

SOLAPUR UNIVERSITY, SOLAPUR

M.Sc. Part-I Biotechnology

Revised Syllabus (New CGPA Semester System)

w.e.f. June 2015

Solapur University, Solapur

M. Sc. I Biotechnology

Revised syllabus (New CGPA semester pattern)

(w.e.f. June, 2015)

1) Title of the Course: M.Sc.-I Biotechnology

2) Introduction: This course provides a broad overview of biotechnology and to produces expert hands that would have sufficient knowledge and expertise to solve the urgent problems of the region by using biotechnology. The course structure is technology-centric where students basically learn technology and are taught necessary basic subjects for that purpose.

3) Objectives of the course:

The objectives of M. Sc. Biotechnology course are

- To provide an intensive and in-depth learning to the students in field of biotechnology.
- Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today scientific and changing business world.
- To develop awareness & knowledge of different organization requirement and subject knowledge through varied subjects and training methodology in students.
- To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

4) Advantages of the Course:

Biotechnology has tremendous job potential. The successful students will be able to establish trading, industrial and consultancy organizations in pharmaceuticals, paper, fermentation, food processing & preservation, agriculture, environment protection and also their own industry for micropropagation of commercially important plants in vitro, transgenic plants, vaccine production, clinical pathology, genetic counseling, human karyotyping etc.

- Multinational companies dealing with production of tissue cultured and genetically modified plants, food products, leather, dairy, beverages, pharmaceutical, chemical Industries, agribusiness, Environment protection.
- Medical & Scientific Research Organizations.
- Universities in India & abroad.

5) Eligibility of Course:

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 B.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.

6) Duration:

- The duration for this program is of 2 years with semester pattern(04 Semesters)

7) Medium of Instruction: English

8) Structure of the Course:

- Structure of M.Sc. course in faculty of Science has total of 4 semesters for 2 years.
- M. Sc. I comprises of total two semesters and M. Sc. II comprises of total two semesters.
- Each semester includes four theory papers and two practical course i.e. M.Sc. I Semester I comprises four theory papers (Paper I, II, III, and IV) carrying 100 marks each and two practical papers (Paper I and II) carrying 100 marks each. M.Sc. I Semester II comprises four theory papers (Paper V, VI, VII, and VIII) carrying 100 marks each and two practical papers (Paper III and IV) carrying 100 marks each.
- Each theory paper comprising of 5 units which are distributed in total 45 lecture hours having weightage of 4 credits.
- Practical papers are to be conducted at the end of their respective semester.
- Final year project work should begin in 3rd semester and the complete thesis should be submitted during the practical exam of the 4th and the final semester.
- Student would have to present his/her project work during the thesis submission which would be evaluated by the internal as well as the external examiner.
- As per the credit system, the assessment of Theory paper of 100 marks weightage will be as: 70 marks theory assessment by University examination (UA) and 30 marks internal assessment by the college (CA). For internal assessment of candidate, periodical tests/seminars/ viva/oral / quiz etc. may be suitably adopted.
- As per the credit system, the assessment of practical paper of 100 marks weightage will be as: 70 marks theory assessment by University examination (UA) and 30 marks internal assessment by the college (CA).
- In each semester student has to give a compulsory seminar which has weightage of 25 marks in each semester.



SOLAPUR UNIVERSITY, SOLAPUR
Syllabus for M.Sc. Biotechnology Part - I
(w.e.f. June, 2015)

COURSE STRUCTURE

Semester I

Theory Papers						
Paper No.	Paper Code	Title of Paper	Marks			Credits
			UA	CA	Total	
I	MBT 101	Microbiology	70	30	100	4
II	MBT 102	Concepts of Biochemistry	70	30	100	4
III	MBT 103	Inheritance biology	70	30	100	4
IV	MBT 104	Biostatistics and Bioinformatics	70	30	100	4
Practical Papers						
Paper No.	Paper Code	Title of Paper	Marks			Credits
			UA	CA	Total	
I	MBTPr 105	Microbiology and Concepts of Biochemistry	70	30	100	4
II	MBTPr 106	Inheritance biology and Biostatistics & Bioinformatics	70	30	100	4
		Seminar	--	25	25	1
Total Marks and Credits			625			25



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COURSE STRUCTURE

Semester-II

Theory Papers						
Paper No.	Paper Code	Title of Paper	Marks			Credits
			UA	CA	Total	
V	MBT 201	Cell Biology	70	30	100	4
VI	MBT 202	Enzyme Technology	70	30	100	4
VII	MBT 203	Molecular Cell Processing	70	30	100	4
VIII	MBT 204	Immunology and Immuno techniques	70	30	100	4
Practical Papers						
Paper No.	Paper Code	Title of Paper	Marks			Credits
			UA	CA	Total	
III	MBTPr 205	Cell biology and Enzyme Technology	70	30	100	4
IV	MBTPr 206	Immunology and Immune techniques	70	30	100	4
		Seminar	--	25	25	1
Total Marks and Credits			625			25

M. Sc. Biotechnology (Semester –I)

PAPER NO. I MICROBIOLOGY

4 Credit

(45 L)

UNIT-I: Microbial Taxonomy

[9]

History of Bergey's Manual, Prokaryotic Domains, Taxonomic ranks, Traditional and Modern methods of prokaryote Identification, General outline of Numerical and Polyphasic Taxonomy, Bacterial Nomenclature, Type Strain, Major Bacterial Culture collection units, Introduction to PHYLIP software.

UNIT-II: Microbial Diversity

[9]

General characters of oxygenic and anoxygenic Photosynthetic microbes, Magnetotactic bacteria, Methanogenic archaeobacteria. Gram positive and gram negative pathogenic bacteria, Extremophiles: General characters (origin, habitat, molecular adaptations) and examples of Extremophiles: Acidophiles, Alkalophiles, Thermophiles, Psychrophiles, Barophiles, Halophiles, Barophiles (Piezophiles), Xerophiles, Radiophiles, Metallophiles, Endoliths, and Osmophiles. Applications of Extremophiles.

UNIT-III: Microbial Techniques

[9]

Simple and differential, fluorescent, negative; Structural staining: capsule, spore, cell wall and reserve food material. Fungal staining. Sterilization: Physical and chemical methods. Cultivation of microorganisms: culture media and types of culture media. Isolation of microorganism: serial dilutions, streak plate, pour plate & spread plate. Characterization & identification of colonies, Preservation of cultures.

UNIT-IV: Mycology

[9]

Etimology, History, Characteristics, Classification, Morphology-Microscopic structure and macroscopic structure. Diversity, Growth and physiology, Reproduction, Mycotoxins, Symbiosys-with plant, cyanobacteria and algae, insects; Pathogenesis and Industrial Applications.

UNIT-V: Virology

[9]

Classification of viruses, Isolation, Cultivation and Enumeration of Bacteriophages, Cultivation of Animal viruses by using- Egg inoculation, Animal cell culture and Live animals. Electron microscopy (SEM & TEM), Reproduction of Viruses: Lytic cycle (T phage, phage θ -X 174), Lysogenic cycle (λ , and Mu1 phages), Replication of viruses: ssRNA + stranded (Polio), ssRNA - stranded (Influenza), dsRNA(HIV), ssDNA(Parvo), dsDNA(Hepatitis B); Plant viruses- reproduction of TMV.

References:

- 1) Bergy's Manual of Systemic Bacteriology.
- 2) Brock Biology of Microorganisms – MF Madigan
- 3) General Microbiology – Stanier et al.
- 4) Microbiology – Pelczar JR.
- 5) Microbial Genetics - Freifelder
- 6) General Virology - Luria
- 7) Introduction to Plant Virology – Bos I

8) Animal Virology – Fenner, F and White, D.O.

PAPER NO. II: CONCEPTS OF BIOCHEMISTRY

**4 Credit
(45 L)**

UNIT-I: Biomolecules

[08]

Composition, structure and role of carbohydrates, lipids, proteins, nucleic acids and vitamins. Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds). Stability of protein and nucleic acid structures. Cyclic AMP-its structure and role.

UNIT-II: Energy Concepts

[05]

Bioenergetics, thermodynamic principles of biology, concept of free energy, energy conservation and release, biological energy transducers, energy rich bonds, coupled reaction, redox potential, Phosphorylation potential.

UNIT-III: Metabolism of Biomolecules

[10]

Reactions, energetic, regulations of glycolysis, gluconeogenesis, glycogen metabolism, pentose phosphate pathway, TCA cycle, fatty acid biosynthesis, β -oxidation, nucleic acid metabolism and general reactions of amino acid metabolism. Disorders of Metabolism- Introduction, Nutritional disorder-Protein Energy Malnutrition (PEM) (Kwashiorkar and Marasmus), Obesity Metabolic disorders-Diabetes. Inborn errors of metabolism- Protein-PKU, Alkaptonuria and Maple syrup & Gauchers. Carbohydrates- glycogen storage disorders, Cori's disease and Pomes disease. Lipids- Atherosclerosis. Nucleic acids- Gout, Lesch-Nyhan syndrome, Sickle cell anaemia

UNIT-IV: Oxidative phosphorylation and Photosynthesis

[10]

Oxidative phosphorylation - Locations, components and their arrangement, mechanism of working, theories and evidences for it, stoichiometry, inhibitors and uncouplers. Photosynthesis – Location, light harvesting in green plants, photosystem I & II, Z scheme of noncyclic photophosphorylation, Cyclic photophosphorylation, dark reactions – C3 and C4 pathway, rubisco enzyme, synthesis of sucrose and starch.

UNIT-V: Hormones

[12]

General classification of hormones, Cell membrane and intracellular receptors for hormones, Secondary messengers. 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. Plant growth hormones - auxins, gibberellins, abscisic acid, cytokinins, and ethylene. Phenoromones.

References:

1. Biochemistry by Lubert Stryer, 4th Edition
2. Biochemistry by Mathew VanHolde
3. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
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

9. Textbook of medical physiology by Arthur C. Guyton 11th Edition
10. Plant Physiology by Taiz & Zeiger, 3rd Edition
11. Life: The Science of Biology, by David Sadava, 9th Edition
12. Biochemical Methods.1st, (1995), S.Sadashivam, A.Manickam, New Age International Publishers, India
13. Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet & Judith Voet , John Wiley and Sons, Inc. USA
14. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.
15. An Introduction to Practical Biochemistry.3rd Edition, (2001), David Plummer, Tata McGraw Hill Edu.Pvt.Ltd. India

PAPER NO. III: INHERITANCE BIOLOGY

**4 Credit
(45 L)**

UNIT-I: Mendelian Genetics

[10]

Concept of Gene: Allele and its types, Mendelian laws- Law of Dominance, Co- Dominance, Incomplete Dominance, Segregation, Independent assortment. Test cross, Back cross, Allelic interactions, gene interactions, Linkage and crossing over.

UNIT- II: Cytogenetics

[10]

Chromosomes-Morphology, Heterochromatin & Euchromatin, Lampbrush chromosome, Polytene chromosome, Role of chromosome in heredity. Numerical changes- Aneuploidy, Euploidy. Chromosomal aberrations: Deletion, duplication, inversion, translocation. Structure of sex chromosomes, Sex linked inheritance, extra chromosomal inheritance- chloroplast, mitochondria, and plasmid.

UNIT- III: Microbial Genetics

[05]

Methods of genetic transfers –Transformation, competency Conjugation-nature of donor strain and compatibility, Hfr, F, map of F plasmid. Transduction- generalized and specialized

UNIT- IV: Population genetics

[10]

Neo-Darwinism, Genetic polymorphism, Hardy-Weinberg genetic equilibrium, causes of changes in allele frequency, gene frequency, factors affecting gene frequency. Significance of population genetics.

UNIT- V: Evolutionary genetics

[10]

Theory of evolution, genetic basis of evolution. Genome mapping (Physical maps), C-value paradox, Functional genomics, Repetitive DNA-Microsatellite, Minisatellite, LINES, SINES, Alu family.

References:

1. Principles of Genetics 8th edition, Eldon J. Gardner, Michael J. Simmons, and D. Peter Snustad, Wiley India Edition (Indian edition).
2. Molecular Genetics: An introductory Narrative (2nd Edition) Gunther S. Stent and Richard Calendar, CBS Publishers and Distributors (Indian Edition) –Reprint 2004.
3. Principles of Genetics, 7th Edition, Robert H Tamarin, Tata McGraw Hill Edition (Indian Edition) –Reprint 2004
4. Genetics 5th edition –Strickberger, Pearsons publisher –Low Price Edition (Indian Edition).
5. Modern Microbial Genetics –Editors Uldis N Streips and Ronald E. Yasbin Wiley –Liss publications, 1991.

PAPER NO. IV: BIOSTATISTICS AND BIOINFORMATICS

**4 Credit
(45 L)**

UNIT-I: Basic terms, measures of central tendency and dispersion [13]

Population, Sample, sampling method, variable, parameter, classification of data, Frequency Distribution, tabulation, graphic and diagrammatic representation. 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: Definition of probability (frequency approach), independent events. conditional probability, Examples of Bernoulli, Binomial, Poisson and Normal distributions. Coefficient of distribution, Use of these distributions to describe in biological models.

UNIT-II: Bivariate data [10]

Scatter plot, correlation coefficient (r), properties (without proof), Interpretation of r , linear regression. Fitting of lines of regression, regression coefficient, coefficient of determination. Hypothesis testing: Hypothesis, critical region, and error probabilities. Z-test, 't'-test, Chi-square test for independence. P-value of the statistic. Confidence limits, Introduction to analysis of variance.

UNIT-III: Introduction to bioinformatics [8]

Introduction to genomics and proteomics; NCBI; SRS.

Biological Databases: Nucleic acid sequence databases:- EMBL, DDBJ, GenBank; Primary Protein sequence databases:- PIR, MIPS, Swiss – PROT, TrEMBL, NRL-3D; Composite Protein sequence databases: - NRDB, OWL, MIPSx, SWISS-PROT+ TrEMBL; Secondary Protein databases: - PROSITE, PRINTS, BLOCKS, PROFILES, Pfam, IDENTIFY; Structure classification databases: - SCOP, CATH, PDBsum.; Structural Databases: - PDB, NDB, MMDB.

UNIT-IV: Sequence analysis methods [6]

Methods, Algorithms, tools and applications of Pairwise sequence analysis and multiple sequence analysis. Phylogenetic analysis: Elements of phylogeny, methods of phylogenetic analysis, Phylogenetic tree of life, phylogenetic analysis tools- Phylip, ClustalW.

UNIT-V: Homology modeling [8]

Homology modeling, prediction of protein structure from sequences, Secondary structure, three-dimensional structure prediction, Validation of 3-D structure (Ramchandran plot). Molecular Modeling: Introduction, molecular mechanics, force field, potential energy functions, energy minimization, single point calculations, full-geometry optimization, conformational search, docking, molecular dynamics simulations, molecular modeling packages.

References:

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. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).

7. An introduction to Computational Biochemistry. (C. Stain Tsai, A JohnWiley and Sons, Inc., publications).
8. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck).
9. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery. (Rastogi S. C. Mendiratta, and Rastogi P.)
10. NCBI Web site: <http://www.ncbi.nlm.nih.gov>

PRACTICALS

PAPER NO. I: MICROBIOLOGY AND CONCEPTS OF BIOCHEMISTRY

4 Credit
(45 L)

Microbiology

1. Study of aseptic techniques-Disinfection, cotton plug making, cleaning and sterilization of used and new glassware's.
2. Preparation of culture media for growth of various microorganisms.
3. Isolation of bacteria from different sources (Soil, water and air) by spread, pour and streak plate method.
4. Study of colony characters of bacteria.
5. Microscopic Examination- Motility, Simple, Gram's stain, Acid-fast stain and Lactophenol cotton blue staining (Fungi).
6. Structural staining: capsule, endospore, cell wall, flagella and reserve food material.
7. Growth curve of *E. coli*.
8. Study of morphological and biochemical characters *E. coli* and *Bacillus sp.*.
9. Study of ClustalW tool for phylogenetic relationship among related species.
10. Isolation and characterization (morphological and biochemical) of Acidophilic/Alkalophilic/ Thermophilic/ Halophilic bacteria.
11. Antimicrobial susceptibility test by disc diffusion method.
12. Isolation and cultivation of Bacteriophages (Plaque assay).
13. Embryonated Chick egg technique.

Concepts of Biochemistry

14. Qualitative and Quantitative analysis of carbohydrates.
15. Qualitative and Quantitative analysis of proteins.
16. Qualitative and Quantitative analysis of amino acids.
17. Quantitative analysis of nucleic acids
18. Estimation of Vitamin C and Riboflavin.
19. Lipid isolation detection and estimations
20. Fractionation of egg proteins
21. Disruption of plant/animal/microbial cells by Physical/chemical/biological methods of extraction of intracellular proteins.
22. Assay of Extracted proteins
23. Study of Kranz anatomy
24. Production and estimation of indol acetic acid.
25. Isolation of chloroplast and spectrophotometric assay of Hill's oxidation.

PAPER NO. II: INHERITANCE BIOLOGY AND BIOSTATISTICS AND BIOINFORMATICS

**4 Credit
(45 L)**

Inheritance Biology

1. Demonstration of Mendelian principles using *Drosophila* / plant system.
2. Numerical exercises related to Mendelian principles, gene interactions, linkage and gene mapping.
3. Studies on induction and detection of sex linked recessive lethals (*Drosophila*).
4. Studies on mutagenic treatment to seeds, pollen grains and its mitotic and meiotic analysis.
5. Study of mutation analysis in bacteria (antibiotic resistance).
6. Study of Karyotype.
7. Strain improvement using physical and biological agent.
8. Study of transformation, conjugation and transduction.
9. Study of construction of restriction map of plasmid DNA.

Biostatistics and Bioinformatics

10. Measures of Central Tendency and Dispersion on Excel
11. Statistical Analysis using EXCEL (Diagrammatic and graphical presentation)
12. Introduction to PubMed & PMC and retrieval of literature.
13. Retrieval of an amino acid sequence, nucleotide sequence and performing BLAST and FASTA.
14. Multiple sequence alignment by CLUSTAL X/ CLUSTAL W (offline tool).
15. Predication of secondary structure of proteins.
16. Homology modeling for prediction of 3D structure & its visualization.
17. Structure analysis: secondary, tertiary and quaternary structure, bond angle, bond length, different interactions by RasMol.
18. Phylogenetic studies & construction of phylogenetic tree.
19. Introduction to chimera.
20. Primer designing by primer3 server.

M. Sc. Biotechnology (Semester –II)

PAPER NO. V: CELL BIOLOGY

4 Credit
(45 L)

UNIT- I: Cell theory and Cell Dynamics

[8]

Cell Theory, Cell Structure and organization of prokaryotic and eukaryotic (plant and animal) cells. Cell motility, Cell dynamics, Extracellular matrix. Cell-cell interactions and cell-matrix interaction. Cell lineages and the context of Developmental biology. Cell differentiation, hormones and growth factors.

UNIT-II: Cytoskeleton and Cell Organelles

[9]

Cytoplasmic Membrane: Chemical Composition of Membrane, Structure and function of Membrane. Models of cell membrane. Structure and functions of microtubules, microfilaments and intermediary filaments. Working of actin, kinesin, dynein and ATPase as motor protein. Actin and myosin in heart. Structural and functional capitalization of Cell organelles – mitochondria, chloroplast, endoplasmic reticulum, ribosomes, golgi apparatus, lysosomes, peroxisomes and nucleus.

UNIT-III: Cell cycle and Cell adhesion

[9]

Cell Cycle: Cell Cycle Phases-mitosis and meiosis, Role of cyclins and Cdks, Cell cycle check points. Cell Adhesion- Extracellular matrix. Cell-cell interactions and cell-matrix interaction. Desmosomes, Hemidesmosomes, Integrins, Selectins, Cadherins, Tight Junction, Gap Junction. Cell senescence and programmed cell death. Biology of oncogenes and anti-oncogenes.

UNIT-IV: Cell signaling

[10]

Extracellular Messengers & their receptors, G-protein- Coupled receptors their second messengers and signal transduction pathway- Regulation of Glucose levels, Protein Tyrosine Kinases-RTK-Dimerization, Protein Kinase activation, RTKs activates downstream signaling pathway, signaling by the insulin receptors (RTKs) , Calcium as an intracellular messenger: IP3 and Voltage-Gated Ca²⁺ Channels, Calcium binding Protein(calmodulin) & its role in signaling Intrinsic pathway of Apoptosis; Light induced signal transduction (Plant transduction). General Pathways of Ras- MAP Kinase pathway, Hedgehog pathway, WNT signalling pathway, Notch Pathway, Nf-κB Pathway.

UNIT-V: Embryonic development

[10]

Structure of gametes, cellular and biochemical processes during early fertilization, strategies for monospermy and conservation of species specificity, cascade of events (acrosome reaction and egg activation cleavage blastulation, gastrulation) embryonic development in frog, morphogenetic movements origin of embryonic endoblasts (ecto, meso and endoderm)regeneration in animals with reference to hydra, planaria and salamander limb.

REFERENCES:

1. Molecular Cell Biology, Lodish et al. Scientific American Books (1995)
2. The World of the Cell Becker, W.M. et al. Benjamin Cummings (2004)
3. Cell and Molecular Biology, Karp G, John Wiley and Sons. (1999).
4. Molecular Biology of Cell, Alberts B et al. Garland Publishers, (2001)
5. Lehninger Principle of Biochemistry, Nelson DL and Cox MM, Worth Publishers, (2000)
6. Principles of cell and Molecular Biology, Kleinsmith LJ & Kish VM, Harper Collins College Publishers (1995).

UNIT I: Enzymes**[13]**

Historical aspect, Nomenclature and 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, Ribozymes, Abzymes. Multienzyme complex: Properties, pyruvate dehydrogenase system (*E. coli* and mammalian), Tryptophan synthetase, multienzyme complex from *E. coli*, fatty acid synthetase.

UNIT-II: Enzyme Kinetics**[07]**

Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics. Significance of V_{max} and K_m . 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.

UNIT-III: Structure Function Relations**[05]**

Lysozyme, ribonuclease, trypsin, carboxypeptidase, phosphorylase, aspartate transcarbamylase and Na - K ATPase. Clinical aspects of enzymology: LDH isozymes, SGOT, SGPT, creatine kinase, alpha amylase, phosphatase.

UNIT-IV: Allosteric Interactions**[10]**

Allosteric sites, Modulators, 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.

UNIT-V: Engineering Techniques**[10]**

Metabolic engineering, enzyme engineering. 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 K_m). 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

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)

- 7) Principles and Applications in Engineering Series: Biotechnology for Biomedical Engineers - Martin L. Yarmush, CRC Press, Boca Raton London New York Washington, D.C.
- 8) Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia. 1988

UNIT-I: Genome organization**[10]**

Organization of prokaryotic and eukaryotic genome; Role of nuclear matrix in chromosome organization and function; Matrix binding proteins; Heterochromatin and Euchromatin; DNA reassociation kinetics (Cot curve analysis); Repetitive DNA and unique sequences; Satellite DNA; DNA melting and buoyant density. Structure and conformation of nucleic acids [(A, B & Z), Triplex DNA, t-RNA, micro-RNA. DNA as a genetic material (Avery MacLeod and McCarty; Hershey and Chase experiments). Prokaryotic and eukaryotic gene structure.

UNIT-II: DNA Replication**[10]**

Unit of Replication (Replicon: Bacterial, Eukaryotic and Extra chromosomal). Enzymes involved in replication (DNA Polymerases of *E. coli* and eukaryotes) Replication origin and Replication fork, Fidelity of Replication. Replication initiation, elongation and termination in prokaryotes and eukaryotes. DNA proof reading, DNA methylation.

UNIT-III: Transcription**[10]**

Prokaryotic transcription: RNA Polymerases, Sigma factor and specificity binding to DNA, Promoters and their consensus sequences, Transcription initiation, Elongation and Termination (Rho dependent, Rho independent), RNA Editing, splicing. Eukaryotes transcription: RNA Polymerases (I, II & III) & subunits, Promoter elements for three polymerases, Activators, Enhancers, Repressors. Initiation, Elongation and Termination of transcription. Post transcription modification-RNA editing, splicing, polyadenylation. Transcriptional regulation-Positive and negative; Operon concept-lac, trp, ara, his, and gal operons, Reverse transcription.

UNIT-IV: Translation**[10]**

Prokaryotic and eukaryotic ribosomes, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post translational modification of proteins.

UNIT-V: DNA Repair and Recombination**[5]**

Photoreactivation, Nucleotide and base Excision, Mismatch, SOS, Recombination repair, Eukaryotic repair Mechanisms Recombination: Recombination between heteroduplex, Holiday intermediate, Proteins involved in Recombination, Role of recA, recBCD pathway in *E.coli*, single strand assimilation in Bacteria.

References:

1. Benjamin Lewin -Gene VI, Gene VII, Gene IX, Gene X Oxford University press
- 2 David Friefieder -Essentials of Molecular Biology, Jones &Barlett publications
- 3 J. Kendrew Encyclopedia of MolecularBiology Blackwell Scientific publications.
- 4 Weaver Molecular Biology
- 5 J.D.Watson, N.H.Hopkins ,J.W Roberts,et alMolecular Biology of the Gene,Benjamin Cummings publ.co.inc.,California
- 6 J.Darnell. *et. al.*, molecular biology of the cell (2nd edition) Garland Publishing Inc.
- 7 Meyers R.A (ed)., Molecular biology and biotechnology.VCH publishers NY Inc.

- 8 Alberts B *et. al.*, Molecular biology of the cell. Garland Publishing Inc.
- 9 Watson J.D., Recombinant DNA.
- 10 Malacinski; Essentials of Molecular Biology.
- 11 Stansfield; Molecular and cell biology.
- 12 Walker Molecular biology and Biotechnology.
- 13 Brown T.A Essential of Molecular biology Vol 1 and 2 each.
- 14 Dale Molecular Genetics of Bacteria

PAPER NO. VIII: IMMUNOLOGY AND IMMUNE TECHNIQUES

4 Credit
(45 L)

UNIT I: Immunity

[9]

Innate immunity- 1st and 2nd line of Defense (Phenomenon of Phagocytosis, Necrosis, Apoptosis) Role of Primary and Secondary Lymphoid organ, Role of Immune cells (Macrophages, Dendritic Cells, Follicular Dendritic Cells, B cells, T cells), 3rd Line of Defense Humoral immunity- Components of Humoral immunity Clonal selection theory, Primary and Secondary immune response, Mechanism of antibody production against TI and TD antigens, Structures of Antibodies, Gene expression and Ig Diversity. Cell-Mediated immunity- Components of CMI, lysis of Self-altered cells, Lytic pathways of CMI.

UNIT II: Antigen, MHC, Complement and Cytokines

[9]

Antigen- Types, Factors affecting antigenicity, Epitopes, Haptens, Adjuvants, Mitogens, MHC- Genetic organization and inheritance, Antigen processing and presentation (Cytosolic and Endocytic pathway), Presentation of non-peptide antigens, Complements- Complement activation pathways, Regulation of complement pathways, Cytokines- Introduction, Properties, General Functions, Cytokines secreted by TH1 and TH2 cells and its regulation, Cytokines based Therapy.

UNIT III: Medical Microbiology

[9]

General information, structure/morphological and cultural characters, Life cycle, pathogenicity, Laboratory Diagnosis and prophylaxis of Bacterial Diseases (*C. diphtheria*, *Cl. tetani*, *M. tuberculosis*, *S. typhi*), Viral Diseases (Hep a & b, Influenza, HIV), Fungi (*Candida albicans*), Protozoan (*Plasmodium malaria*).

UNIT IV: Clinical Immunology

[9]

Hypersensitivity: Gell and Coomb's Classification and general mechanism of hypersensitivity) Autoimmunity: general mechanism, (organ specific, non-organ specific). Transplantation immunology- Immunologic Basics of Graft rejection, Immuntolerance to allograft, Immunosuppressive Therapy, Tumor immunology- Tumor antigens, Immune response to tumor antigens, Tumor evasion of the immune system, Cancer immunotherapy.

UNIT V: Antigen-Antibody Interactions and Vaccines

[9]

Antigen-antibody interactions: Principles, applications, strength, cross-reactivity, features of interactions, precipitation, immunodiffusion, Immunoelectrophoresis, agglutination, complement fixation test, immunofluorescence test, Radioimmunoassay, ELISA, Flow cytometry with fluorescence. Genetically Engineered Vaccines- Subunit vaccines (Herpes simplex, SARS, *S. aureus*), Peptide vaccines (Foot and Mouth disease, Malaria), DNA vaccines (Dental caries), Attenuated vaccines (Cholera, Salmonella, Leishmania), Vector vaccines.

References:

1. Immunology - Kuby
2. Essential Immunology- Roitt
3. Cellular and Molecular Immunology- Abbas
4. Immunology and Serology- Philip Carpenter
5. Textbook of Immunology- Barrette J.T.

6. Basic and Clinical Immunology- Funderberg H.
7. Biology of Immune response- Abramoff and Lavice
8. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul
9. Immunology an Introduction- Tizard
10. Molecular Biotechnology-Principles and applications of rDNA- 4th Edition, Bernard R. Glich et al.
11. Textbook of Microbiology- Ananthanarayan and Paniker
12. Microbiology 5th Edition- Prescott
13. Microbiology – Pelczar JR.
14. Microbial Genetics - Freifelder
15. Brock Biology of Microorganisms – MF Madigan
16. General Microbiology – Stanier et al.
17. General Virology - Luria
18. Animal Virology – Fenner, F and White, D.O.
19. Virology – Dulbecco R. and Ginsberg H.S.
20. Medical Microbiology- Fritz H. Kayse

PRACTICAL

PAPER NO. III: CELL BIOLOGY AND ENZYME TECHNOLOGY

**4 Credit
(45 L)**

Cell Biology

1. To isolate and study Animal cell (human), Plant cell, Bacteria, and Fungi under a microscope and prepare a comparative table.
2. To study all the phases of Mitosis and Meiosis in a cell.
3. To study Permeable and Semi-permeable membrane of cell using the concept of Osmosis.
4. To investigate the effect of Heat/Enzymes/Chemicals on the permeability of plant cell membranes.
5. Isolation and Observe chloroplast under microscope.
6. Isolation and Observe mitochondria under microscope.
7. Preparation of salivary gland chromosome.
8. To observe red blood cells and white blood cells.
9. Visit to nearest Hospital to study flow cytometer (FACS).
10. Study of Micrometry and Measurement of given biological sample.
11. Study of Plant and Animal Organs Histology.
12. Developmental stages of chick embryo.

Enzyme Technology

13. Isolation and quantification of activity of – amylase / invertase / alkaline phosphatase (salivary / plant source)
14. Determination of specific activity of enzyme.
15. Determination of activity of enzyme in presence of activator and inhibitor.
16. Determination of K_m and V_{max} of Invertase.
17. Determination of optimum parameter of enzyme – pH and temperature.
18. Induction and estimation of beta- galactosidase.
19. Immobilization of enzyme/Cell

PAPER NO. IV: MOLECULAR CELL PROCESSING AND IMMUNOLOGY AND IMMUNE TECHNIQUES

**4 Credit
(45 L)**

Molecular cell processing

1. Effect of protein synthesis inhibitors on the induction of beta galactosidase.
2. To study the photoreactivation in bacteria
3. Isolation of bacterial genomic DNA.
4. Isolation plasmid DNA.
5. Isolation of DNA from Plant/yeast.
6. Isolation of RNA from Plant cell / yeast.
7. Silver nitrate staining of DNA.
8. Isolation of organelle DNA (Chloroplast / mitochondria)

Immunology and Immune Techniques

9. Study of Immunodiffusion. (Ouchterlony Technique.)
10. Study of Immuno-electrophoresis. (CIEP, Rocket Immuno-electrophoresis)
11. Preparation of *Salmonella typhi* antigens.
12. Study of slide agglutination test by colony emulsion method for the diagnosis of *Salmonella typhi*.
13. Diagnosis of *Salmonella typhi* by Widal test (Qualitative and Quantitative test)
14. Isolation of *Candida* species and study its morphological characters (Budding, Mycelia, Spores).
15. To study the Dot-blot ELISA.
16. Demonstration of ELISA for HIV diagnosis.

Examination Pattern (UA - University assessment)

The examination for theory / practical (70 marks) are conducted semester wise by university as per University Time Table.

Nature of Theory question paper for each theory paper.



Solapur University, Solapur

Nature of Question Paper for Semester Pattern

(New C.G.P.A.)

Faculty of Science

M.Sc. Biotechnology

Time:- 3 hrs

Total Marks-70

Note: 1) Section - I Compulsory

2) Answer any four questions from Section - II

Section - I

Q. 1 A) Multiple choice questions (07)

i) -----

a) b) c) d)

ii)

iii)

iv)

v)

vi)

vii)

B) Define the following terms (07)

i)

ii)

iii)

iv)

v)

vi)

vii)

Section - II

Q. 2) Long answer type question (14)

Q. 3) Long answer type question (14)

Q. 4) Long answer type question (14)

Q. 5) Answer any TWO of the following (14)

i) Short answer type question

ii) Short answer type question

iii) Short answer type question

Q. 6) Write Short notes on any TWO of the following (14)

i) Short note

ii) Short note

iii) Short note