Solapur University, Solapur

M.Sc. Part-I

Syllabus of Academic year – 2010-11

Biotechnology

- **Intake Capacity:** 30 students per year.
- **Eligibility:** A Candidate possessing B.Sc. Degree with Biotechnology/Biochemistry/Chemistry/Microbiology/Botany/ Zoology/B.Pharm/MBBS/B.E./B.Sc.Agri./life sciences as a principal subject (Biotech), and who have passed the entrance examination conducted by the Solapur University shall be held eligible For admission to M.Sc. Course in Biotechnology. Students from other University with B.Sc. General degree and who have passed the entrance examination conducted by the University are also eligible.

- **Admission :** Merit list based on average of B.Sc. aggregate and entrance exam conducted by University. For other university student merit list only on basis of entrance examination conducted by University.

SEMESTER-I

MBT 101: Cell Biology, Microbiology and Virology
MBT 102: Proteins – Structure and Functions
MBT 103: Biomolecules
MBT 104: Biostatistics and Bioinformatics with Computer Orientation
MBT Pr. 101: Laboratory Course I
MBT Pr. 102: Laboratory Course II

SEMESTER-I

MBT 101: Cell Biology, Microbiology and Virology (60 lectures)

UNIT I (15)

CELL BIOLOGY:

Cell as a basic unit life. Cell organization of prokaryotic and eukaryotic cells. Structural and functional capitalization of cell, mitochondria, chloroplast, lysosomes, golgi bodies, plasma membrane and cytoskeleton, cell wall, nucleus.

UNIT II (15)

Cell cycle, cell division – mitosis and meiosis.

Chromosome structure, gene, gene number, gene clusters and Pseudogene, Polytene and lampbrush chromosomes. Packing of DNA, supercoiled DNA, nucleosome, Inverted repeats, repetitive DNA sequence, satellite DNA.

Cell trafficking.

UNIT III (15)

MICROBILOGY:

Structure, classification and general characteristics of Bacteria (including ribotyping), Micoplasma, Protozoa, archea and yeast, fungi, Association of bacteria. Methods in microbiology: Pure culture techniques, principles of mictrobial nutrition, constructions of culture media, enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. Sterilization-Application of sterilization methods in biotechnology, Various sterilization methods, Microbial contamination control and Sterility testing.

Microbial growth: The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yield, synchronous growth, continuous culture.

UNIT IV (15)

VIROLOGY:

Classification and General properties of plant, animal and bacterial viruses, Bacteriophages – lytic cycle & lysogeny. Structure of viruses, assembly of viral membrane.

Life cycle and replication of viruses:

RNA-negative strand (VSV), positive strand (Polio), segmented [Influenza]

Retrovirus-RSV and HIV

DNA-adenovirus and SV-40

Cultivation in cell culture, chick embryo and animal inoculation.

Persistent chronic and acute viral infections.

Mechanism of interferon and antiviral therapy.

Host virus interactions; plant and animal.

Suggested readings :

1. Clark M. S. & Wall W. J. (1996) Chromosomes, Chapman & Hall, London.
2. Textbook of Medical Physiology by A.C. Guyton and J. E. Hall, W.B. Saunders Publication, 9 th Edition, 1996.
3. Physiology Illustrated by Lipfold and Cogdell
4. Cells by David Prescott
5. Cell Structure and Function by Loewy and Gallant
6. Essential Cell Biology by Albert Bray et al, Garland Publication New York 1997.
7. Introduction to Modern Virology by Dimmock and Primrose
8. Molecular Virology by Alan Cann
9. Madigam M.T., Martinko J.M. and Parker J. (2001) Biology of Microorganisms 9th ed. Prentice Hall, Int.(U.K.) Ltd., London.
10. General Microbiology by Stanier, Adelberg and Ingraham, The Macmillan Press Ltd., Hong Kong.

MBT 102: Proteins – Structure and Functions (60 lecturers)

UNIT I (15)

AMINO ACIDS:

Chemical structure and general properties, pI of amino acids, base concepts. Henderson and Hasselbaclh equation: General metabolism scheme of amino acids and Urea cycle.

PROTEINS

Classification – size, shape, degree of association, complexity.

Classification of proteins according to biological functions (Enzymes,transport, storage, contractile, structural, defense and regulatory)

Structure of peptide bond – restricted rotation, cis – trans bending, Ramchandran plot. Peptides.

UNIT II (15)

Secondary structure – alpha helix and beta pleated structure, triple helix (collagen) and super secondary structures.

Tertiary structure – forces stabilising tertiary structure, unfolding/refolding experiment, prediction of secondary and tertiary structure. Dynamics of protein folding, role of molecular chaperones in protein folding, Lysosomal and membrane proteins.

Quaternary structure – forces stabilising quaternary structure. Structure function relationship – myoglobin and haemoglobin.

Techniques for studying primary sequence of proteins, experimental methods, end group analysis, finger printing and sequenators.

UNIT III (15)

Chemical synthesis of peptides/ solid phase automated synthesis, prediction of conformation from amino acid sequence, zymogens and their conversion into active proteins

Protein evolution – phylogenic tree, convergent and divergent trees, sequence analysis, comparison matrix, Dot matrix and substitution matrix.

Protein turnover: Ubiquitination, proteasome and protein degradation.

UNIT IV (15)

Concept of prosthetic group, apoenzyme, holoenzyme, enzyme.

Coenzyme:

Vitamins as coenzymes: sources, requirements, functions and deficiency symptoms of water soluble vitamins. Structure and biochemical role. Assay of vitamins.

Confactors: Role of trace elements, their bound forms in biological systems and in enzyme structure and function.

Suggested Readings :

1) Lehninger's Principles of Biochemistry by D. L. Nelson and M. M. Cox, CBS Publications, 2000
2) Biochemistry by Lubert Stryer, 4th Edition
3) Biochemistry by David Rawn
4) Principles of protein structure by Shulz and Schirmer
5) Fundamentals of Enzymology by Royer
6) Fundamentals of enzymology by Price and Steavens

MBT 103: Biomolecules (60 lectures)

UNIT I (15)

CLASSIFICATION AND STRUCTURES:

Classification, characteristics and functions of monosaccharides, disaccharides – polysacchrides, Epimers, isomers, anomers, chiral carbon atom, chair and boat form, glucopyranose and fructopyranose.

CARBOHYDRATE METABOLISM:

General scheme of metabolism, historical and experimental details in derivation of a metabolic pathway. Glycolysis – aerobic and anaerobic, regulation of glycolysis. Krebs cycle and its regulation; Hexose monophosphate shunt,

UNIT II (15)

OTHER PATHWAYS OF CARBOHYDRATE METABOLISM

Phosphoketolase pathway, Entner Dudroff pathway, glyoxylate and glucuronate pathways, Cori cycle. Interconversion of sugars, gluconeogenesis, synthesis of disaccharides and polysaccharides. Regulation of blood glucose and homeostasis.

Glycogenesis and glycogenolysis and their regulation.

COMPLEX CARBOHYDRATES:

Types and general functions, amino sugars, sialic acid and mucopolysaccharides. Structure and functions of glycoproteins and proteoglycans. Blood group sugar compounds, sugar nucleotides, bacterial cell wall components. Lecting – specificity, characteristic and uses, pectin, xylans.

UNIT III (15)

LIPIDS:

Definition and classification of lipids. Fatty acids – general formula, nomenclature and chemical properties Structure, function and properties of simple, complex, acylglycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins.

Beta oxidation – pathway and regulation.

Role of acyl carnitine in fatty acyl transport. Synthesis of fatty acid – structure and composition of fatty acid synthetase complex, pathway and regulation. synthesis of triacyl glycerides.

Ketone bodies – formation and utilisation.

UNIT IV (15)

NUCLEIC ACIDS:

Structure of nucleoside, nucleotide. De novo and salvage pathways of nucleotide synthesis. Experimental evidence for nucleic acids as genetic material. Secondary structure of DNA, Watson and Crick model of DNA. A,B and Z forms of DNA , Tm and its relation to GC content Chemical and enzymatic degradation of nucleic acids.

Suggested Readings:

1) Lehninger's Principles of Biochemistry by D. L. Nelson and M. M. Cox, CBS Publications, 2000
2) Biochemistry by Lubert Stryer, 4th Edition
3) Biochemistry by Zubay
4) Biochemistry By Garrett and Grisham
5) Complex Carbohydrate by Nathan Sharon

MBT 104: Biostatistics and Bioinformatics with Computer Orientation (60 lectures)

UNIT I (15)

BASIC TERMS, MEASURES OF CETRAL TENDENCY AND DISPERSION**:**

Population, Sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, pie diagram, cumulative frequency curves. Mean median, mode, quartiles and percentiles, measures of dispersion: range, variance, standard deviation, coefficient of variation, symmetry: measures of skewness and kurtosis

PROBABILITY AND DISTRIBUTIONS:

Sample space, events, equally likely events. Definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, Examples Bernoulli, Binomial, Poisson and Normal distributions. Mean and variance of these distributions (without proof). Sketching of p.m.f. and p.d.f., Use of these distributions to describe in biological models. Models sampling and Simulation study.

UNIT II (15)

BIVARIATE DATA:

Scatter plot, correlation coefficient (r), properties (without proof), Interpretation of r, linear regression. Fitting of lines of regression, regression coefficient, coefficient of determination.

METHODS OF SAMPLING:

Use of random numbers to generate simple random samples with replacement and without replacement. Sampling distribution and standard deviation of sample mean. Stratified sampling and its advantages.

HYPOTHESIS TESTING:

Hypothesis, critical region, and error probabilities. Tests for proportion, equality of proportions, equality of means of normal populations when variance known and when variances are unknown. Chi-square test for independence. P-value of the statistic. Confidence limits, Introduction to one way and two-way analysis of variance.

UNIT III (15)

COMPUTER RELATED INTRODUCTORY TOPICS:

History of development of computers, Basic components of computers, Hardware; CPU, input, output, storage devices. Software; operating systems, Programming languages (Machine, Assembly and Higher level)

APPLICATION SOFTWARE:

Introduction to MSEXCEL-Use of worksheet to enter data, edit data, copy data, move data. Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients etc. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL for presentation of data. Introduction to MSWORD word processor-editing, copying, moving, formatting, Table insertion, drawing flow charts etc.

UNIT IV (15)

BIOINFORMATICS :

Introduction to Internet and use of the same for communication, searching of database, literature, references etc. Introduction to Bioinformatics, Databank search-Data mining, Data management and interpretation, BLAST, Multiple sequence alignment, Protein Modeling, Protein structure Analysis, Docking, Ligplot interactions, Genes, Primer designing, Phylogenetic Analysis, Genomics and Proteomics.

Suggeted Readings :

1. Biostatistics : A foundation for Analysis in the Health Sciences 7/E /Wayne W. Daniel, Wiley Series in Probability and Statistics.
2. Introductory Statistics. Fifth Edition. (2004) Prem S. Mann John Wiley and Sons (ASIA) Pte Ltd.
3. Basic Statistics-Aprimer for Biomedical Sciences-(Olive Jean Dunn).
4. Biostatistics-An introductory text – (Auram Gold Stein).
5. Statistics : An Introductory Analysis (Taro Yamane) Harper and Row Publisher 1964,67,73
6. Computational Biochemistry, By: C. Stan Tsai, A John Wiley & Sons, Inc., publication.

MBTPr 101: Laboratory Course I (60 lecturers)

1) Introduction to basic laboratory instruments like – pH meter, colorimeter, single pan balance – calibration, centrifuge etc.
2) Preparation of reagents, buffers etc.
3) Determination of total amino acid concentration by ninhydrin method.
4) Estimation of protein concentration by
   i) Biuret method ii) Lowry method
   ii) Spectrophotometric method iv) Dye binding method.
5) Estimation of reducing sugar concentration by
   i) DNSA method
6) Estimation total sugar concentration by
   i) Phenol-H_2SO4 method ii) Anthrone method
7) Estimation of glucose concentration by
   a) Glucose oxidase method

8) Determination of fructose concentration by resorcinol method.
9) Estimation of DNA and RNA
   a) Estimation of DNA by diphenyl amine method.
   b) Estimation of DNA by Spectrophotometric method.
   c) Estimation of RNA by orcinol method.
10) Estimation of Cholesterol
11) Estimation of Inorganic phosphate by Fiske & Subbarow Method
12) Estimation of Vit. C concentration by DCPIP method
13) Isolation of Characterization of casein from milk.
14) Isolation and characterization of starch from potato.
15) Isolation of DNA and RNA.
16) Isolation of cholesterol and lecithin from egg yolk.
17) Determination of hyperchromicity and study of melting curves.

MBTPr 102: Laboratory Course II (60 lecturers)

Biostatistics and bioinformatics:

1) Measures of Central Tendency and Dispersion
2) Statistical Analysis using EXCEL (Descriptive statistics and graphical presentation.)
3) Sketching of pmf/pdf of Binomial, Poisson and Normal distributions.
4) Correlation and Regression Analysis
5) Simple random sampling and stratified sampling.
6) Hypotheses testing and confidence intervals.
7) Analysis of Variance.
8) Word processing.
9) Getting an amino acid sequence, nucleotide sequence and blasting.
10) Multiple sequence alignment
11) Homology modelling
12) Structure analysis: secondary, tertiary and Quaternary structure, bond angle, bond length, different interactions.
13) Searching for possible ligand, ligand protein interactions.
14) Primer designing.
15) Phylogenetic studies.

Suggested Readings:

1) Practical Biochemistry: An Introductory Course by Fiona Frais.
2) Methods in Enzymology Vol. I by S.P.Colowick and N.O.Kaplan eds.
3) Basic Biochemical Methods 2nd ed. by R.R. Alexander and J.M.Grilffith
4) Biochemical Methods 2nd ed. by S.Sadasivam and A. Manickam
5) Hawk's Physiological Chemistry ed. by Bernard L Oser.
6) A Textbook of Practical Biochemistry by David Plummer.
7) Laboratory Mannual in Biochemistry by S. Jayaraman.

Solapur University, Solapur,

Syllabus

M. Sc. Part I (Biotechnology), Semester II

MBT -201 -Enzymology

MBT -202 -Molecular Biology

MBT -203 -Bioenergetics

MBT -204 -Tools and Techniques in Biosciences

MBT –PR 201 -Laboratory Course III

MBT –PR 202 -Laboratory Course IV

SEMESTER- II

MBT 201	**Enzymology**	**60**
UNIT I	**ENZYMES:** Classification - IUB system, rationale, overview and specific examples. Characteristics of enzymes, enzyme substrate complex. Concept of active centre, binding sites, stereospecificity and ES complex formation. Effect of temperature, pH and substrate concentration on reaction rate. Activation energy. Transition state theory. **ENZYME CATALYSIS**: Factors affecting catalytic efficiency - proximity and orientation effects, distortion or strain, acid - base and nucleophilic catalysis. Methods for studying fast reactions. Chemical modification of enzymes. Isoenzymes and multiple forms of enzymes.	15
UNIT II	**ENZYME KINETICS:** Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics. Significance of Vmax and Km. Bisubstrate reactions. Graphical procedures in enzymology - advantages and disadvantages of alternate plotting. Enzyme inhibition - types of inhibitors - competitive, non-competitive and uncompetitive, their mode of action and experimental determination. Enzyme activity, international units, specific activity, turnover number, end point kinetic assay	15
UNIT III	**STRUCTURE FUNCTION RELATIONS:** Lysozyme, ribonuclease, trypsin, carboxypeptidase, phosphorylase, aspartate transcarbamylase, glutamine synthetase and phosphofructo kinase. Multi enzyme complexes - pyruvate dehydrogenase and fatty acid synthetase; Na - K ATPase.	15
UNIT IV	**ALLOSTERIC INTERACTIONS**: Protein ligand binding including measurements, analysis of binding isotherms, cooperativity, Hill and Scatchard plots and kinetics of allosteric enzymes. **ENZYME REGULATION:** Product inhibition, feedback control, enzyme induction and repression and covalent modification. Allosteric regulation. **IMMOBILIZED ENZYMES:** Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and Km). Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Immobilized multienzyme systems Biosensors - glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors	15
	References: - 1) Fundamentals of Enzymology- Price and Stevens 2) Enzymes -Dixon and Webb 3) Isoenzymes By D. W. Moss 4) Immobilized Biocatalysts- W. Hartneir 5) Selected papers Allosteric Regulation -M. Tokushige 6) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Trevor Palmer, (2004)	

MBT 202	Molecular biology	60
UNIT I	**Genome organization** Organization of bacterial genome, Structure of eucaryotic chromosomes; role of nuclear matrix in chromosome organization and function, matrix binding proteins, heterochromatin and euchromatin, molecular components, DNA reassociation kinetics (Cot curve analysis), repetitive and unique sequences, kinetics and sequence complexities, satellite DNA, DNA melting and buoyant density, packing and organization of chromatin, nucleosome phasing, DNase I hypersensitive regions, DNA methylation & Genetic Imprinting, **Mutation**; Nonsense, missense and point mutations, intragenic and intergenic suppression,frameshift mutations, physical, chemical and biological mutagens.	15
UNIT II	**DNA Replication, Repair & Recombination** Concepts of replication initiation (Replicon), elongation and termination in prokaryotes and eukaryotes, enzymes and accessory proteins involved in DNA replication, Fidelity in replication, replication of single stranded circular DNA. Gene stability and DNA repair, DNA repair enzymes, photoreactivation, Base excision repair, mismatch repair, methyl mediated mismatch repair (MMR), SOS repair. **Recombination:** homologous – Generalized (Prophase, synaptonemal complex with evidences in recombination), site specific (FLP/FRT and Cre/Lox recombination RecA and other recombinases). and non-homologous recombination – Transposons as illegitimate recombination agency, μU transposon, retroposon, conservative, replicative transposition. Holliday structure, resolution of holiday junction, chi sequences in prokaryotes, recBCD Pathway, gene targeting, gene disruption. **Bacterial genetic recombination:** Transformation, Conjugation, Transduction.	15
UNIT III	**Prokaryotic & Eukaryotic Transcription** Prokaryotic Transcription & Regulation: Promoters (WRT –various sigma specificity), Regulatory elements, Transcription unit, constitutive and inducible promoter, operators, Initiation, Termination, Rho-dependent and independent termination, Anti-termination, Transcriptional regulation, **Operon concept**; Positive (the *ara* operon) and Negative (the *lac* operon), Attenuation (the *trp* operon), transcriptional control in lambda phage –Genetic switch wrt Lysogeny /Lytic control, the mRNA Processing- 3' end formation, capping and splicing, Processing of tRNA and rRNA Eucaryotic **Transcription and regulation**: RNA polymerase structure and assembly, RNA polymerase I, II, III, Eukaryotic promoters and enhancers, General Transcription factors, TATA binding proteins (TBP) and TBP associated factors (TAF), Activators and repressors, transcription initiation, elongation and termination, activation and repression, Transcriptional and post-transcriptional gene silencing, expression Nuclear export of mRNA, mRNA stability, catalytic RNA.	15
UNIT IV	**Translation & Transport –Prokaryotic and Eukaryotic** The translation machinery, ribosomes, composition and assembly, Universal genetic code, degeneracy of codons, termination codons, isoaccepting tRNA, wobble hypothesis. Mechanism of initiation, elongation and termination, Co- and post-translational modifications, genetic code in mitochondria. Protein synthesis, Transport of proteins and molecular chaperones, protein stability, protein turnover and degradation	15

	References:- 1. Stryer L (1995) Biochemistry, 4 th edition, W. H. Freeman & company. 2. Watson J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. and Weiner, A. M. (1988) Molecular biology of the gene, 4 th edition, Pearson (publisher) 3. Benjamin Lewin (1999) Genes IX or X, oxford University Press, Oxford. 4. Weaver R. F. (1999) Molecular biology, WCB McGraw-Hill companies, I 5. Brown T A (1995) Essential molecular biology, vol. I, A practical approach. 6. Genes and Genomes -Maxine Singer and Paul Berg, 7. Microbial Genetics –David Freifelder, J. E. Cornan, S. R. Maloy, (1994), Jones and Bartlett Learning publisher.	

MBT 203	Bioenergetics	60
UNIT I	**FREE ENERGY CONCEPT:** Molecular basis of entropy, concept of free energy, standard free energy and measurement of free energy, significance in metabolism. Application of first and second law of thermodynamics to biological systems. Energy rich bonds - ATP and interconversions of nucleotide phosphates. Phosphorylation potential **NITROGEN FIXATION:** Biological fixation of nitrogen- symbiotic and non-symbiotic. Nitrogenase enzyme complex - azoferredoxin and Molybdoferrodoxin. Physiological electron donors and mechanism of nitrogen reduction, assimilation of ammonia, nitrogen cycle. *nif* genes and its regulation (*Klebsiella* and *Rhizobium*).	15
UNIT II	**MITOCHONDRIA:** Architecture, chemical activity of mitochondria. Sequence of electron carriers and sites of oxidative phosphorylation, ATP generation, heme and non- heme iron proteins. Thermodynamic considerations, oxidation - reduction electrodes, standard electrode potential, redox couples, phosphate group transfer potential. Respiratory controls. Theories of oxidative phosphorylation, uncouplers and inhibitors of energy transfer. ATP synthetase complex	15
UNIT III	**CHLOROPLAST:** Architecture, - light harvesting complexes, bacteriorhodopsin, plastocyanin, carotenoids and other pigments. Hill reaction, photosystem I and II - location and mechanism of energy transfer, photophosphorylation and reduction of carbon dioxide. Calvin cycle, quantitative efficiency, photorespiration, C4 - metabolism. Chemiosmotic theory and evidence for its occurrence, ion transport through membranes, proton circuit and electro-chemical gradient, ionophores, Q cycle and stoichiometry of Proton extrusion and uptake, P/O and H/P ratios, reverse electron transfer. Fractionation and reconstitution of respiratory chain complexes.	15
UNIT IV	**HORMONES :** General classification of hormones - synthesis, structure, secretion, transport, metabolism and mechanism of action of pancreatic, thyroid, parathyroid, hypothalamus, pituitary, adrenal and prostaglandins. Hormonal control of spermatogenesis, menstrual cycle, Pregnancy and lactation. Cell membrane and intracellular receptors for hormones. Secondary messengers Plant growth hormones - auxins, gibberllins, abscessic acid, cytokinins. Phenoromones	15
	References:- 1. Biochemistry by Lubert Stryer 4th Edition 2. Biochemistry by Mathew VanHolde 3. Lehningers Principles of Biochemistry by Nelson and Cox 4. Hormones by Norman Litwack 5. Basic and Clinical Endocrinology- Greenspan and Baster 6. Biochemistry and Physiology of Plant Hormones- Thomas Moore 7. Annual Review of Biochemistry 1977 8. Thermodynamics for Biological Systems -Baine	

MBT 204	Tools and Techniques in Bioscience	60
UNIT I	**TECHNOLOGY FUNDAMENTALS (Life Science):** General scheme for purification of bio-components. Methods for studying cells and organelles. Sub-cellular fractionation and marker enzymes. Methods for lysis of plant, animal and microbial cell. Ultra filtration, freeze drying and fractional precipitation. Use of detergents in isolation of membrane proteins.	15
UNIT II	**CHROMATOGRAPHY:** Basic principles and applications of ion-exchange, gel filtration, partition, affinity, HPLC and reverse phase chromatography, gas chromatography, TLC and HPTLC, Paper chromatography. Chromatofocussing. **CENTRIFUGATION:** Ultracentrifugation - velocity and buoyant density determination. Density gradient centrifugation, molecular weight determination.	15
UNIT III	**ELECTROPHORESIS:** Basic techniques, poly acrylamide/ starch/ agarose gel electrophoresis, use of SDS/urea, isoelectric focusing, capillary electrophoresis. Pulse field gel electrophoresis. **TRACER TECHNIQUES:** Principles and applications of tracer techniques in biology, Measurement of alpha, beta and gamma radiations. Radiation dosimetry, Radioactive isotopes and half life of isotopes, Autoradiography, Cerenkov radiation, Liquid Scintillation spectrometry.	15
UNIT IV	**DETERMINATION OF BIOPOLYMER STRUCTURE** (Principles and applications): X-ray diffraction, fluorescence, UV, visible, CD/ORD, ESR, NMR and Mass spectroscopy, atomic absorption spectroscopy. Plasma emission spectroscopy. **MICROSCOPY:** Principles and application of light , phase contrast, fluorescence, scanning and transmission electron microscopy	15
	References:- 1) Protein Purification by Robert Scopes, Springer Verlag Publication, 1982 2) Tools in Biochemistry David Cooper 3) Methods of Protein and Nucleic acid Research, Osterman Vol I – III 4) Centrifugation D. Rickwood 5) Practical Biochemistry, V th edition, Keith, Wilson and Walker. 6) Plant Drug Analysis: A Thin Layer Chromatography Atlas, Hidelbert Wagner and Sabine Bladt. Springer –Verlag –2nd Edition (2009).	

MBT PR 201	**Laboratory Course III**	
	1] Separation and identification of amino acid mixture by i] Paper chromatography technique. ii]Paper electrophoresis technique 2] Thin layer chromatographic separation of sugars and membrane lipids. 3] Separation and identification of serum proteins by polyacrylamide/agarose gel electrophoresis. (BSA/Hb). 4] Separation of DNA by agarose gel electrophoresis. 5] Separation of proteins (hemoglobin & cytochrome c) using molecular sieve chromatography. 6] Determination of capacity of ion exchange resin [Dowex- 50] 7] Purification of protein by ion exchange chromatography. [DEAE cellulose chromatography] 8] Determination of activity of invertase from immobilized cells of Saccharomyces cerevisiae 9] Determination of Reassociation kinetics of genome 10] Dark Repair, Photoreactivation 11] Bacterial Transformation 12] Bacterial Conjugation	
MBT PR 202	**Laboratory Course IV**	
	1. Identification and quantitation of activity of : Amylase/cellulase/amyloglucosidase/invertase/alkaline phosphatase (salivary/microbial/animal/plant source] 2. Determination of specific activity. 3. Determination of activity in presence of activators. 4. Determination of activity in presence of inhibitors. 5. Determination of optimum pH 6. Determination of optimum temperature 7. Determination of Km/ Vmax 8. Determination of Competitive, non-competitive inhibitors	
	References:- 1) Methods in Enzymology Vol. I and II by S.P.Colowick and N.O.Kaplan eds. 2) Basic Biochemical Methods 2nd ed by R.R.Alexander and J.M.Griffith. 3) Hawk's Physiological Chemistry ed. by Bernard L Oser. 4) A Textbook of Practical Biochemistry by David Plummer. 5) Laboratory Mannual in Biochemistry by S. Jayaraman. 6) Practical Biochemistry by Clarke and Switzer 7) Methods in Enzymatic analysis by Bergmeyer, Vol I – III	