3.14 Proteins: structures and molecular properties Thomas E. Creighton

3.15 Chemoinformatics Edited by Johann Gasteiger and Thomas Engel

3.16 Structural Bioinformatics, Edited Philip E. Bourne and Helge Weissig

3.17 Computer Science, J.G. Brookshear, Pearson, Addison Wesley
3.18 Introduction to Bioinformatics – T.Attwood, Parry Smith .
3.19 Bioinformatics – Managing Scientific Data, Zoe' Lacroix and Terence Critchlow
3.20 Bioinformatics – Sequence, Structure and Databanks, Des Higgins & Willie Taylor.
3.21 Structural Bioinformatics, Philip E. Bourne, Helge Weissig 2003.
3.22 Statistical Methods in Bioinformatics: An Introduction, G.R.Grant,W.J. Ewens, Springer .

Swami Ramanand Teerth Marathwada University Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics Third year

Semester Pattern Effective from-2016

Practical Paper CCBP-XVI (Annual practical's based on CCBP-XII & XIII)

[Total Marks: 50] [Exam Duration: 4hrs] ***[Total Workload: 45 hrs]*** *[Credits: 02]*

LIST OF PRACTICALS [Based on IMMUNOLOGY]

8. Demonstration of Immunization of Rabbit
9. To perform immunodiffusion by Ouchterlony method.
10. Single radial immunodiffusion(Mancini method)
11. Analysis of the Ouchterlony and Mancini method
12. Countercurrent Immunoelectrophoresis
13. Characterization of the Blood Group by agglutination
14. To perform ELISA checkerboard experiment.
15. To perform Complement fixation assay
16. To perform Immuno affinity chromatography.
17. To perform Agglutination inhibition Assay
18. To perform sandwich ELISA.
19. To perform Immunoprecipitation
20. To perform Coomb's test.
21. Hemolytic plaque assays.

LIST OF PRACTICALS [Based on BIOINFORMATICS & STRUCTURAL BIOLOGY]

12. Searching of scientific information in NCBI, EBI,DDBJ using Entrez, SRS
13. Surveying Primary, Derived, specialized & structural biological databases & compiling information
14. Identification of gene using gene scan & EST analysis
15. Primer designing using software
16. Pair wise alignment BLAST & FASTA
17. Multiple sequence alignment CLUSTAL W
18. Prediction of primary and secondary structure and various parameters in protein structure and function
19. 3D analysis of protein molecule & molecular visualization using RASMOL,Cn3D

20. Phylogenetic analysis using PHYLIP or other software
21. Molecular Docking using AUTODOCK or other software.
22. Access to Expasy server.

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – VI)

Paper DSEBP -XIV: Radiation Biophysics

Semester Pattern Effective from-2016

[Total Marks: 50](40Ext.+10 Int.) *[Exam Duration: 2 hrs]* *[Total Workload:45 hrs]*

Unit 1: Basics of Radiation Physics

Atomic structure models, Constituents of atomic nuclei, Isotopes, Isobars, Isotones, Isomers, Radioactivity, law of Radioactivity, General properties of alpha, beta and gamma radiations, Radiation units: Units of measurement of radioactivity. Curie, Becquerel. Units of exposure, Roentgen, units of measurement of absorbed dose Rad, Gray, relative biological effectiveness, Dose equivalent, Interaction of radiation with matter: Excitation and ionization, Photo electric effect, Compton Effect, pair production, Characteristic radiation. Properties, Characteristics X-rays ,Nonionizing radiations-UV, IR, Microwaves & Radio waves, their characteristics, interactions & implications in bio systems.

Unit 2: Basics of Radiochemistry & Radiobiology

Radiolysis of water, Production of free radicals & their interactions, Direct and indirect effects of radiation. Radiation chemical yield and G value, Target theory, Single hit & Multi hit theory, Effect of radiation on Nucleic acids, Proteins, Enzymes, Action of radiation on living system – Viruses, Prokaryotic & Eukaryotic cells Cellular effects of radiation, somatic & genetic effects, Inhibition of Mitosis, survival curves, concept of **LD_{50}** , acute and chronic (whole body) effects of radiation, Radiation syndrome in human beings

Unit 3: Introduction to Radiation Detection & Measurement

Radiation sources, Tele-gamma Unit (Cobalt unit), Gamma chamber, Particle Accelerators, Nuclear reactors, gamma camera, Principles of radiation detection and measurement, General principles of Dosimeters., Basic principle, design and utility of ionization chamber, proportional counter, GM-counter, Scintillation Detectors. Thermo-luminescent dosimeter, chemical dosimeter-Fricke, Free radical dosimeters,

Unit 4 : Radiation Safety measures and Application

Natural & Man-made radiation exposures, Basic Principles of Radiation protection concept of Maximum permissible dose (MPD) personal & area monitoring, licensing & other administrative procedures for procurement of Radioisotopes, legal aspect of radiation protection, Disposal of radioactive waste.

Radioisotopes in biology, Medicine(Therapy & diagnosis),Agriculture, Plant breeding, Soil plant relationship & plant physiology, Biological applications of radioisotope, Radio-labeling & Tracer techniques, Food irradiation, radiation sterilization of medical product,

Autoradiography-Principle procedure and Application of autoradiography.

Reference Books:

9. Primer in Applied Radiation Physics: F.A. Smith.

10. Introduction to Experimental Nuclear Physics: R.M. Singru.

11. Radiation Biophysics: E.L. Alpen.

12. Atom, Radiation and Radiation Protection: J. Turner.

13. Atomic and Nuclear Physics Vol. II: Ghoshal.

14. Nuclear Structure: Preston and Bhaduri.

15. Nucleon-nucleon Interaction: Brown and Jackson.

16. Introductory Nuclear Physics: S.S.M. Wong.

17. Nuclear Structure: M.K.Pal

18. Radiation Detection and Measurement: G.F. Knoll.

19. Nuclear Physics Techniques: W.R. Leo.

20. Introduction to Nuclear and Particle Physics(2nd Edition): A Das and T. Ferbel.

21. Radiation Biophysics by L.Alpen Edward, Academic Press, (1988).

22. Biophysics—An Introduction. John Wiley and Son, (2002).

23. Yurii B. Kudryashov Radiation Biophysics (Ionizing Radiations)

24. Edward L. Alpen Radiation Biophysics, Second Edition

25. Biophysics by Glaser Rowland (2001). Springer Verlag, Berlin

26. Bushong, Stewart, Radiologic Science for Technologists, C. V. Mosby, 2009,9th edition.

27. NCRP Report 105. Radiation Protection for Medical & Allied Health Personnel.

28. NCRP Report 116. Limitation of Exposure to Ionizing Radiation.

29. NCRP Report 102. Medical X-ray, Electron Beam, and Gamma-Ray Protection.
30. A Parrish, R Rox Anderson, F Urbach, and D Pitts. UV-A: Biological Effects of Ultraviolet Radiation Plenum Press,
31. An Introduction to Lasers – theory and applications, M.N. Avadhanulu, S.Chand and Experiments with He+Ne Laser by Sirohi
32. Optical fibre and Laser – Principle and applications, Anuradha De, New Age International
33. Thormod Henriksen Radiation & Health Taylor & Francis
34. F.R. Hallett, J.L. Hunt, E.L. McFarland G.H. Renninger, R.H. Stinson and D.E. Sullivan Physics for the Biological Sciences 3rd and 4th Ed.
35. H. Cember and T.E. Johnson, Introduction to Health Physics, (McGraw Hill)

Swami Ramanand Teerth Marathwada University,Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics (Semester – VI)

Paper DSEBP -XV: Medical Biophysics

Semester Pattern Effective from-2016

[Total Marks: 50](40Ext.+10 Int.) *[Exam Duration: 2 hrs]* *[Total Workload:45]*

Unit 1: Basic Electrophysiology:

Nature of bioelectric signal, Fundamental concepts in bioelectricity & bioelectronics, principles & utility of patch-clamp,
ELECTROCARDIOGRAPHY (ECG) Fundamental principles of electrocardiography, Cardiac electrical field generation during activation , Electrocardiograph lead systems,The normal P wave, Artial repolarisation ,Atrio-ventricular node conduction and the PR segment,Ventricular activation and the QRS complex ,Ventricular recovery and ST-T wave U wave ,Normal variants ,Rate and rhythm Principle, instrument design and medical utility : EEG ,EMG ,ERG,EOG ,Visual evoked potentials, biological impedance and its significance.

Unit 2: Medical Imaging:

Physical aspects of medical imaging, LASER beam in biology & medicine, Fundamentals of laser physics, Medical lasers(Carbon Dioxide Laser, Nd:YAG Laser,),Applications of Lasers in therapy and diagnosis, photo-thermal effects, photochemical effects, Principle, instrumental set up, procedure and medical utility of X-ray imaging, Xeroradiography, Fluoroscopy, Computer Tomography Scan, Magnetic Resonance Imaging, Ultrasound in medicine-Physical properties of ultrasound (the velocity, the frequency, intensity) Ultrasound interactions with the tissues (reflection, diffraction, refraction, absorption, scattering,), Ultrasound application in medicine. safety Aspects of diagnostic and therapeutic ultrasound.

Unit 3: Nuclear Medicine :

In-vitro & in-vivo imaging using radioisotopes, Blood volume determinations by isotopic method, Radioiodine diagnosis & therapy in thyroid disorders, Principle, method and applications of Radioimmunoassay, organ scans-thyroid, liver, brain, bone, renal imaging, cardiac imaging, PET scan, nuclear medicine for therapy, radiopharmaceuticals-concept, production & use.

Unit 4: Biomedical Instrumentation

Basic concepts in medical instrumentation, Basic sensors-principles, transducers, amplifiers, measurement of blood pressure, blood volume ,blood flow, respiratory measurements, cardiac output measurements, patient monitoring equipments, audiometers, cardiac pacemakers, surgical diathermy, physiotherapic equipments, hemo dialysis machine, automated drug delivery systems, ICU and Operation theater equipments , blood bank instrumentation.

References

10. Beiser A.: Physics, Addison-Wesley, Massachusetts 1991, Chapter 27, pp. 803-807
11. Katzir A.: Lasers and Optical Fibers in Medicine, Academic Press, Inc. 1993

12. Medical Instrumentation applications and design by John G. Webster.

13. Biomedical Instrumentation Technology and applications by Khandpur. Mc Graw –Hill.

14. Biomedical Instrumentation systems by Shakti Chatterjee.

15. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', McGraw Hill Publishing Co Ltd. 2003.

16. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education

17. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies,

18. L.A. Geddes & L.E.Baker, Principles of Applied Bio-Medical Instrumentation, John Wiley

19. J.Webster, Medical Instrumentation', John Wiley & Sons, 1995.

11. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Ins

8. James Moore George Zouridakis Biomedical Technology and Devices Handbook CRC Press

9. Bronzino Biomedical Engineering Handbook CRC Press

10. Physics of Diagnostic Imaging , Universities press (India) Ltd, Orient Longman ltd, 2000.

11. Goddess & Baker Principles of Applied Biomedical Instrumentation, JohnWiley

12. Carr & Brown Biomedical Instrumentation & Measurement ,Pearson

17. Cromwell Biomedical Instrument Prentice Hall of India, New Delhi

18. Sanjay Guha Medical Electronics and Instrumentation , University Publication

19. Edwand J. Bukstein Introduction to Biomedical electronics Sane and Co. Inc.USA.

2.16 JohnG Webster, Medical Instrumentation application design, Houghon Mifflin Co.

2.17 Joseph Dfu Bovy,Introduction to Biomedical Electronics, Mc Graw Hill.

2.18 J.B.Cameron & Skofornik Medical Physics, Academic Press

Swami Ramanand Teerth Marathwada University Nanded

Choice Based Credit System (CBCS) Course Structure

B. Sc. Biophysics Third year

Semester Pattern Effective from-2016

Practical Paper CCBP- XVII (Annual practical's based on CCBP-XIV & XV)

[Total Marks: 50] [Exam Duration: 4 hrs] ***[Total Workload: 45 hrs]*** *[Credits: 02]*

LIST OF PRACTICALS [Based on Radiation Biophysics]

8. To calibrate the UV source using Potassium ferrioxalate actinometry.
9. To measure the UV intensity using UV meter
10. To study the effect of UV,X-rays on mitotic cell division .
11. To study the effect of UV,X-rays on biomolecules – amino acids, proteins , Nucleic acids, enzymes.
12. To study the effect of UV, X-rays on seed germination and study cytogenetic changes
13. To study the effect of UV, X-rays on cell membrane- RBC
14. To study the effect of UV, X-rays on bacterial cell growth and evaluate $\mathbf{LD_{50}}$
15. To investigate background radiation, learn how to measure it, and compensate for it.
16. To study the characteristics of a Geiger-Muller counter and to determine plateau and operating voltage of the GM counter.
17. To determine the resolving time of a GM counter.
18. To estimate the efficiency of the Geiger-Mueller tube for a particular source.
19. To demonstrate the Statistical Nature of Radiation Counting & investigate the statistics related to measurements with a Geiger counter.
20. To investigate the relationship between the distance and intensity of radiation and verify the inverse square relationship between the distance and intensity of radiation.
21. To investigate the relationship between absorber material (atomic number) and backscattering and study the relationship between absorber thickness and backscattering.
22. To determine the range of an alpha particle in air, and consequently the alpha particle's energy.
23. To investigate the attenuation of radiation via the absorption of beta particles.
24. To determine the maximum energy of decay of a beta particle.
25. To investigate the attenuation of radiation via the absorption of gamma rays.

LIST OF PRACTICALS [Based on Medical Biophysics]

9. Identification of different block/sub system of circuits in X-Ray machine
10. Operation and function of all the controls of hospital X-Ray machine (visit to hospital)
11. Operation and function of all the controls of dental X-Ray machine (Visit to Hospital)
12. Observe its wave shape on CRO the output of blood pressure transducers, body Temperature transducers and pulse sensors
13. Measurements of B.P. and recording of Kortov sound
14. Measurements of body temperature using GSR and thermister probe
15. Measurements of skin resistance using GSR
16. Use of sphygmomanometer for measurement of blood pressure
17. To determine respiratory parameters using Spirometry(PFT).
18. Concept of ECG system and placement of electrodes
19. Measurement of leakage currents with the help of safety tester
20. To study EMG system and placement of electrode
21. To study EEG system and placement of electrode
22. To study ophthalmologic instruments
23. Identification of different types of pH electrode
24. Visit to hospital and demonstration of biomedical equipments in ICU,ICCU & operation theater
25. Basic electronic experiments- transistor, semiconductor diode characteristics, rectifier , operational amplifiers, use of CRO etc.
26. To perform computer based Lab Tutor experiments using Power Lab instrumentation(AD-Instruments, Australia)
27. Visit to Medical Imaging centres and demonstration of CT Scan, MRI, Ultrasonography, Angiography.
