

**D R. BABASAHEB AMBEDKAR  
MARATHWADA UNIVERSITY,  
AURANGABAD.**



**Curriculum under Choice Based Credit &  
Grading System  
M.Sc. I & II Year  
Bio-Technology  
Semester-I to IV**

**run at college level from the  
Academic Year 2015-16 & onwards**

**DR. BABASAHEB AMBEDKAR  
MARATHWADA UNIVERSITY,  
AURANGABAD.**



**Syllabus of**

**M. SC. I & II YEAR**

**Biotechnology**

**Semester-I to IV**

**For College level**

**[ *Effective from academic year 2003-14 & onwards* ]**

## **M. Sc. Biotechnology revised syllabus, to be implemented from June 2011**

### **A two year M. Sc. Biotechnology course**

1. Syllabus structure is for four semesters, total 1200 marks (96 credits). Each semester consists of four theory and four laboratory courses.
2. Theory examinations would be conducted at the end of odd as well even semesters, practical examination on laboratory courses would be conducted at the end of even semester, between March and May.
3. Practical examination would be of two days for each semester, a pair of examiner would be appointed. Marks secured beyond 80% could be subjected for moderation.
4. Writing business, such as; approach, principle, requirements, in brief procedure for all four laboratory courses must be done on day I, practicals needing incubations should be started on day I itself, however practicals without incubations can be performed on day I or day II, this would be left at examiners discretion.
5. Each examiner would function as external for two courses where as same examiner would function as an internal for other two courses.
6. Each examiner would conduct common viva for both courses, viva may be divided in two days if examiner desires or conducted on day II but no on day I, only.
7. Dissertation is being submitted in lieu of two laboratory courses (Bioinformatics and Tissue Technology), weighing 50 marks (4 credits). Although this is submitted in lieu of stated courses, actual project may or may not be directly related to these two courses. Project should however, be directly related to any of the aspects of sixteen theory courses or remaining fourteen laboratory courses.
8. Dissertation writing should be as a manuscript submitted to "Cell", an international peer reviewed journal. Regional format would not be entertained. Mentor and student, both, are expected to understand the writing style of research paper (full length) published in Journal titled "Cell". The cell word should not be mistaken for cell biology books or any such standard or substandard books.
9. Dissertation would include abstract, introduction, materials and methods, results, discussion, acknowledgments, references in chronological order. The writing should not be less than 4000 words without space, excluding figures and tables.
10. Each centre is expected to purchase permanent mounts, essential instruments and every ingredient required for practicals mentioned in various laboratory courses.
11. Each centre should purchase adequate copies of books mentioned in reference list  
below theory courses.

**M. Sc. Biotechnology**  
**BT 1001 – 4 credits**  
**Biostatistics and Biomathematics**

**Unit I: Elements of mathematics-I**

**Derivatives:** derivative of function, Derivatives of First Principles, Derivatives of inverse, exponential functions and trigonometric functions,

**Integration:** Methods of Integration: direct integration, integration by parts

**Unit II: Elements of mathematics-II**

**Determinant:** determinant of order 2 or 3, expansion of determinant, properties of determinant, Cramer rule

**Matrix:** Types of matrix, Algebra of matrices, Inverse matrix.

**Logarithm :** Fundamentals of logarithm, natural logarithm and logarithm to other bases, significance of logarithmic scales

**Unit III: Sampling, Data Collection and Presentation:**

Introduction to Biostatistics, Common Terms and Notations, Applications.

**Sampling:** Representative Sample, Sample Size, Sampling Bias and Sampling techniques.

**Data Collection and Presentation:** Type of Data, Method of Collection of Primary and Secondary Data, Methods of Data Presentation, Graphical Representation by Histogram, Polygon, Ogive Curve, Pie Diagram.

**Unit IV: Central Tendency:**

**Measure of Central Tendency :** Mean ,mode ,median

**Measure of Variability :** Standard Deviation, Standard Error Range ,Mean Deviation, Coefficient of Variation, Correlation Coefficient and Regression (Positive & Negative), Calculation of Correlation Coefficient & Regression Coefficient , Linear Regression and Regression Equation, ANOVA One and Two Way Classification.

**Unit V: Test of Significance :& Computer based statistical techniques:**

**Test of Significance :** F-test , Z-test .T-test and Chi-Square ,Probability Distribution : Binomial , Poison and Normal Distributions.

**Computer based statistical techniques:**Frequency Table of Single Discrete Variable , Bubble Sort , Computation of Mean , Variance and Standard Deviation, T-test , Correlation Coefficient

**References :**

1. B.K Mahajan method in Biostatistics Jaypee brother medical pulisher Ltd .india .
2. Richard ah Introduction to Biostatistics prentice hall of biostat
3. Campbell R.C Statistics for biologist, Cambridge University Press,Cambridge
4. Wardlaw,A.C.(1985) Practical Statistics for experimental Biologists
5. Baily N.T.J. Statistical methods in Biology English University press
6. P.S.S. Sunderrao & J.Richard An Introduction to Biostatistics Prentice hall of India pvt.ltd. India
7. Khan, Fundamentals of Biostatistics
8. B.K. Mahajan Methods in Biostatistics, Jaypee brothers medical publisher ltd,India
9. Robert sokal and James Rohlf Introduction to Biostatistics W.H. Freeman Press

**M. Sc. Biotechnology**  
**BT 1002 – 4 credits**  
**Biomolecules & Bioenergetics**

**UNIT I : Fundamentals**

Structure of atoms, molecules and chemical bonds (bond strength, cleavage of C-C bond), Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction.).

Principles of biophysical chemistry (pH,pKa, titration curve, weak acids, bases) buffer,thermodynamics,(laws, concept of entropy, enthalpy, equilibrium constant, free energy change, free energy change for ATP hydrolysis), colligative properties.

Bioenergetics; oxidative phosphorylation (ETC) coupled reaction (redox reactions) group transfer, biological energy transducers-Substrate level Phosphorylation.

**UNIT II :Carbohydrates**

Classification, Composition, Structure, Function and Metabolism of Carbohydrates (Glycolysis, TCA cycle, HMP shunt pathway, Gluconeogenesis, Glycogen Synthesis, Biosynthesis of Starch, Lactose & Sucrose.)[Kinetics of each reaction].

Regulation of Carbohydrate metabolism (with reference to glucose), Metabolic Disorders.(Diabetes,Hypoglycemia,Diabetes as a factor for coronary disfunction,Lactose intolerance).

**UNIT III :Proteins**

General reactions of amino acids, amino acid Metabolism- Biosynthesis,Degradation, Regulation and Metabolic disorders –Phenylketoneria.

Classification, Composition, Structure {Conformation (Ramachandran Plot examples, Secondary, Tertiary, & Quaternary Structure, Domains,Motifs & Folds.)} and function of Proteins, Stability of Protein Structures, Sequencing of proteins.

**UNIT IV : Nucleic Acids**

Composition, Structure ( including Conformation of nucleic acids (A-, B-, Z-,DNA), t-RNA, rRNA & Ribosomes, Micro-RNA; and Stability of nucleic acid structures) and functions of nucleic acids

Metabolism of nucleotides-.Biosynthesis and Regulation of Purines and Pyrimidines by *de novo* and Salvage pathways,

**UNIT V : Lipids, Harmones and Vitamins:**

Lipids: Definition, Composition, Classification, Structure, Function, Storage lipids, Membrane lipids, Essential & Non-essential fatty acids, {Good & Bad lipids (Cholesterol)}.

Metabolism of lipids: General reactions, Functions, Biosynthesis and Degradation {fatty acids [oxidation of saturated ( $\alpha$  &  $\beta$ ) and unsaturated], Triglycerides, Phospholipids, Cholesterol, Prostaglandins}, Metabolic disorders (Triglyceridemia, Naiman Sacchs Disease)

Vitamines: Classification, Functions, Role in metabolism, Vitamins as co-factors.

Metabolic Disorders –A,B,C,D,K.

Hormones : Classification of hormones, Endocrine glands, basic mechanism of hormone action, neuroendocrine regulation [TSH,  $T_3$ ,  $T_4$ ] Pitutary gland secreted hormone

:Prolactin;Gonadotrophin releasing hormon:LH; role of hormones in reproduction

(Estrogen,Testesteron,hCG,FSH,LH), control of fertility(Prolactin,Progesteron,FSH,LH), gametogenesis,human growth hormones , hormonal disorders{Thyroiditis(hypothyroidism, hyperthyroidism),Polycystic Ovarian Syndrome/Polycystic Ovarian

Disorder(PCOS/PCOD), Insulin Dependent Diabetes,Phaeochromocytoma.}

#### **References:**

1. Cohn & Stump – Outline of Biochemistry Wiley Eastern Ltd.
2. Harpers Review of biochemistry – Prentice Hall
3. Cregnton – Protein Structure & Molecular Properties
- A. L. Lehninger, D. L. Nelson & M M Cox – Principles of Biochemistry.
4. Lubert Stryer – Biochemistry
5. David Meltzer – Biochemistry : The Chemical Reactions of living Cells –Academic Press, New York
6. Dixon & Webb –Enzymes
7. J. Jayraman- Practical Biochemistry
8. Plummer, –Practical Biochemistry.
9. Horton; priciples of biochemistry.
10. Hames; Instant Notes in Biochemistry.
11. Holme ; Analytical Biochemist
12. A.C.Deb Fundamentals of biochemistry
13. Ramakrishnan , Text book of Medical Biochemistry, Orient Longman
14. Zuby - Biochemistry 4<sup>th</sup> edition
15. Boyer- Concepts in Biochemistry
16. Cooper -The tools of Biochemistry

**M. Sc. Biotechnology**  
**BT 1003 – 4 credits**  
**Microbiology**

**Unit I: Microbiological Techniques:**

Differences between prokaryotic and eukaryotic cells

STAIN & STAINING: Classification of stains, staining theories and staining techniques: Negative, Monochrome and Differential Staining (Gram, capsule, spore & acid fast staining).

BIOCHEMICAL TESTS: basic medium for biochemical tests, importance of biochemical tests, routine biochemical tests performed in microbiology: principle, procedure and applications of IMViC tests, sugar utilization tests, TSI, Enzyme activity( catalase, protease, lecithinase) tests.

**Unit II: The diversity of the microbial world:**

Bacterial taxonomy: conventional, adensonian, and molecular approaches to bacterial taxonomy ,including ribotyping, rRNA sequencing, characteristics of primary domains (from five kingdom system of classification ),introduction to diversity among Microorganisms, Survival mechanism and their importance (thermophiles, psycrophils, methanogns, alkalophiles, acidophiles, halophiles,)

**Unit III: Microbial growth and control**

Definition of growth, Bacterial cell division , generation time , specific growth rate mathematical expression of growth Monoauxic, diauxic & synchronized growth curves, various methods to obtain synchronized cultures, Direct & indirect methods of microbial growth assessment,

Effect of environmental factors (solutes, temperature, pH, O<sub>2</sub>) on microbial growth; Control of microorganisms by physical & chemical agents including antimicrobial chemotherapy.

**Unit IV: Nutrition and pure culture technique:**

Pure culture techniques, principles of microbial nutrition, nutritional classification of microorganisms :autotrophic, heterotrophic ,saprophytic & parasitic microbes, construction of microbial culture media: purpose and type **simple medium** [mineral medium (MS) MS plus carbon, MS plus nitrogen, MS plus carbon plus nitrogen plus supplements] **Complex media** Selective, Enrichment, Differential

Techniques of culture collection: isolation, purification, cultivation & preservation of microbes.

**Unit V: Microbial physiology;**

**Sporulating bacteria**, stages of sporulation, cytological and macromolecular changes during sporulation. Spore germination



Microbial toxins: detection and molecular mechanism of action.

Microbial stress response, stress proteins and their role in normal cellular physiology.

Two component system

**References:**

1. Stenier R.Y et al ., General microbiology Mc Millan Press. Inc.
2. Pelczar ., Reid et al., Microbiology, TMH Publication.
3. Madigan M.T.,et al Brock biology of microorganisms J prentice hall Inc.
4. Johri B.N Extremeophiles. Springer Verlag, NY
5. Talaro; Foundations in Microbiology.
6. Ananthanarayan; Text book of microbiology. Orient Longman Delhi
7. Cappucinno; Microbiology – a laboratory manual. 4th ed.
8. Harrigan W.E. , Laboratory methods in Food Microbiology, Academic Press
9. Toratora, Funke & Care Microbiology : An Introduction
10. Salley A.J Fundamental Principles of Bacteriology
11. Atlas R.M. Principles of Microbiology
12. Methods in Microbiology series
13. Bergys Manual Vol 1-4

**M. Sc. Biotechnology**  
**BT 1004 – 4 credits**  
**Inheritance Biology**

**UNIT-1: Gene Concept, Mendelism and Extension of Mendelian Principles**

- A. **Concept of Gene:** Allele, Multiple Alleles, Pseudoallele, Complementation tests.
- B. **Mendelian Principles:** Dominance, Segregation, Independent Assortment, Deviation from Mendelian Inheritance.
- C. **Extensions of Mendelian Principles:** Codominance, Incomplete Dominance (Partial Dominance), Gene Interactions, Pleiotrophy, Genomic Imprinting, Penetrance and Expressivity, Phenocopy, Linkage and Crossing over, Sex determination, Sex Differentiation, Sex Linkage, Sex limited and Sex influenced characters.

**UNIT 2: Mutation and Structural Alterations of Chromosome**

- A. **Mutation:** Types, Causes and detection, Mutant types –lethal, Conditional, Biochemical, Loss of Function, Gain of Function, Germinal versus Somatic mutants, Insertional Mutagenesis (Transposon based –biological mutagens).
- B. **Structural and Numerical alterations of Chromosome:** Deletion, Duplication, Inversion, Translocation, Ploidy and their genetic implications.

**UNIT 3: Microbial Genetics**

Methods of genetic transfers –Transformation, Conjugation, Transduction, Sex-duction, Mapping genes by interrupted mating, Fine structure analysis of genes –S Benzer's work.

**UNIT 4: Gene Mapping Methods**

Linkage maps, Tetrad analysis, Mapping with molecular markers, Mapping by using somatic cell hybrids, development of mapping population in plants.

**UNIT 5: Extra Chromosomal Inheritance**

Inheritance of mitochondrial and chloroplast genes, Maternal Inheritance, Plasmid inheritance.

**References:**

1. **Principles of Genetics 8<sup>th</sup> edition, Eldon J. Gardner, Michael J. Simmons, and D. Peter Snustad, Wiley India Edition (Indian edition).**
2. **Molecular Genetics: An introductory Narrative (2<sup>nd</sup> Edition) Gunther S. Stent and Richard Calendar, CBS Publishers and Distributors (Indian Edition) –Reprint 2004.**
3. **Principles of Genetics, 7<sup>th</sup> Edition, Robert H Tamarin, Tata McGraw Hill Edition (Indian Edition) –Reprint 2004**
4. **Genetics 5<sup>th</sup> 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.**

**BTP 1002 -Practicals based on Theory Paper BT 1001 -2 credits**

**Practicals:**

1. Representation of statistical data by histogram ogive curves and pie diagram.
2. Measure of Central tendencies : Arithmetic Mean , median and mode
3. Calculation of Measure of Dispersion : Mean deviation , Standard deviation and coefficient of variation , Quartile deviation .
4. Test of Significance : Chi-square test , t- test , Standard error

**BTP 1002 -Practicals based on Theory Paper BT 1002 -2 credits**

**Practicals**

1. Preparation of buffers applying HH equation
2. Estimation of pKa values of amino acids
3. Demonstration of colligative properties
4. Estimation of carbohydrates by qualitative methods
5. Estimation of carbohydrates by quantitative method ( DNSA / Anthrone / GOD-POD)
6. Purification of polysaccharides
7. Estimation of proteins –( Folin Lowry / Biurets method,Bradford )
8. Determination of isoelectric pH of proteins / aminoacids
9. Isolation of proteins- casein from milk / hemoglobin (from RBC) / pulses
10. Estimation of DNA
11. Denaturation & renaturation kinetics of DNA
12. Estimation of RNA
13. Acid values Iodine number& Saponification values of fats (commercial samples)
14. Isolation and purification of lipids from microbes and eukaryotes
15. Simple assays for vitamins and hormones
16. Preparation / isolation of biomolecules from natural resource (Starch, glycogen, Lecithin, Cytochrome

**BTP 1003 -Practicals based on Theory Paper BT 1003** -2 credits

**Practicals**

1. Staining and Microscopic examination of microorganisms (bacteria, Yeasts & molds): Gram staining, acid fast staining, negative staining & other methods
2. Isolation of pure cultures of microorganisms by different plating techniques & serial dilution methods from soil water and air
3. Storage & preservation of microorganisms
4. Growth curve of microorganisms
5. Micrometry
6. Measurement of bacterial population by turbidometry, serial dilution ,methods
7. Effect of temperature, pH on microbial growth.
8. Biochemical characterization (IMViC) of selected microorganism
9. Assay of antibiotics

**BTP 1004 -Practicals based on Theory Paper BT 1004 -2 credits**

**Practicals:**

1. Study of one factor cross
2. Study of two factor cross
3. Study of three factor cross
4. Isolation of plasmid DNA
5. Isolation of Chloroplast / Mitochondria -DNA
6. Fluctuation test
7. Isolation of antibiotic resistance spontaneous mutant
8. UV induced mutagenesis
9. UV survival curve
10. Mutagenesis with Ethidium bromide/ nitrous acid/ hydroxyl amine/ NTG or EMS.
11. Survival curve with chemical mutagen.

**SEMISTER II**  
**M. Sc. Biotechnology**  
**BT 2001 – 4 credits**  
**Molecular Biology**

**UNIT I : DNA Repair Mechanisms**

Excision ,Mismatch,SOS, Photoreactivation,Recombination repair,Eukaryotic repair Mechanisms.

**UNIT II : Recombination**

Recombination between heteroduplex,Holiday intermediate,Proteins involved in Recombination,Role of recA,recBCD pathway in E.coli,single strand assimilation in Bacteria.

**UNIT III : DNA Replication**

Unit of Replication(Replicon : Bacterial,Eukaryotic and Extrachromosomal )

Bacterial Replication is connected to cell cycle,Enzymes involved in replication(DNA Polymerases of E.coli and Eukaryotes) Replication origin and Replication fork,Fidelity of Replication.

**UNIT IV : Transcription**

Prokaryotic transcription: RNA Polymerases, Sigma factor and specificity binding to DNA,Promoters and their consensus sequences , Initiation of transcription,Elongation of transcription, Termination of transcription (Rho dependent ,Rho independent termination, Antitermination) RNA Editing,Splicing

Eukaryotic transcription: RNA Polymerases, types & subunits ,Promoter elements for three polymerases, Activators, Enhancers ,Repressors. Elongation and Termination of transcription.

RNA editing , splicing, polyadenylation.

**UNIT V: Translation**

Ribosome, 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



**References:**

1. Benjamin Lewin -Gene VI, Gene VII, Gene IX, Gene X Oxford University press
- 2 David Friefieder Essentials of Molecular Biology, Jones & Bartlett publications
- 3 J. Kendrew Encyclopedia of Molecular Biology Blackwell Scientific publications.
- 4 Weaver Molecular Biology
- 5 J.D.Watson, N.H.Hopkins, J.W Roberts, et al Molecular Biology of the Gene, Benjamin Cummings publ.co.inc., California
- 6 J.Darnell, et al molecular biology of the cell (2<sup>nd</sup> 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

**M. Sc. Biotechnology**  
**BT 2002 – 4 credits**  
**Enzyme Technology**

**Unit I Enzymology: an Introduction:**

Enzymes as biocatalysts, Theories & Mechanism of enzyme action, specificity of enzyme action (lock and key and induced fit model of enzyme activity), mechanisms of enzyme catalysis, units of enzyme activity, turnover number, activation energy

Types of Enzymes (A. Simple enzymes B. Complex enzymes, multienzyme complex, allosteric enzymes, isozymes; Multi-substrate enzymes; Coenzymes and their role in enzyme action  
Classification and nomenclature of enzymes

**UNIT II: Experimental Measures of Enzyme Activity**

Enzyme induction, active site determination; Initial velocity measurements, detection methods, separation methods in enzyme assays, factors affecting the velocity of enzymatic reactions, reporting enzyme activity data, enzyme stability

**Unit III: Enzyme Kinetics and Inhibition**

Michaelis- Menton kinetics (Pre-steady state, Steady state, Derivation of M-M equation)  
Determination and significance of  $V_{max}$  and  $K_m$ ; Linear plots for enzyme kinetic studies

Enzyme inhibition: A. Competitive inhibition B. Uncompetitive inhibition C.

Noncompetitive inhibition and kinetics of these types of inhibitions; Importance of studying enzyme inhibition

**Unit IV: Enzyme Immobilization**

Introduction; aim of Enzyme Immobilization; effect of immobilization on [a] Physical properties [b] Chemical properties [c] Stability [d] activity of enzyme; Advantages of Immobilization; Limitations of immobilized enzyme; Methods of immobilizations  
Carrier matrices, Adsorption of enzymes, Covalent coupling (Functional groups that affects the covalent coupling, use of cyanogen bromide Ethyl chloroformate, Carbodiimide, Glutaraldehyde, 3-aminopropyltriethoxysilane) Entrapment and Encapsulation of Enzymes  
Crosslinking

Application of immobilized enzymes in the industries,

**Unit V Applied Enzymology**

Use of enzymes in industries, textile, leather, food, industries. Purification strategies

Use of purified enzymes in biosensors Enzyme sensors for clinical diagnosis, environmental analysis, and other applications of biosensors

Effect of organic solvents on enzyme catalysis, denaturation,.

**REFERENCES:**

1. Dixon & Webb –Enzymes; Academic press New York
2. A.L. Lehninger- Biochemistry
3. A.L. Lehninger, D. L. Nelson & M M Cox – Principles of Biochemistry.
4. Cohn & Stump – Outline of Biochemistry; Wiley Eastern Ltd.
5. Lubert Stryer – Biochemistry
6. R.L. Foster – The nature of Enzymology; Croom-Helm London
7. Harpers -Review of biochemistry –;Prentice Hall New york
8. R.A. Copeland -Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis,; John Wiley and Sons Inc.
9. Zubby,Parson, and Vanse –principles of Biochemistry; Wm.C. Brown Publishers
10. J. Jayraman- Practical Biochemistry New age Publishing house, Bangalore
11. Plummer. –Practical biochemistry; TMH New Delhi

**M. Sc. Biotechnology**  
**BT 2003 – 4 credits**  
**Cell Biology**

**Unit I**

**Structural Organization and Function of Intracellular Organelles:**

Definition of cell, Diversity of cell size and shape, Structure of prokaryotic and Eukaryotic cells Organization, Structure and Functions of subcellular organelles of (Cell wall, plasma membrane, cilia, flagella, capsule, pilinucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast,) bacteria, yeast, plant and animal cell.  
structure & function of cytoskeleton and its role in motility (actin, myosin, microtubules and intermediate filaments)

**Unit II**

**Membrane structure and function:**

Structure of model membrane ( plasma membrane, Endoplasmic reticulum, membrane, nucleus, mitochondrial & chloroplast membrane ) lipid bilayer and membrane protein diffusion, osmosis,  
Transport across membranes: Types of membrane transport (Active, Passive) Role of carrier proteins, ion channels, ion pumps ( $\text{Na}^+$ ,  $\text{Ca}^+$  pumps,  $\text{K}^+$  pumps and ATPase) Protein sorting  
Mechanism and regulation of intracellular transport, Cotransport by Symporters and antiporters, membrane potential in membrane transport (electrical properties of membranes).

**Unit III**

**Cell division and cell cycle:**

Cell Cycle (Mitosis and meiosis) steps in cell cycle, regulation, Molecular control of cell division,  
Cellular Mechanisms of Development: Cell differentiation in prokaryotic cells. &  
Morphogenesis, Abnormal cell division – leading to tumor, Cell cell fusion in normal and abnormal cell division, Strategies of Microbes.

**Unit IV**

**Organization of genes and chromosomes:**

Defination of genes, Chromosomal organization of genes, Operon, interrupted genes, gene families, unique and repetitive DNA, transposons,

Organization of chromosomes: Definition of chromosomes, structure of chromatin and chromosomes, heterochromatin, euchromatin, Histones Proteins.

#### **Unit V**

##### **Cellular Communication and Cell signaling:**

general principles of cell communication, , cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, Neurotransmissions and its regulation, Hormones and their receptors, cell surface receptor, G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

##### **References**

- 1 Alberts B et al Molecular biology of the cell. Garland Publishing Inc.
- 2 Lodish et al., Molecular cell biology. Freeman & company ,New York 1999
- 3 Gennis R.B Biomembranes- molecular structure and function. Springer.
- 4 G.Posil ,S.T.Crooke (Eds) mechanism of receptor regulation. Plenum press,1985
- 5 DM Prescott; Reproduction in Eukaryotic cells, Academic Press
- 6 S.F Gilbert; Developmental Biology, Sinauer Associates inc
- 7 Sheeler; cell and Molecular Biology.
- 8 Sadava ; cell biology

**M. Sc. Biotechnology**  
**BT 2004 – 4 credits**  
**Basic Immunology**

**UNIT I: Immunity & Antigen**

Antigen, Epitopes, Immunogenicity, Antigenicity of a compound, Factors influencing antigenicity, Haptens, Adjuvants, Chemical basis of antigen specificity, Superantigens.

**Immunity:** Innate, Acquired, Humoral, Cell mediated, Immunization (Active & Passive)

**Cells & Organs of Immune System:** Primary & Secondary Lymphoid Organs, Lymphatic System, Hematopoiesis.

**UNIT II: Antibodies & BCR:**

**Antibody:** Basic structure, Fine structure, Classes & their biological activity, Multigene Organization, Recombination, Generation of antibody diversity, Class Switching, Expression of Ig genes, Regulation of transcription, Ig Superfamily, Monoclonal antibody (Chimeric Antibody & Humanized Antibody) & its formation & Applications

**B cell Receptor:** Structure & Organization.

**UNIT III: TCR & MHC:**

**T Cell Receptor :** Structure & Organization, TCR-CD3 Complex, T Cell Rearrangement of TCR & Expression of TCR genes, T Cell accessory molecules & their role in activation of T Cells.

**MHC:** General Organization & Inheritance, haplotypes, Structure & Organization of Class I & Class II MHC, Polymorphism of MHC, Acceptance & Rejection of Graft, Self MHC Restriction, Alloreactivity of T Cells, Foetus as Unrejected Graft.

**UNIT IV: Lymphocyte Activation & Regulation, Effector Mechanism:**

**T Cell:** Maturation in Thymus, Positive & Negative Selection in Thymus, Activation by interaction with Antigen Presenting Cells, Signal transduction, Differentiation & Maturation of T Cells, Clonal energy & Mechanism of Tolerance.

**B Cell:** Maturation, T Dependant & Independent Activation, Germinal Centers, Ag induced B Cell Differentiation, B Cell Tolerance.

**Effector Mechanism:** Cytokines, their properties, receptors, TH1 & TH2 balance, Regulation of Cytokine Synthesis, Cell Mediated Effector Mechanism, Mechanism of Cytolysis,

**Complement:** Function, Complement Activation, Regulation of Complement System

**UNIT V: Antigen-Antibody Interaction:**

Strength of Antigen-Antibody Interaction (Antibody Affinity & Antibody Avidity),

**Precipitation:** Precipitation in Fluids, Precipitation in Gel (Radial Immunodiffusion & Double Immunodiffusion), Immunoprecipitation.

**Agglutination:** Hemagglutination, Bacterial Agglutination, Passive Agglutination.

Radioimmunoassay, Enzyme-Linked Immunosorbent Assay, Immunofluorescence, Flow Cytometry & FACS, Mixed Lymphocyte Reaction, Cytotoxicity Reaction, In situ localization by techniques such as FISH & GISH, Migration Inhibition Assay.

**References:**

1. Roitt I M, Essential Immunology , Blackwell Scientific Publications,Oxford
2. Weissman I L Wood, Immunology, Benjamin Cummings
3. Kuby - Immunology ,4th ed Freeman press
4. Stites DP Basic & Clinical Immunology, Appleton & Lang press
5. Ellis, Vaccines, A new approach to Immunology
6. W E Paul, Fundamental Immunology, Raven Press
7. D M Weir Experimental Immunology 4 volumes
8. William Paul Fundamentals of Immunology
9. Abbas- Cellular and Molecular Immunology
10. Rose- Manual of Clinical and Laboratory immunology
11. Benjamini- Immunology :A short Course
12. Brooks – Medical Microbiology 21st ed
13. Joshi – Immunology
14. Janeway -Immunobiology

## **SEMESTER II**

**BTP 2001 -Practicals based on Theory Paper BT 2001** -2 credits

### **Practicals**

1. Spontaneous mutation in bacteria
2. Induced mutation using chemical and physical mutagens
3. Scoring and enrichment of mutants
4. Ampicillin enrichment of Auxotrophs
5. Isolation of different auxotrophic mutants by using selective plates
6. Chromosomal aberration due to radiations
7. Repair mechanisms in E.coli –dark,photoreactivation
8. Repair mechanisms in Yeast
9. Study of genotypes and its conformation



**BTP 2002 -Practicals based on Theory Paper BT 2002** -2 credits

**PRACTICALS**

1. Enzyme production from microbes and seeds
2. Enzyme purification by salting out
3. Effect of enzyme parameters on activity
4. Enzyme kinetic analysis (Determination of  $V_{max}$  and  $K_m$ , reciprocal plots)
5. Effect of inhibitors on enzyme activity
6. Immobilization of enzymes and study of different parameters of immobilized enzyme preparation

**BTP 2003 -Practicals based on Theory Paper BT 2003** -2 credits

**Practicals**

1. Transport across membranes.
2. Effect of detergents on membrane permeability.
3. Isolation of cellular organelles.
4. Study of marker enzymes from the isolated organelles.
5. Preparation of liposomes.
6. Preparation of Feulgen-Stained Chromosomes in root tip squashes for the observation of ~~effect of~~ Colchicine on Chromosome movements during Mitosis.

**BTP 2004 -Practicals based on Theory BT 2004** -2 credits

**Practical:**

1. Study of Immune Cells TLC/DLC
2. Isolation of PBMC FROM Heparinised Blood
3. Enrichment of T & B Cells
4. E-Rosetting for T Cells
5. Reverse Plaque Assay for B Cells
6. Isolation of Bacterial Antigen
7. Isolation of Protein A from *Staphylococcus aureus*
8. Immunoelectrophoresis
9. Antigen-Antibody Interaction: Precipitation (In Liquid & In Gel)
10. Haemagglutination
11. Complement Activity on RBC
12. Bactericidal Assay

**End First Year**