SYLLABUS
2015-2016

BASTAR UNIVERSITY JAGDALPUR,
CHHATTISGARH
SCHOOL OF STUDIES IN BIOTECHNOLOGY

BASTAR UNIVERSITY, JAGDALPUR
CHHATTISGARH 494001

Syllabus

BIOTECHNOLOGY

M. Sc.
(Semester System)

2015-2016
2016-2017
### SCHEME OF SEMESTER EXAMINATION FOR SESSION 2015-17

**SCHOOL OF STUDIES IN BIOTECHNOLOGY**

**M. Sc. BIOTECHNOLOGY (Semester I to IV)**

**July 2015 – December 2015**

<table>
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**January 2016 – June 2016**

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*Each theory paper will have 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise.*
**1. Each student will be evaluated continuously throughout the semester.
2. There will be a class test based on each theory paper. The full marks will be 10 for each paper.
3. There will be a poster/oral presentation based on each theory paper. The full marks will be 10 for each presentation.
4. Each student will be required to submit a brief write-up (not more than 20 pages) on his/her poster/oral presentation.

*** 1. A student of IV semester will have the option to opt for project work in lieu of four theory papers and two lab courses provided he/she secures at-least 65% or more marks in aggregate in semester I and II.
2. The project has to be carried out in recognized national laboratories or UGC recognized universities. No student will be allowed to carry out project in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur.
3. The valuation of all the projects will be carried out by the external examiner and HoD of UTD or its nominee at the UTD Centre.

- M.Sc. Students of Biotechnology have to attend one excursion or visit in one academic year (within or outside Chhattisgarh)
# Scheme of M.Sc. (Biotechnology)
## Scheme of Examination
### Semester I

<table>
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School of Studies in Biotechnology
Semester I
Paper 1: Cell Biology

Unit I

1. Cell Theory
2. Structure of Prokaryotic and Eukaryotic cells

Unit II

1. Cellular organelles – Plasma membrane, cell wall, their structural organization; Mitochondria; Chloroplast; Nucleus and other organelles and their organization.
2. Transport of nutrients, ions and macromolecules across membranes.
3. Cell cycle – molecular events and model systems

Unit III

1. Cellular responses to environmental signals in plants and animals – mechanisms of signal transduction.
2. Cell motility – cilia, flagella of eukaryotes and prokaryotes
3. Biology of cancer

Unit IV

2. Cellular basis of differentiation and development – mitosis, gametogenesis and fertilization. Development in Drosophila and Arabidopsis; Spatial and temporal regulation of Gene Expression

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:

List of Practicals:-

1. To prepare the temporary stained slide of onion bulb peel to study the structure of plant cell.
2. To prepare the temporary stained slide of cheek squamous epithelial cells of mouth of Human Beings.
3. Preparation and Study of slide of mitosis using from onion root tips squash.
5. To determine the abnormal mitotic index.
6. Preparation and study of slide for meiosis using young anthers of Allium cepa.
7. To determine the meiotic index in the flower bud of Allium cepa.
Unit I
1. Introduction to genetics; Beginning of genetics as a science. Early studies involving genetics
2. Mendel and genetics; Mendel’s laws of genetics; Physical and chemical basis of Heredity. Genetic variation.
3. Gene - Types of genes, Prokaryotic, Eukaryotic and Viral genes
4. Genetics and human affairs.
5. Fine structure of gene, Eukaryotic genome organization (Structure of chromatin, coding and non-coding sequences, satellite DNA); rearrangement in DNA. Central dogma

Unit II
1. Regulation of gene expression in Prokaryotes and Eukaryotes; Attenuation and antitermination; Operon concept; DNA methylation.
2. Gene to Phenotype – Interactions between the Alleles of one gene, interfering gene interaction.
3. Mutation; Types of mutations, Changes in Chromosome number and structure - Euploidy and Aneuploidy, mutagens – UV and chemical mutagens, Ames test; Dosage compensation; Mutational Assay System.

Unit III
2. Genes and Quantitative traits; Genotypes and Phenotypic Distribution; Heritability of Quantitative Character; Quantifying Heritability; Locating genes.
3. Genetic disorder and syndromes.

Unit IV
2. Viruses and their Genetic system: Phage I and its life cycle; RNA phases; RNA viruses; Retroviruses
3. Genetic system of Yeast and Neurospora.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.
Books:-
- Genetics; Benjamin Pierce; W. H. Freeman
- Principles Of Genetics; Eldon John Gardner, Michael J. Simmons, D. Peter Snustad; Wiley India Pvt Ltd
- Principles of Gene Manipulation and Genomics; SANDY PRIMROSE and RICHARD TWYMAN; Wiley-Blackwell

Practical:
- Experiments for Mendel’s experiments
- Studies of prokaryotic & eukaryotic cells
- Karyo-type studies
- Mutation in bacteria
- Plasmid isolation

School of Studies in Biotechnology
Semester I
Paper 3: Microbial Physiology

Unit I
1. Microbial Evolution, Systematics and Taxonomy – New approaches to bacterial taxonomy classification including ribotyping; Ribosomal RNA sequencing; Characteristics of primary domains; Nomenclature and Bergey’s Manual.
2. Prokaryotic cells: Structure and function – Cell walls of eubacteria (peptidoglycan) and related molecules: Outer – membrane of Gram negative bacteria; Cell wall and cell membrane synthesis; Flagella and motility; Cell inclusions like endospores, gas vesicles.

Unit II
1. Microbial Growth – The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen.
2. Metabolic Diversity among Microorganisms – Photosynthesis in microorganisms; Role of Chlorophylls, carotenoids and phycobilins; Calvin cycle; Chemolithotrophy;
Hydrogen – iron – nitrite – oxidizing bacteria; Nitrate and sulphate reduction; Methanogenesis and acetogenesis; Fermentations – diversity, syntrophy, Nitrogen metabolism; Nitrogen fixation.

Unit III
1. Bacteria: Purple and green bacteria; Cyanobacteria; Homoacetogenic bacteria; Acetic acid bacteria; Budding and appendaged bacteria; Spirilla; Spirochaetes; Gliding and sheathed bacteria; Pseudomonads; Lactic and propionic acid bacteria; Endospore forming rods and cocci; Mycobacteria; Rickettsias, Clamydias and Mycoplasmas. Archaea: Archaea as earliest life forms; Halophiles; Methanogens; Hyperthermophilic Archaea; Thermoplasma.

2. Algae, Fungi, Slime moulds and Protozoa. Viruses: Bacterial, Plant, Animal and tumor viruses; Discovery, classification and structure of viruses; Lysogeny; DNA viruses; Positive strand, Negative strand and double stranded RNA viruses; Replication; Examples of Herpes, Pox, Adenoviruses, Retroviruses, Viroids and Prions.

Unit IV
1. Microbial diseases – Infectious disease transmission; Respiratory infections caused by bacteria and viruses; Tuberculosis; Sexually transmitted diseases including AIDS; Diseases transmitted by animals (rabies, plague), insects and ticks (Rickettsias, Lime disease, malaria)
2. Food and water borne diseases
3. Host – Parasite Relationships – Normal microflora of Skin, Oral cavity, Gastrointestinal tract; Types of toxins (Exo –, Endo -, Entero -) and their structure; Virulence and Pathogenesis.
4. Chemotherapy/Antibiotics – Antibiotics and Antimicrobial agents; Broad-spectrum antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance to antibiotics.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:

Practicals:-

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods.
   Slants and stab cultures. Storage of microorganisms.
3. Isolation of pure culture from soil and water.
5. Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores.
7. Assay of antibiotics and demonstration of antibiotics resistance.
8. Analysis of water for portability and determination of MPN.
10. Biochemical characterization of selected microbes.
11. Transduction
12. One step growth curve of bacteria

School of Studies in Biotechnology
Semester I
Paper 4: Bio-molecule

Unit I


Unit II

1. Amino acids and peptides – classification, chemical reactions and physical properties
2. Sugars – classification and reactions

Unit III

1. Lipids – classification, structure and functions.
2. Proteins – classification and separation, purification and criteria of homogeneity, end group analysis, hierarchy in structure, Ramachandran map.

Unit IV

1. Polysaccharides – types, structural features, methods for compositional analysis
2. Analytical techniques in biochemistry and biophysics for small molecules and macromolecules for quantization.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:


List of Practical’s:-

- Qualitative test for Carbohydrate. (Molisch's test)
- Qualitative test for Carbohydrate.(Anthrone test)
• Qualitative test for Carbohydrate. (Benedict's test)
• Qualitative analysis of Carbohydrate by Barfoed's test.
• Qualitative test for amino acid by Ninhydrin reaction.
• Qualitative test for amino acid by Xanthoprotic reaction.
• Qualitative test for Proteins using Biuret test.
• Qualitative test for amino acid by Millon's test.

Lab. Course 1

Based on Theory Papers 1 and 2

Time: 6 hrs

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Lab. Course 2

Based on Theory Papers 3 and 4

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School of Studies in Biotechnology  
Semester II  

Scheme of Examination

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School of Studies in Biotechnology  
Semester II  
Paper 5: Biostatistics & Computer Application in Biotechnology  
M.M. 80

Unit I
1. Brief description and tabulation of data and its graphical representation.

Unit II
1. Simple linear regression and correlation
2. Tests of significance (F & T test), chi – square test.

Unit III
1. Introduction to digital computers: Organization; low – level and high – level languages; binary number system
2. Flow charts and programming techniques

Unit IV
1. Introduction to programming in Q Basic and C.
2. Introduction to data structures and database concepts, introduction to Internet and its application.
3. Introduction to Word processing, Spreadsheets and presentation software
4. Introduction to Image processing

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:


List of Practical’s:

Biostatistics

1. Calculate the mean value of given 20 leaves.
2. Calculate the median of the given sample of 20 leaves.
3. Find out the mode value of given 20 leaves.
4. To complete correlation of leaf length & breadth of a given leaf sample.
5. To perform the t-test for the given data of sample. (Leaves)
6. To perform the Chi- Squre test for the given data.
7. To calculate Standard deviation from the data (Sample).

Computer Application

1. Formulation of Basic Programs on Q basic
2. Writing basic programs on C
3. Draw Histogram, Pie, Graph, Line graph.
4. Data management
5. Slide preparation
6. Use of Internet.
7. To perform spreadsheet application.

School of Studies in Biotechnology
Semester II
Paper 6: Molecular Biology

Unit I

1. Introduction to Molecular Biology

2. DNA Replication – Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication. Enzymes and accessory proteins involved in DNA replication.
3. DNA Repair and Recombination. Homologous recombination – Holiday junction, gene targeting, FLP/FRT and Cre/Lox recombination, RecA and other recombinases.
4. Transcription – Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation. Modification in RNA - 5' – cap formation, Transcription termination, 3' – end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA, mRNA stability

Unit II

1. Translation – Prokaryotic and Eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co – and post – translational modifications of proteins.
2. Protein Localization – Synthesis of secretory and membrane proteins, Import into nucleus, mitochondria, chloroplast and peroxisomes, receptor mediated endocytosis.
Unit III

2. Antisense and Ribozyme technology – Molecular mechanism of Antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer – head, hairpin and other ribozymes, strategies for designing ribozymes, Applications of Antisense and ribozyme technologies.

Unit IV

1. Molecular Mapping of genome – Genetic and physical maps, physical mapping and map – based cloning, Southern and fluorescence in situ hybridization for genome analysis, Chromosome micro dissection and micro cloning.
2. Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease prognosis, genetic counseling, Pedigree, varietal etc.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books: Molecular Biology

List of Practical:-

1. Extraction of DNA from plant leaves by CTAB methods.
2. Estimation of plant genomic DNA by Spectrophotometer methods.
3. Separation of plant genomic DNA by Agarose gel electrophoresis.
4. Extraction of DNA from animal cells.
5. Estimation of animal genomic DNA by Spectrophotometer methods.
7. Separation of Bacterial proteins by vertical SDS-PAGE electrophoresis.
8. Extraction of RNA from Yeast cells.

School of Studies in Biotechnology
Semester II
Paper 7: Plant Biotechnology

Unit I
1. Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids.
2. Tissue culture media (composition and preparation)
3. Initiation and maintenance of callus and suspension culture; single cell clones.
4. Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil
5. Shoot – tip culture: Rapid clonal propagation and production of virus free plant

Unit II
1. Embryo culture and embryo rescue
2. Anther, pollen and ovary culture for production of haploid plants and homozygous lines
3. Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids.
4. Germplasm conservation – Cryopreservation and slow growth cultures

Unit III
1. Plant transformation technology: Basis of tumor formation, Mechanism of DNA transfer, Features of Ti and RI plasmids, role of virulence genes, use of Ti and Ri as vectors, binary vectors, markers, use of reporter genes, 35S and other promoters, multiple gene transfers, particle bombardment, electroporation, microinjection.
2. Chloroplast Transformation: Advantages, vectors

Unit IV
2. Molecular Marker –RFLP maps, linkage analysis, RAPD markers, STS, microsatellites, SCAR (Sequence characterized amplified regions), SSCP (Single strand conformational polymorphism), AFLP, map based cloning, molecular marker assisted selection.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-

2. Vasil IK – Plant Cell and Tissue Culture; Springer 1994
3. Bhojwani SS and Razdan MK – Plant Tissue Culture; Elsevier
Practicals:

1. Media preparation
2. Meristem / bud culture, shoot multiplication & rooting
3. Organogenesis
4. Somatic embryogenesis
5. Plantlet acclimatization
6. Embryo culture
7. Anther culture
8. Study of molecular markers
9. Extraction of DNA from plant
10. Estimation of plant DNA by Agarose gel electrophoresis and Spectrophotometer.

School of Studies in Biotechnology
Semester II
Paper 8: Macromolecules and Enzymology

Unit I

1. Macromolecules and supra molecules assemblies – Types of macromolecules in biological systems, molecular assemblies like membranes, ribosomes, extracellular matrix.
2. Sequencing of proteins and nucleic acids.

Unit II

1. Protein – protein and protein – ligand interactions, physical and chemical methods of study.
2. Conformational properties of polynucleotides and polysaccharides – secondary and tertiary structural features and their analysis – theoretical and experimental; protein folding – biophysical and cellular aspects
Unit III

1. Enzyme catalysis in solution – kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences.
2. Physical and chemical methods for immobilization of enzyme.
3. Glyco and lipoproteins – structure and function

Unit IV

1. Organization of macromolecular complexes – chromatin and ribosomes; Protein denaturation
2. Ribozymes and Catalytic antibodies – Functional proteins – structure and drug targets (enzymes and receptors)

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:

List of Practicals:-
- Qualitative assay of Protein by the Biuret method.
- To estimation of Protein Qualitatively by Folin Lowry Method.
- Estimation of cholesterol by the method of Crawford
- Determine the activity of Alkalie Protease.
- Determine the activity of neutral Protease.
- Effect of temperature on the activity of α-amylase.
- Determine the activity of catalase.
- Determine the activity of urease.
- Perform protein isolation by SDS PAGE.
- Enzyme kinetics

Lab. Course 3

Based on Theory Papers 5, 6

Time: 6 hrs

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Lab. Course 4

Based on Theory Papers 7 and 8

Time: 6 hrs

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School of Studies in Biotechnology  
Semester III  
Scheme of Examination

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<td>Biology of Immune System</td>
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<td>11</td>
<td>Bioprocess Engineering &amp; Technology</td>
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<td>Lab Course 6 (Based on paper 11 &amp; 12)</td>
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School of Studies in Biotechnology  
Semester III  
Paper 9: Genetic Engineering  

M.M. 80

Unit I
1. Scope of Genetic Engineering.
2. Milestones in Genetic Engineering: Isolation of restriction enzymes, DNA sequencing, 
gene synthesis and mutation, detection and separation, cloning, gene expression. Cloning 
and patenting of life forms. Genetic engineering guidelines.
3. Molecular tools and their application: Restriction enzymes, modification enzymes, 
molecular markers.
4. Nucleic acid purification, yield analysis
5. Nucleic acid amplification and its applications

Unit II
1. Gene cloning vectors: Plasmids, bacteriophages, phagemids, cosmids, Artificial 
chromosomes
2. Restriction Mapping of DNA Fragments and Map Construction, Nucleic acid sequencing.
3. cDNA synthesis and cloning: mRNA enrichment, reverse transcription, DNA primers, 
linkers, adaptors and their chemical synthesis, Library construction and screening.
4. Alternative strategies of gene cloning: Cloning interacting genes – Two and three hybrid 
systems. Nucleic acid micro array assay.

Unit III
1. Site – directed mutagenesis and protein engineering.
2. DNA Transfection, Southern blot, Northern blot, Western blot, Primer extension, S1 mapping, RNase protection assay, and reporter assays.
3. Expression Strategies for heterologous genes: Vector engineering and codon optimization, host engineering; expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants
4. Phage display: Technique and applications

**Unit IV**

2. T – DNA and transposon tagging: Role of gene tagging in gene analysis, t – DNA and transposon tagging, Identification and isolation of genes through T – DNA or transposon; Targeted gene replacement, Chromosome engineering.

**NOTE:** Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

**Books:**

List of Practicals:-

1. Extraction of DNA from *E.coli*. Bacteria.
2. Estimation of bacterial DNA by Spectrophotometer methods.
4. Hot phenol method for preparation of total cellular RNA from *E.coli*.
6. Restriction digestion of DNA with restriction enzymes.
7. Ligation of DNA
8. Isolation of plasmid DNA from *E.coli*.
9. DNA amplification by PCR

School of Studies in Biotechnology

Semester III
Paper 10: Biology of immune system

M.M. 80

Unit I
1. Introduction – Phylogeny of immune system, innate and acquired immunity, Clonal nature of immune response.
2. Organization and structure of lymphoid organs.
4. Antibody structure and function; antibody engineering
5. Antigen – antibody interactions

Unit II
1. Major histocompatibility complex
2. BCR & TCR, generation of diversity.
3. Complement system.

Unit III
1. Regulation of immune response – Antigen processing and presentation, generation of humoral and cell mediated immune responses; Activation of B – and T – lymphocytes;
cytokines and their role in immune regulation; T – cell regulation, MHC restriction; Immunological tolerance.
3. Hypersensitivity, Autoimmunity.

Unit IV
1. Transplantation: General concept and Application
2. Immunity to infectious agents (intracellular parasites, helminthes and viruses), AIDS and other immunodeficiencies.
3. Hybridoma Technology and Monoclonal antibodies

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-
7. Abul K. Abbas, Andrew H. Lichtman, & Shiv Pillai; Cellular and Molecular immunology; Elsevier Inc
List of Practical’s:-

1. Enumeration of WBC in blood sample.
2. Preparation of a blood smear and differential blood count.
3. To separate serum from the given blood sample.
4. To determine Albumin Globulin ratio in given serum sample.
6. Isolation of Immunoglobulin.
7. Separation of serum protein by SDS PAGE.
8. Detection of class specific Antibody by Double Diffusion method.
9. Observe Ag-Ab interaction by Immunoelectrophoresis.
10. Observe Ag-Ab interaction by counter current Immunoelectrophoresis.
11. Study of Agglutination reaction
12. Study of ELISA technique.

School of Studies in Biotechnology
Semester III
Paper 11: Bioprocess Engineering & Technology

Unit I
1. Introduction to Bioprocess Engineering.
2. Kinetic of microbial growth and death
4. Media for industrial fermentation
5. Air and Media Sterilization

Unit II

Unit III
1. Downstream processing: Introduction, Removal of microbial cells and solid matter, foam reparation, precipitation, filtration, centrifugation, cell disruption, liquid – liquid

2. Whole cell Immobilization and their industrial applications.

Unit IV

1. Industrial production of chemicals: Alcohol (ethanol), Acids (citric acetic and gluconic), solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycins, tetracycline), Amino acids (lysine, glutamic acid), Single cell protein. Use of microbes in mineral beneficiation and oil recovery.

2. Introduction to food technology: Elementary idea of canning and packing, Sterilization and pasteurization, of food products, technology of typical food/food products (bread, cheese, idli), Food preservation.

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-


List of Practical’s:-

1. Isolation and identification of microorganisms from industrial waste water.

2. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism (Bacteria and Fungi).

4. To study the production of citric acid by \textit{Aspergillus niger} and also qualitative and quantitative test.

5. To study the bacterial growth curve.

6. To study the fungal growth curve.

7. Enzyme kinetics

8. Bio-ethanol production

School of Studies in Biotechnology
Semester III
Paper 12: Environmental Biotechnology

Unit I
1. Environment: Basic concepts and issues.
2. Environmental Pollution: Types of pollution, Methods for the measurement of pollution; Methodology of environmental management – the problem solving approach, its limitations.
3. Air pollution and its control through Biotechnology

Unit II
2. Microbiology of waste water treatments, aerobic process: Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds.

Unit III
1. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries, Bioremediation
2. Xenobiotics in Environment – Ecological considerations, oil pollution, surfactants, pesticides.

**Unit IV**
1. Biopesticides in integrated pest management.
2. Solid wastes: Sources and management (composting, wormiculture and methane production).
3. Global Environmental Problems: Ozone depletion, UV – B, green house – effect and acid rain, their impact and biotechnological approaches for management.
4. Role of National organization in Biotechnology.
5. IPR.

**NOTE:** Each theory paper will have five questions of equal marks, First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

**Books:-**
List of Practical’s:-

- To determine the total dissolved solids of water (TDS).
- Determination of dissolved oxygen (DO) of water.
- Determination of chemical oxygen demand (COD) of water.
- Determination of biochemical oxygen demand (BOD) of water.
- To screen the antagonism between *Trichoderma* sp. and *Curvularia* sp.
- Determination of effect of fungicide on the growth of fungi (*Trichoderma* sp.).
- Effect of fungicide on the antagonism between *Trichoderma* sp. and *Curvularia* sp.
- To determine the Most Probable number (MPN) of a given water sample.

Lab. Course 5

Based on Theory Papers 9, 10

Time: 6 hrs 

<table>
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<th>Description</th>
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<td>Experiment based on Theory paper 9 (one major &amp; one minor)</td>
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<tr>
<td>Q.2</td>
<td>Experiment based on Theory paper 10 (one major &amp; one minor)</td>
<td>30</td>
</tr>
<tr>
<td>Q.3</td>
<td>Spotting based on Theory papers</td>
<td>10</td>
</tr>
<tr>
<td>Q.4</td>
<td>Viva Voce.</td>
<td>10</td>
</tr>
<tr>
<td>Q.5</td>
<td>Sessional</td>
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Total Marks – 100
Lab. Course 6

Based on Theory Papers 11 and 12

Time: 6 hrs

Total Marks – 100

Q.1 Experiment based on Theory paper 11 (one major & one minor) 30
Q.2 Experiment based on Theory paper 12 (one major & one minor) 30
Q.3 Spotting based on Theory papers 10
Q.4 Viva Voce. 10
Q.5 Sessional 20

School of Studies in Biotechnology

Semester IV

Scheme of Examination

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<td>14</td>
<td>Advanced techniques in Biotechnology</td>
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<tr>
<td>15</td>
<td>Animal Biotechnology</td>
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<td>16</td>
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School of Studies in Biotechnology

Semester IV

Paper 13: Basic Concept of Bioinformatics and Nanobiotechnology

Unit – I
Bioinformatics: Introduction, History, Scope of Bioinformatics, Biotechnology and Bioinformatics, BTIS network in India, Bioinformatics tools, Sequence and Nomenclature, Application of Bioinformatics

Unit – II
Types of Sequences - Genomic DNA, cDNA, ESTS, GSTS, Organelle’s DNA; Biological database, Biological database: Introduction, primary, secondary and tertiary biological database; Information sources with special reference to NCBI, EMBL, DDBJ, Gene bank

Unit-III
Cheminformatics, Pharmacogenomics, Genomic mapping, Microarray technology, Bioinformatics in Drug discovery, Human Genome Project

Unit-IV
Nanobiotechnology: General Introduction, Nanotechnology and Nanobiotechnology; Nanoscale; Nanomicroorganisms – Nanovirus, Nanobacteria; Application of Nanobiotechnology

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:-


**List of Practical:**

1. To extract protein / nucleotide database of phosphoprotein P of *Swine parainfluenza virus 3*

2. To find out and study the human nucleotide sequence records associated with cancer

3. To find out the location of particular target gene on human chromosome map

4. To study the future and scope of BLAST in Biotechnology research

5. To study how to develop primer (F+R) from given nucleotide sequences

**School of Studies in Biotechnology**

**Semester IV**

**Paper 14: Advanced techniques in Biotechnology**

**M.M. 80**

**Unit I**

1. Principles and application of: Microscopy, Centrifugation, Chromatography, Electrophoresis, HPLC.
2. Principles and application of: Colorimetry, Spectrophotometry and densitometry
3. RIA and autoradiography in biology, ELISA
Unit II

1. Methods in Microbiology – Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition; Types of culture media: defined and undefined media, selective and differential media, minimal and enrichment media; Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms.
2. Principles and application of Thermocycler

Unit III

1. Principles and application of DNA micro array
2. Fluorescence spectroscopy
3. NMR and X-ray diffraction

Unit IV

1. Principles and application of Cytophotometry
2. Flow cytometry
3. Southern, Northern, and Western Blotting.
4. DNA sequencer

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Reference Books:-

2. Upadhya and Upadhya: Biophysical Chemistry.
4. Anthony J.F. Griffiths, William M. Gelbart, Richard C. Lewontin and Jeffrey H. Miller; Modern Genetic Analysis; Publisher: W. H. Freeman
5. Ralf Pörtner; Animal cell biotechnology: methods and protocols; Humana Press
List of Practical:-

1. Preparation of different culture media for culture of various microorganisms, like – Bacteria, Fungi, Yeast, Actinomycetes, Algae, etc
2. Perform the various culture techniques for microbial culture
3. Perform various laboratory techniques, like – centrifugation, chromatography, spectrophotometery, electrophoresis, etc.
4. Pure culture techniques of microbes from various sources
5. Perform the advance biotechnological techniques, like – ELISA, PCR, Southern blotting, etc.

School of Studies in Biotechnology

Semester IV

Paper 15: Animal Biotechnology

Unit I
1. Animal cell: Structure and organization
2. Equipments and materials for animal cell culture
3. Primary and established cell line cultures.
4. Constituents of culture media and their application
5. Application of animal cell culture

Unit II
1. Biology and characterization of the cultured cells, measuring parameters of growth
2. Basic techniques of mammalian cell culture in vitro; disaggregating of tissue and primary culture; maintenance of cell culture; cell separation
3. Scaling - up of animal cell culture.
4. Cell synchronization: Cell growth stages
5. Cell cloning: Basic techniques for cell cloning
6. Cell transformation: Characteristics of transformed cells

Unit III
1. Stem cell cultures, embryonic stem cells and their applications.
2. Cell culture based vaccines: General introduction, Vaccines for Malaria and AIDS
3. Somatic cell genetics.
4. Ethical issues in relation to animal biotechnology

Unit IV
1. Transgenic animals: Mice, Sheep, Birds and Fish
2. Apoptosis.
3. Tissue engineering: Elementary idea of tissue engineering, Artificial skin, artificial cartilage

NOTE: Each theory paper will have five questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit-wise.

Books:
3. Animal Cell Culture Techniques, M Clynnes.

Practicals:
1. Extraction and estimation of DNA from blood
2. Extraction and estimation of DNA from spleen
3. Extraction and estimation of DNA from muscle tissue
School of Studies in Biotechnology
Semester IV
Paper 16: Functional Genomics & Proteomics

M.M. 80

UNIT – I
- Genomics – General introduction, Types of genomics, Structural genomics, Functional genomics, Comparative genomics, Genome sequencing, Genome mapping, Future of genomics
  - Plant Genomics
  - Genomics in medicine: Gene medicine, Disease models, The impact of genomics on medicine

UNIT – II
- Human genome project, Methods of gene sequencing: - Random shotgun sequencing, EST. Whole genome shotgun sequencing, Genome prediction and gene counting, Single nucleotide polymorphisms (SNPs)
  - Comparative Genomics: Sequence comparison, Comparative genomics in bacteria, Comparative genomics in Eukaryotes & organelles

UNIT – III
- Proteomics – General concept, Gene and Protein, Types of proteomics, Structural proteomics and Functional proteomics
  - Methods of study the protein, Protein arrays, protein chips, System biology, Practical application of proteomics

UNIT – IV
- Future of proteomics, Analysis of protein structure,
  - Protein-Protein interactions, Protein database, Global analysis of protein, Expression analysis and characterization of protein

Books:
- Principles of Gene Manipulation and Genomics; by Primrose & Twyman
- Gene cloning and DNA analysis: An introduction; by TA Brown
- Genomics, Proteomics & Vaccines; by Guido Grandi
- Genomics: Application in Human biology; by Primrose & Twyman
- Introduction to molecular Genetics and Genomics; JBH Publication
- Proteomics by Timothy Palzkill
- P.K. Gupta: Biotechnology and Genomics. Rastogi Publication
### Lab. Course 7

**Based on Theory Papers 13, 14**

**Time:** 6 hrs  
**Total Marks – 100**

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### Lab. Course 8

**Based on Theory Papers 15 and 16**

**Time:** 6 hrs  
**Total Marks – 100**

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## Project

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<td>Viva-voce</td>
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1. A student of IV semester will have the option to opt for project work in lieu of four theory papers and two lab courses provided he/she secures at-least 65% or more marks in aggregate in semester I and II.

2. The project has to be carried out in recognized national laboratories or UGC recognized universities. No student will be allowed to carry out project in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur.

3. The valuation of all the projects will be carried out by the external examiner and HoD of UTD or its nominee at the UTD Centre.

The project work should be related to the field of Biotechnology. The project report should include declaration by the candidate, certificate by the supervisor, acknowledgement, title and introduction along with the following points:

1. Introduction
2. Review of Literature
3. Materials and Methods
4. Results & Discussions
5. Summary
6. Bibliography