

Swami Ramanand Teerth Marathwada University, Nanded

Syllabus B.Sc. Biotechnology SY (Revised)

(w.e.f. June - 2014)

B. Sc. Biotechnology Second Year (Third Semester)

Code No.	Paper Title	Teaching Periods/ Week	Maximum Marks T/P (A)	Internal Test Marks (B)	Total Marks (A+B)	Duration of Exam (in Hrs)
BTT-3.1	Metabolism-I	04	80	20	100	03
BTT-3.2	Cytology	04	80	20	100	03
BTT-3.3	Molecular Biology	04	80	20	100	03
BTT-3.4	Mathematics, Biostatistics and Computers	04	80	20	100	03
BTP-3.1	Lab Course -5 Practical Based on (BTT-3.1 + BTT-3.2)	03+03	100	-	100	03
BTP-3.2	Lab Course -6 Practical Based on (BTT-3.3+ BTT-3.4)	03+03	100	-	100	03
				Total	600	

B. Sc. Biotechnology Second Year (Fourth Semester)

Code No.	Paper Title	Teaching Periods/ Week	Maximum Marks T/P (A)	Internal Test Marks (B)	Total Marks (A+B)	Duration of Exam (in Hrs)
BTT-4.1	Metabolism-II	04	80	20	100	03
BTT-4.2	Applied & Medical Microbiology	04	80	20	100	03
BTT-4.3	Immunology and Virology	04	80	20	100	03
BTT-4.4	Plant and Animal Cell Culture	04	80	20	100	03
BTP-4.1	Lab Course -7 Practical Based on (BTT-4.1 & BTT-4.2)	03+03	100	-	100	03
BTP-4.2	Lab Course -8 Practical Based on (BTT-4.3 & BTT-4.4)	03+03	100	-	100	03
				Total	600	

B.Sc. Biotechnology Second Year -III Semester**BTT.3.1 : Metabolism-I****Marks 80****Hours 50****Objective:** To provide an understanding of basic thermodynamics and metabolic activities.

UNIT I : Thermodynamics:- Fundamentals of thermodynamics- Law of thermodynamics, endergonic and exergonic processes, enthalpy, entropy, activation energy, free energy change, phosphoryl transfer reaction, oxidation reduction reaction, redox potential, equilibrium and non equilibrium thermodynamics, high energy compounds, causes of energy richness in ATP.

UNIT II : Carbohydrate Metabolism :EMP Pathway, HMP And ED Pathway, TCA Cycle.

UNIT III : Concept of respiration, Types of phosphorylation (substrate, photo and oxidative), mitochondrial electron transport chain, Electron Transport Chain: Components of the chain, sites of ATP synthesis, chemiosmotic theory of oxidative phosphorylation Regulation of ATP synthesis.

UNIT IV : Fattyacid oxidation, Oxidation of fatty acids, role of carnitine, oxidation of unsaturated fatty acids & odd carbon fatty acids.

Metabolic breakdown of amino acids, Transamination (mechanism). Oxidative & Non-oxidative deamination. Urea cycle, metabolic disorders of urea cycle.

Text and Reference:

1. Hayne -Biological thermodynamics -Oxford
2. G Gottschalk-Bacterial Metabolism (2nd Ed) - Springer
3. Nelson & Cox- Lehninger Principles of Biochemistry – W.H. Freeman
4. Lehninger Principles of Biochemistry- Kalyani Publication
5. Stryer- Biochemistry –W.H. Freeman
6. Voet & Voet- Biochemistry – Wiley
7. Cohn and stumpt- Outlines of Biochemistry – Wiley India
8. P.M.Dey- Plant Biochemistry-Academic Press
9. B.P. Pandey- Plant Physiology –Vikas
10. Herper -Biochemistry – McGraw Hill
11. S.K. Verma- Plant Physiology & Biochemistry- S.Chand
12. Bioenergetics by Lehninger- W. A. Benjamin

Practicals :

1. Problems based on Entropy, Enthalpy, Free energy and Gibbs Equation (Two of each)
2. Detection of sugars by Paper chromatography / TLC
3. Separation of Photosynthetic pigments by TLC
4. Demonstration of Hill Reaction
5. Study of Enzymatic hydrolysis of Lipids
6. Demonstration of aerobic and anaerobic respiration in microorganisms
7. Estimation of fatty acids by suitable method.

B.Sc. Biotechnology Second Year -III Semester**BTT-3.2: Cytology****Marks: 80****Hours: 50****Objective:** To provide an understanding of structure and function of Cell and its organelles**Unit I: Introduction to the Cell:**

Diversity of cell size and shape, History & Evolution, Cell as the basic unit of life, cell theory, Structural organization of prokaryotes and eukaryotes. Biogenesis of Mitochondria, Chloroplast.

Unit II: Molecular architecture of cell: Structure and function of plasma membrane (Membrane proteins, lipids.) Structure and functions of Cell wall, Cytosol. **Cell organelles** (Structure, organization & function): Endoplasmic Reticulum (Rough & Smooth), Mitochondria (aerobic & anaerobic), Chloroplast, Ribosome, Golgi apparatus, Lysosome, Melanosome, Nucleus (Nuclear membrane & nuclear pore, Nucleoplasm, Nucleolus), **Cytoskeleton** : Microtubules, Microfilament, intermediate filaments, **Micro bodies:** Glyoxisome, Peroxisomes. **Locomotory organs:** Cilia & Flagella.

Unit III: Cellular transport: Transport across cell membrane, Passive transport: Simple diffusion & osmosis , Active Transport: Endo & Exocytosis, (Phagocytosis, Pinocytosis, receptor mediated, Clathrin mediated). Na / K ion Channel, Vesicular transport,

Unit IV: Cellular regulation: Cell division and cell cycle – General events of Mitosis and Meiosis, **Cell-cell interaction** (Plasmodesmata, GAP junction, Tight junction, Desmosome), **Cell signaling:** G protein coupled receptor, Autocrine Signaling, Brief introduction of concept of Cancer.

Text and Reference:

1. Verma Agrawal; Cell biology - S. Chand.
2. Gerld Carp- Cell and Molecular biology -Wiley
3. David Sadava; Cell and Molecular biology. Jones & Bartlett Publishers
4. P.S. Verma, V.K. Agarwal- Cytology- S. Chand
5. C.B. Powar- Cell biology - Himalaya Pub.
6. Lodish- Cell and Molecular biology- W.H. Freeman
7. Albert Bruce- Molecular Biology of The Cell- Garland
8. De Robertis; Cell and Molecular biology- Lippincott Williams & Wilkins

Practicals:

1. Study of different Cell types
2. Sub cellular fractionation and isolation of Mitochondria, Chloroplast.
3. Study of Meiosis by maceration technique
4. Study of Mitosis. by maceration technique
5. Study of Karyotyping to find chromosomal position
6. Study of Osmosis, and membrane selective permeability
7. Study of Polytene Chromosome.
8. Study of Tissue/ cells by Microtomy
9. Study of Microscopy; Bright field Microscope/ Light microscope
10. Determination of cell density by turbidometry
11. Demonstration of dialysis.

B. Sc. Biotechnology Second Year -III Semester**BTT-3.3: Molecular Biology****Marks: 80****Hours: 50**

Objective: To extend understanding of the molecular mechanisms of gene expression via which genetic information are stored, expressed and transmitted among generations

UNIT I: DNA structure, replication & repair:

DNA structure: Structure of DNA, Properties of DNA, Cot curve

DNA replication: Replication in prokaryotic and eukaryotic cells, models & mechanism of DNA replication, Enzymes involved in DNA replication –Primosome, Replisome, Topoisomerase, DNA polymerase, SSBP & Ligase. **DNA Repair-** Direct repair – Photo Reactivation, Excision, mismatch, Recombination repair, SOS repair

UNIT II: Transcription and RNA processing

Transcription in Prokaryotes: Initiation, Elongation & Termination. Structure of RNA polymerase, Role of sigma factor, Promoter.

Transcription in Eukaryotes: Initiation, Elongation & Termination. Upstream & downstream Promoters, Enhancer. RNA Polymerase I, II & III., Co & Post transcriptional modification in m-RNA- 5'capping, Intron Splicing, polyadnylation. RNA processing & Transport.

UNIT III: Translation

Prokaryotic and Eukaryotic- Mechanism, initiation, elongation, termination.

Co & post translational modifications in proteins, Heat shock proteins, Chaperons & Chaperonins. Properties of genetic code , Role of mRNA, tRNA, rRNA.

UNIT IV: Regulation of gene expression

Regulation of transcription in prokaryotes , Operon concept, trp-operon, lac- operon, ara- operon.

Text and Reference :

1. Kakoli and Upadhyya- Molecular Biology- Himalaya
2. Watson – Molecular biology of gene- Pearson
3. David Freifelder - Microbial Genetics – Narosa
4. David Freifelder – Molecular Biology – Jones and Bartlett /Narosa
5. Gardner – Principals of Genetics – Wiley international pub.
6. Simmonds & Snustad – Principles of Genetics IV ed- Wiley international
7. T.A. Brown – Genomes – Garland Science
8. Albert Bruce- Molecular biology of the cell- Garland Science.
9. Loddish - Molecular cell biology – W-H. freeman
10. B. Lewin – Genes- IX- Oxford

Practicals:

1. Study of Ames test
2. Study of fluctuation test
3. Isolation and quantization of DNA from Bacteria, Yeast,
4. Effect of UV radiation on yeast / bacteria
5. Study of DNA repair mechanism by photo reactivation.
6. Agarose gel electrophoresis of genomic DNA & plasmid DNA
7. Isolation of Lac mutants by using Replica plate method.
8. Determination of Tm value of DNA/ Cot curve.

B.Sc. Biotechnology Second Year –III Semester**BTT-3.4 :Mathematics, Biostatistics and Computers****Marks: 80 Hours: 50****Objective:** To develop skills of Mathematics, Statistics and Computers in the field of biology**Unit I:****Set Theory:** Set, types of set, subset, universal set Venn diagram, set operation. Examples.**Relation & function:** Cartesian product, relation, function types of function, introduction to limit, introduction to derivative examples.**Unit II:****Preliminary concept** Definition of statistics, Data& types, Frequency distribution.

Graphical representation (Histogram, frequency polygon, frequency curve).Diagrammatic representation (simple Bar, Subdivided bar, pie chart)

Central Tendency: Concepts, definition, formulas of ungrouped and grouped data examples of Mean, Median, Mode and Quartiles.**Unit III****Measures of Variation:** Concept, Definition, formula, examples of Range, Standard Deviation. Definition, examples of Variance and Coefficient of Variation**Test of significance:** Z test, t- test, Chi-Square test, Correlation & linear regression**Unit IV****Basics of Computer:**

Introduction to computer system low level high level language flow chart & programming techniques, Introduction to OS. Windows & Linux. MS Office covering word processing spread sheets & presenting software.

Internet concept, WWW, URL, http, Browsers, Search engines etc

Text Reference

1. Introduction of Mathematics for Life science- E. Batschelet - Springer
2. Discrete Mathematics- Semyour Lipschutz & Marc Lipson-McGraw Hill
3. Statistical Methods - Gupta-Himalaya
4. Fundamental of Biostatistics – P. Hanamantrao
5. Introduction to Biostatistics Dr. Pranabkumar Banerjee
6. Introduction of Computer Science- Pcushman& R. Mata Toledo, McGraw Hill
7. Computer fundamentals - PK Sinha- BPB New Delhi
8. Microsoft Office-2000 Complete- BPB

Practicals

1. Calculation oriented statistical techniques
2. Problem based on test of significance
3. Introduction to computer Hardware and Networking
4. Study of word processing MS- word,
5. Preparation of chart & graphs by MS- Excel and MS word
6. Making presentation in MS power point
7. Internet- E- mail, Search Engines

B.Sc. Biotechnology (Semester Pattern) IV Semester**BTT-4.1 : Metabolism-II****Marks 80****Hours 50****Objective:** To understand principles of biosynthesis of building blocks of living system.**UNIT I: Enzymes:** Definition, Nomenclature, Classification of enzymes, Specificity of active sites, E units Enzymes Kinetics: - Michaelis-Menton Equation, significance of K_m and V_{max} , factors affecting enzyme activity.**UNIT II: Biosynthesis of Carbohydrate:** Trapping of solar energy into chemical energy (PS-I & PS-II) in green plants, utilization of this energy to synthesize carbohydrate (Calvin cycle, cycle in C-4 and CAM plants), photorespiration (C-2 cycle).
Gluconeogenesis, glycogenesis, and glycogenolysis, glucosides, peptidoglycan**UNIT III: Nucleotide and Amino acid Biosynthesis:** Purines, Pyrimidines, deoxynucleotides, Salvage and de novo pathway. Synthesis of amino acids (Lysine, Arginine & Tryptophan)**UNIT IV: Biosynthesis of Fatty acids:** fatty acid synthase complex, regulation, Microsomal & Mitochondrial system of chain elongation and synthesis of unsaturated fatty acids. Cholesterol and phospholipids**Biosynthesis of Secondary metabolites:** Plants :- Synthesis of Alkaloids, Flavonoids Hormone IAA, Cytokine, Gibberlic acid. Microorganisms :- Antibiotics Beta lactum, tetracycline and macrolides**Text and Reference:**

1. G Gottschalk-Bacterial Metabolism (2nd Ed) - Springer
2. Nelson & Cox- Lehninger Principles of Biochemistry – W.H. Freeman
3. Lehninger Principles of Biochemistry- Kalyani Publication
4. Stryer- Biochemistry –W.H. Freeman
5. Voet & Voet- Biochemistry – Wiley
6. Cohn and stumpf- Outlines of Biochemistry – Wiley
7. G Carp- Cell and Molecular Biology –Wiley
8. P.M.Dey- Plant Biochemistry-Academic Press
9. B.P. Pandey- Plant Physiology –Vikas
10. Herper -Biochemistry – McGraw Hill
11. S.K. Verma- Plant Physiology & Biochemistry- S.Chand

Practical s:

1. Study of Enzyme activity: Amylase/ Cellulase
2. Effect of pH /temperature/ Substrate concentration on Enzyme activity
3. Study of Michaelis-Menten equation
4. Production of Plant hormones from biological sources
5. Extraction and Purification of Flavonoids, Alkaloids
6. Estimation of Cholesterol, bilirubin
7. Extraction and Purification of lipids; Thin layer Chromatography
8. Extraction and Purification of amino acids ; Thin layer Chromatography
9. Identification of production of antibiotics by bioassay

B.Sc. Biotechnology Second Year IV Semester**BTT -4.2: Applied and Medical Microbiology****Marks 80****Hours 50****Objective:** To understand applications of microorganisms in different areas.

UNIT I: Soil Microbiology: Importance of Biogeochemical cycles: Carbon Cycle: - Carbon assimilation, mineralization, Nitrogen Cycle: Ammonification, Nitrification, Denitrification, and Dinitrogen fixation in symbiotic and non- symbiotic microorganism. Sulphur Cycle: - Sulphur mineralization, oxidation and reduction of sulphur Phosphorus Cycle: - Solubilisation of inorganic phosphorus, Mineralization of organic phosphorus, immobilization, oxidation and reduction of phosphorus.

Air Microbiology: - Significance of microorganisms in air, enumeration of microorganisms and control of airborne microorganisms

UNIT II: Water Microbiology: Types of water, bacteriological examination of water (presumptive confirmative, complete test) MPN, SPC, membrane filter technique, indicator of fecal pollution, significance of index organism (*E. coli*), fecal/ non fecal coli forms (IMViC)

Food Microbiology: Scope of food microbiology, microbial spoilage of food, microbial examination of food, preservation of food by high temperature, chemicals, irradiation, physical techniques. Major food born infections and toxins.

UNIT III: Medical Microbiology: Etiological Agent, Virulence, Pathogenesis epidemiology (Sporadic, endemic, pandemic) Reservoirs of infection, Normal flora, commensals, opportunistic pathogens, carriers, septic shock, septicaemia, pathogenicity, virulence factors, toxins, bio safety levels. Concept of waterborne, airborne, nosocomial infections

UNIT IV: Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive, Measures and chemotherapy for Typhoid, Tuberculosis, Malaria and AIDS.

Plant Pathology: Concept, Host- Pathogen Relationships in plants.

Text and Reference:

1. Alexander – Soil Microbiology-John Wiley
2. N.S. Subbarao – Soil Microbiology – Oxford
3. Atlas & Bartha – Microbial Ecology IV Ed., Tata McGraw Hills Pub.
4. A.J. Salle- Fundamental Principles of Bacteriology IIEd., Tata McGraw Hill Pub.
5. Adams & Moss- Food Microbiology Royal Society of Chemistry
6. Frazier- Food Microbiology- Tata Mc Graw Hill
7. Text book of Microbiology- Anantnarayan & Panikar-Orient Longman
8. General Microbiology- Powar and Daginawala- Himalaya

Practicals :

1. Enumeration of microorganisms from Soil.
2. Isolation of Symbiotic and Non Symbiotic N₂ fixing microorganisms/ PSB from soil.
3. Enumeration and Study of air Micro flora
4. Microbial examination of water, enteric pathogen form water sample. (IMViC test)
5. Isolation & Enumeration of microorganisms from food sample.
6. Isolation of micro flora from human skin and throat etc
7. Analysis of contaminated food material and analysis of toxins
8. Visit to food and Dairy Industry.

B.Sc. Biotechnology (Semester Pattern) IV Semester**BTT-4.3 : Immunology and Virology****Marks 80****Hours 50****Objective:** To understand concepts of immune system and virology and basic techniques used**Unit I :Immunology**

General concept of Immunity, Innate and Acquired Immunity, cellular & Humoral Immunity, Primary Secondary lymphoid organs, hematopoiesis. Types and role of Cells of Immune System.

Unit II: Antigen and Antibody: Immunogenecity, Antigenicity, Adjuvants, Epitopes, Haptens. Structure and functions of Immunoglobulins. Antigen- Antibody interactions. Precipitation and Agglutination reactions. Complement fixation.

Unit III : Virology

Brief introduction / outline on discovery of viruses. Nomenclature & classification of Viruses (ICTV), ultra structure, viral nucleic acid, nucleocapsid, structure and envelope viroids, prions, modes of propagation.

Unit IV : Life cycle and replication of RNA and DNA Viruses. Bacteriophages λ , T M13. Animal Viruses- Adenovirus, Retrovirus. Plant Viruses- TMV CaMV. Brief outline of Vaccines, antivirals, Interferon.

Text and Reference:

1. Immunology – Kuby- W.H. Freeman
2. Essentials of Immunology- Roitt I. M.- Blackwell
3. Immunology- Nandini Shetty- New Age International
4. Textbook of Microbiology – Anantnarayan and Panikar-Orient Longman
5. Immunology- A.K. Abbas- Elsevier
6. An Introduction to Viruses- Amita Biswas- Vikas Publication
7. Bacterial and Bacteriophage Genetics– Edward Birge- Springer
8. Microbial Genetics-David Freifelder- Narosa
9. Virology Principles and Applications- John Carter, Venetia A. Saunders-Wiley
10. Introduction to Modern Virology IV I edition- Dimmock, Primrose
11. Plant Virus- M.V. Nayudu- Tata McGraw Hill

Practicals:

1. Immunodiagnostics (demonstration using Kits- Widal, VDRL, Blood Group etc)
2. Immunodiffusion, Immuno Electrophoresis, Western Blotting, Differential Leukocyte Count
3. Lymphoid organ, Cell and their microscopic observation
4. Immunization, collection of Serum
5. Purification of Ig G from Serum
6. Isolation of bacteriophage from sewage/Titration / one step growth curve of bacteriophage
7. Enumeration of Bacteriophage by PFU method
8. Cultivation of Virus in Embryonated egg, Heamagglutination test
9. ELISA study and demonstration
10. Isolation and study of plant virus

B.Sc. Biotechnology (Semester Pattern) IV Semester**BTT-4.4: Plant and Animal Cell Culture****Marks 80****Hours 50****Objective:** To understand the basic techniques and applications of Plant and Animal cell culture

Unit I : Plant Tissue Culture: Introduction and Principles of plant tissue culture, history, Laboratory Organization, Sterilization Techniques, Cleanliness and care, Nutrition and physiology, Media components, Stock solutions, Totipotency, Callus culture, micro propagation, Types of cultures: Cell suspension culture, embryo culture, organ culture, Anther and Pollen Culture, Plant protoplast culture, De Differentiation, Redifferentiation.

Unit II: Applications of Plant Tissue Culture: Somatic Embryogenesis and artificial seed, Mass propagation, Protoplast fusion and somatic hybridization, Cybridisation, Improved crop varieties through somaclonal variation, Plant improvement for agriculture, horticulture and forestry, production of secondary metabolites, Preservation of plant genetic resources and germplasm conservation.

Unit III: Animal Cell Culture: Principle and Laboratory organization, Sterilization Techniques, Cleanliness and care, Nutrition and physiology. Media components, balanced salt solutions, Serum, serum free media. Cell separation viability and Counting techniques, Primary cell culture, Secondary cell culture and concept of cell lines. Types of animal cell cultures, Organ culture, contact inhibition, cell senescence. Cryopreservation, Flow cytometry.

Unit IV: Applications of Animal Cell Culture:

Commercial application of animal tissue culture, concepts of Stem cells and application, Diagnostics, cytotoxicity, monoclonal antibody production, Recombinant proteins and vaccine production, Tissue engineering, Cloning.

Text and Reference:

1. Elements of Biotechnology- Gupta P.K.-Rastogi publication
2. Introduction to plant tissue culture – M.K. Razdan-Oxford and IBH
3. Biotechnological innovations in crop improvement- Butterworth Heinemann, BIOTOL, Elsevier
4. Plant Cell and Tissue Culture: A Tool in Biotechnology- Karl-Hermann, A. Kumar-Springer
5. Plant Tissue Culture-Bhojwani and Razdan-Elsevier
6. Methods in Plant Tissue culture- U Kumar- Agrobios India
7. Culture of Animal Cells- R Ian Freshney- John Wiley
8. Animal Cell Culture – John Masters- Oxford University Press
9. Animal Biotechnology –R Sasidhara- MJP Publisher
10. In Vitro Cultivation of Animal cells- Butterworth- Heinemann, BIOTOL, Elsevier
11. Biotechnological Innovations in Animal Productivity- Butterworth- Heinemann, BIOTOL, Elsevier

Practicals :

1. Introduction, general operations, aseptic handling and precautions at cell culture laboratory
2. Stock solution and media preparation for animal cell culture / PTC
3. Callus culture technique, Suspension culture technique, Organ culture: Anther, Pollen culture.
4. Aseptic seed germination.
5. Somatic Embryogenesis and preparation of artificial seed
6. Micropropagation Stage I to IV- Initiation to acclimatization and hardening
7. Animal Cell separation-Trypsinization, Cell viability count by Neuber Chamber
8. Primary cell culture and secondary cell culture techniques
9. Visit to a Animal /Plant Tissue culture laboratory