M.Sc. Biotechnology
Kumaun University .Nainital
Curricula/Syllabi

Semester I

1S1 Modern Concepts in cell Biology
1S2 Biochemistry
1S3 Molecular Biology
1S4 Computer Applications and Biostatistics
Practical

Semester II

2S1 Molecular Genetics
2S2 Genetic Engineering
2S3 Biophysical Techniques
2S4 Environmental Biotechnology
2S5 Bioprocess Engineering and technology
Practical

Semester III

3S1 Plant Biotechnology
3S2 Genomic and Functional Genomics
3S3 Immunology and Immunotechnolgy
Elective paper
3S4 Aquatic Biotechnology
3S4 Enzyme Biotechnology
3S4 Medical and Animal Biotechnology
Practical

Semester IV
Project /Thesis work

M.Sc. Biotechnology
Semester I

1S1 Modern concepts in cell Biology (Theory)

1. Evolution of Cell: Concepts of macromolecules, Synthesis and formation of ancestral cell, Development of Ancestral cell to Eukaryotic and Prokaryotic cell.

2. Plasma membranes and cellular transport: Structure of unit membranes and association of proteins and carbohydrates with the lipid bilayers ,intracellular and extracellular transportation, exocytosis and endocytosis, ion transport, Na+/K+ATPase,liposomes.

3. Cellular compartments and intracellular sorting of proteins: endoplasmic reticulum and lysosomes,peroxisomes,synthesis and sorting of proteins(Lysosomal proteins, membranes proteins, secretory proteins).Site of synthesis and transport of lipoprotein, glycolipids and glycoproteins, lipid synthesis and transport .

4. cell nucleus: Organization of nucleus and nuclear membrane, nuclear transport , structure and organization of chromation .

5. Cytosekeleton: Actin filaments and cell cortex, cilliary movements and cytoplasmic microtubules and intermediate filaments.

6. Cell Signaling: Endocrine , Exocrine and synaptic signaling ,surface and intracellular receptors, G proteins and generation of secondary messengers, mode of action of CAMP and Ca++ calmodulin, Target cell adaptation , cellular responses to environmental signals in plants and animals.

7. Cell growth and Division: cell cycle, cell division control and transformation, growth factors, genes for control, mechanism of cell division, cell adhesion and cell junctions, extracellular matrix, cellular differentiation.

8. Biology of cancer.

M.Sc. Biotechnology
Semester I

1S1 Modern concepts in cell Biology (practical)

1. Microscopy
2. Microtomy
3. sub cellular fractionation and marker enzymes.
4. histochemical techniques
5. Mitosis and meiosis

M.Sc. Biotechnology
Semester I

1S2 Biochemistry (Theory)

1. Water: Weak interactions in aqueous system ,Ionization of water, pH, pKa, Titration curves of weak acids, Buffers, Henderson- Hasselbalch equation ,Water as a reactant.

2. Carbohydrates: Mono- Di- and polysacccharids, Optical isomerism,Structure of Carbohydrates , Glycolysis, Gluconeogenesis, pentose phosphate pathways , Citric acid cycle.

3. Lipids: Classification and structural analysis of fatty acids, Glycerols,Waxes, Glycolipids, Phospholipids, Sphingolipids, Sterols, Lipoproteins,B-oxidtion, Biosynthesis of cholesterol and Fatty acids.

4. Proteins:Amino acids as building blocks of proteins and their chemical properties , pI and pKa values, Primary, Secondary, Tertiary and Higher order structure of proteins, Protein Sequencing, Ramchandranplot,conjugatedproteins, Glycoproteins,Liproteins,Haemoproteins.

5. Enzymes: introduction , Classification and Mechanism of action, concept of activation energy, Enzyme Kinetics-Michaelis-Menten and Lineweaver- Burk equation for single enzyme substrate catalyzed reactions, Units of enzyme activity, Turnover number.

6. Nucleic Acids: Biosynthetic pathways of purines and pyrimidines Degradation pathways.

7. Bioenergetics: High energy molecules and energy concepts, Group Transfer, Concepts of Entropy,Enthalpy,and Free energy,oxidation and reduction reactions, Electron transport chains, Oxidative phosphorylation, Photosynthesis.

8. Metabolic regulations including the role of hormones.

M.Sc. Biotechnology
Semester I

1S2 Biochemistry (Practical)

1. Titration of Amino Acids.
2. Colorimetric determination of pKa.
3. Model building using space filling/ball and stick models.
4. Qualitative and quantitative estimation of Proteins and Sugars
5. Isolation, Purity determination and Quantification of cholesterol, DNA and RNA
6. Analysis of oils-Iodine number, saponification value and Acid Number.
7. UV, Visible, Fluorescence and IR spectroscopy and Absorption spectra.
8. Separation techniques- Centrifugation, Chromatography (Gel Permeation, lon exchange, TLC, etc.), and Electrophoresis (SDS-PAGE and Agarose gel electrophoresis).

M.Sc. Biotechnology

COURSES

1ST Semester

1S3 Molecular Biology : Theory

1. Introduction to Molecular Biology, Structure and organization of genomes.
2. Law of DNA constancy, Cot curve and C value paradox, DNA renaturation kinetics and Tm value determination and interpretation, Repetitive DNA, Satellite DNA,Selfish DNA.
3. DNA as a genetic material, DNA replication circle process, DNA damage and repair, Mechanisms including recombinations.
4. Transcription: Prokaryotic and Eukaryotic RNA polymerases, Protin Factors, Mechanism of Transcription, RNA Processing, Formation of mRNA, rRNA and tRNAin prokaryote and eukaryotes.
5. Genetic code, Wobble hypothesis, Protein synthesis in prokaryotes and eukaryotes, Post translational modifications and protein targeting, Genetic codes in mitochondria and ciliated protozoan.
6. Regulation of Gene Expression in prokaryotes and eukaryotes, Operon Concept Positive and Negative Regulation, tac, ara and trp operons.

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Semester I

1S3 Molecular Biology (Practical)

1. Isolation of genomic DNA.
2. Isolation of plasmid DNA.
3. Isolation of total RNA.
4. Purity determination and quantification of DNA and RNA
5. Northern Blotting
6. Labelling of DNA by using non-radioisotopes.
7. Cleavage of DNA with restriction enzyme and electrophoreses of fragments.

M.Sc. Biotechnology
Semester I

1S4 Microbiology (Theory)

1. The Milestones in Microbiology: The discovery of microbial world by Antony van Leeuwenhocek, The controversy over spontaneous generation, Golden age of Microbiology, Scope and importance of Microbiology in Biotechnology.

2. Cell Structure and Functions: Prokaryote cell, size, shape and arrangement of bacterial cells, Cell wall, External and Internal structures to the cell wall.

3. Methods in Microbiology: Pure culture techniques, The theory and practice of sterilization, Principles of microbial nutrition, Construction of culture media, Enrichment of culture techniques for isolation of chemotrophs and photosynthetic microorganisms, Pure culture and its maintenance.

4. Microbial Growh: The definition of growth, mathematical expression of growth curve measurement of microbial growth, Generation time, Synchronous growth,Batch culture, Continuous culture and Fed-batch culture.

5. Microbial diversity and Systemic: Salient features of extremophiles (halophiles, thermophiles, psychrophiles) archaeabacteria, eubacteria,Gram-positive and Gram-negative bacteria, Aerobic and Anaerobic bacteria, Photorophic and Gliding bacteria, Prosthecate and budding bacteria.

6. Viruses: Introduction to virology, General characteristics of viruses, Structure of Bacteriophages (lytic and temperate).

7. Clinical Microbiology: Disease reservoirs, Epidemiological terminologies, Infectious diseases transmission, Respiratory infections caused by bacteria and viruses, Introduction to some common bacterial (Leprosy, Typhoid, Tuberculosis and Gas Gangrene) and viral (Rabies, Influenza, Herpes and AIDS) diseases.

M.Sc. Biotechnology
Semester I

1S4 Microbiology (Practical)

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.
4. Growth curve, Measurement of bacterial population by turbidometry and serial dilution methods, Effect of temperature, pH, carbon and nitrogen sources on growth.
5. Microscopic examination of bacteria, yeast and moulds and study of organisms by gram stain, acid fast stain and staining of spores.
6. Assay of antibiotics and demonstration of antibiotics resistance.
7. Bacterial transformation.
8. Biochemical characterization of selected microbes.

M.Sc. Biotechnology
Semester I

1S5 Computer Applications and Biostatistics (Theory)

1. Brief description and Tabulation of data and its graphical representation.

2. Measure of central tendency and description: Mean, Mode Median, Range, Standard deviation, Variance, idea of two types of errors and level of significance, Tests of significance (F and T test), Chi-Square tests.

3. Simple linear regression and Correlation.

4. Introduction of digital computers: Organizations, Low-Level and High-level languages, binary systems.

5. Flow charts and Programming techniques.

6. Introduction to data structures and data base concepts, Introduction to internet and its applications.

7. Introduction to MS-office software covering word processing, spread sheets and presentation software.

8. Introduction to Harvard graphics/Sigma plotter.

9. Computer oriented statistical techniques: Frequency table of single discrete variable. Bubble sort, Computation of mean, Variance and standard deviations, T-test, Correlation coefficient.

10. Bio-informatics- Internet access and using web search engines to access biological databases, sequence, structure and strain database, Secondary and sequence analysis of DNA, RNA and proteins.

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Semester I

1S5 Computer Applications and Biostatistics (Practical)

1. Use of Internet to assess standard databases.
2. Search for sequence homologies and designing of experimental parameters using internet.
3. Making of flowcharts for given problem.
4. Preparation of Power-Point slides for presentation.

M.Sc. Biotechnology
Semester II

2S1 Molecular Genetics (Theory)

1. Concepts of Genetics: Mendel and experimental approach of genetics, Mendel rediscovered, Molecular explanation of Mendel's Laws, Extension of Mendel's work, Mitochondrial and Chloroplast DNA.

2. Mutations: Molecular basis, Physical and Chemical mutagens, Types of Mutations, Detection of Mutations.

3. Plasmids: Different type of Plasmids and their properties, Detection, purification and transfer of Plasmid DNA Replication, Amplification of Plasmids, Incompatibility and copy number.

4. Bacterial Conjugation: Hfr transfer, F transfer, Rec A proteins and their functions.

5. Transformation: Competent cells and DNA uptake, Molecular mechanism of transformation, Complementation.

6. Transduction: Generalized and Specialized transduction.

7. Transposons: Insertion sequences, Composite Transposons, Transposition and excision of transposons, Genetic phenomenon mediated by Transposons in Bacteria.

8. Molecular Genetics of Lambda: The Genome Packaging, replication and recombination, Regulation of Lytic and Lysogenic Cycles.

M.Sc. Biotechnology
Semester II

2S1 Molecular Genetics (Practical)

1. Preparation of food media for Drosophila culture.
2. Giant chromosome studies.
3. Induction of mutations in fruit flies.
4. Isolation of bacterial genomic DNA.
5. Mapping of polytene chromosomes.
6. Isolation of DNA from fruit flies.

M.Sc. Biotechnology
Semester II

2S2 Genetic Engineering (Theory)

1. Introduction to genetic engineering.

2. Enzymes used in manipulation of DNA and RNA, Restriction endonucleases, DNAses, RNAses, Alkaline phosphatase, Ligases Polynucleotide kinases.

3. Isolation of chromosomal and plasmid DNA, RNA, Phage derivatives, Cosmid and Phagmid Vectors, Cloning and expression vectors.

4. Preparation ofgenomic and cDNA libraries rDNA transfer methodologies. Cloning of genes in microbes, plants and animal systems.

5. Southern, Northern and Western blotting and hybridization techniques, Radioactive and non-radioactive labelling of proble.

6. Expression of cloned genes in prokaryotes and eukaryctes.

7. Principle and application of PCR, Site-directed mutagenesis and protein engineering, Gene targeting Human genome project: History and scope.

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Semester II

2S2 Genetic Engineering (Practical)

1. Preparation of Competent cell.
2. Transformation of bacterial cells.
3. Isolation of plasmid DNA and restriction digestion analysis.
4. Ligation of foreign DNA and gene cloning.

M.Sc. Biotechnology
Semester II

2S3 Biophysical Techniques (Theory)

1. Centrifugation: Basic principles of sedimentation, Peiparative and analytical centrifuges and their use, Ultracentrifugation, Differential, rate zonal and isopycnic separations.

2. Spectroscopic techniques: UV and Visible light absorption spectroscopy, Spectrofluorometry, CD and ORD, Atomic spectroscopy (Absorption and emission). Infrared spectroscopy, Raman Scattering, Application of FT-IR in the study of biomolocules, Nuclear Magnetic Resonance (NMR) spectroscopy,

and EPR, Principles and application in biological sciences, Mass spectroscopy and its applications in biological science.

3. Chromatography: Basic principles of Chromatographic separation, Distribution coefficient, Adsorption and Partition chromatograpjy i.e. Column and Thin layer chromatography, Paper chromatography, Gas liquid, Exclusion, lon Exchange, Affinity and High performance Liquid (HPLC) chromatography.

4. Electrophoresis: Theory and application of electrophoresis, SDS and NATIVE PAGE electrophoresis, lsoelectric Focusing, Two Dimensional Polyacrylamide Gel Electrophoriesis Western Blotting, Agarose Gel Electrophoresis of DNA and RNA, Pulse Field Gel Electrophoresis ,Capillary Electrophoresis.

5. Handing of radioisotopes: X-Ray crystallography, Principle and application light, Phase Contrast, Fluorescence, Scanning and Transmission Electron Microsopy.

M.Sc. Biotechnology
Semester II

2S3 Biophysical Techniques (Practical)

1. Two dimensional chromatography of amino acids.
2. T.L.C. of lipids.
3. Calculation of void volume of a column.
4. Gel Filtration chromatography.

5. Isolation of plasmid DNA from E. coli.
6. Agarose gel electrophoresis of isolated plasmid DNA.
7. Isolation of genomic DNA from E. coli.
8. Extraction and purification of protein from plant and animals.
9. SDS-PAGE of BSA and extracted proteins.
10. Quantitative estimation of enzyme activity.

M.Sc. Biotechnology
Semester II

2S4 Environmental Biotechnology (Theory)

1. Bioremediation,Bioaccumulation, Biomagnification, Bioventing and Biomanipulation.

2. Parameters and objectives of waste water treatment, Aerobic treatments of waste water including trickling filters, Rotating

biological contractors, Fludized bed reactors, Activated sludge, Oxidation ponds.

3. Anaerobic treatment of wastewater, Anaerobic contact digestors, packed bed reactors and anaerobic baffled digestors Treatment methods for removal of suspended solids, nutrient, oil and grease toxic compounds and dissolved inorganic substances from wastewater.

4. Biomineralzation: Microbial leaching and biomining, Use of Microbes in petroleum extraction, metals from solutions, Desulfurization of coal, Biodegradation of chlorinated hydrocarbons and xenobiotic compounds, pesticides, soil toxic and other industrial effluents, solid waste management.

5. Rural biotechnology with special reference to biofertilizers, biocomposting, organic farming, vermiculture.

6. Molecular approach to environment arrangement, degradative plasmids, Xenobiotics, Biological detoxification.

7. Ozone depletion, UV radiation, Green house effect and Acid rain-their impact and biotechnological approaches for management.

M.Sc. Biotechnology
Semester II

2S5 Bioprocess Engineering and Technology (Theory)

1. Introduction to bioprocess engineering.

2. Bioreactors including specialized bioreactors (pulsed,fluidized, photobioreactors etc).

3. Isolation, Preservation and maintenance of industrial microorganisms.

4. Kinetics of microbial growth and types of fermentation process: Analysis of fed-batch and continuous bioreactions,biotransformation, Stability of microbial reactions, Analysis of mixed microbial populations.

5. Downstream processing Introduction, Removal of microbial cells and solid matter, Foam separation, Precipitation, Filtration, Centrifugation, Cell disruptions, liquid extraction, Chromatography, Membrance process, Dying an crystallization, Effluent treatment: DOC and COD treatments and disposal of effluents.

6. Enzyme and Whole cell immobilization and their industrial applications.

7. Industrial production of chemicals: Alcohol (ethanol), acids (citric acid, acetic acid and gluconic acid), Solvents (glycerol, acetone, butanol), Antibiotics (Penicillin, streptomycin, tetracycline), Aminoacids (lysine, glutamic acid), Single cell protein and Vaccines.

M.Sc. Biotechnology
Semester III

3S1 Plant Biotechnology (Theory)

1. Introduction: General laboratory requirements for Plant Tissue Culture Composition, preparation and choice of culture media.

2. Callus Culture: Choice of explant, Preparation and sterillzation of explant, Callus induction, subclture and maintenance.

3. Suspension Cultures: Initiation of suspension cultures from callus, Isolation of suspensions of leaf mesophyll cells, Subculture and growth measurement of supension cultures.

4. Production and uses of Haploids: Anther, Pollen, Ovule culture, Mutant selection in vitro, Use of genetic markers for identifying haploids.

5. Plant and cell requirements for Protoplast isolation, Maintenance; Plant regeneration from protoplast, Somatic hybridization, Selection for somatic hybrid plants, Transformation of plants using protoplast systems.

6. Modes of plant regeneration, Mecropropagation of Plants, Clonal fidelity of micropropagated plants, Explant factors, Nutrient medium factors, Somatic embryogenesis, Organogenesis, Synthetic seeds, Production of virus free plants; Somaclonal variations.

7. Principles and applications of cryopreservation.

8. Secondary product formation by cell suspension cultures: Culture media and environmental conditions supporting secondary product formation, Biotransformation of terpenoids, alkaloids and steroids by suspension and immobilized plant cell cultures.

9. Production and application of transgenic plants: Methods of gene transfer.

M.Sc. Biotechnology
Semester III

3S1 Plant Biotechnology (Practical)

1. Preparation of media.
2. Surface sterilization
3. Organ culture.
4. Callus culture.
5. Protoplast isolation and culture.
6. Anther culture and production of haploids.
7. Cytology of regenerated plants.

M.Sc. Biotechnology
Semester III

3S2 Genomic and Functional Genomics (Theory)

1. DNA microarray: Printing of oligonucleodides and PCR products in glass slides, nitrocellulose paper. Genome analysis for global patterns of gene expression using fluorescent- labeled cDNA of end labeled RNA probes. Analysis of single nucletide polymorphism using DNA chips.

2. Proteome analysis: Two-dimensional separation of total cellular proteins, Protein microarrays, Advantage and disadvantage of DNA and protein microarrays.

3. Mapping of genome: Genetic and physical maps, Physical mapping and map-based cloning, Choice of mapping population, simple sequence repeat loci.

4. Southern and Florescence in situ hybridization for genome analysis, Molecular markers ingenome analysis: RFLP, RAPD and AFLP analysis.

5. Gene replacement and correction gene therapy, Somatic and germline therapies, various methods for transport of recombinant genes to target cells, Antisense therapies, Limitations and applications of gene therapies.

6. Biosafety, Bioethica and IPR issues related with recombinant DNA technologies and Genetically modified organisms.

M.Sc. Biotechnology
Semester III

3S2 Genomic and Functional Genomics (Practical)

1. Southern blotting.
2. RAPD analysis.
3. AFLP analysis.
4. Fluorescence in sity hybridization (non-isotopic).
5. Chromosomal analysis (Eukaryotes).

M.Sc. Biotechnology
Semester III

3S3 Immunology and Immunotechnology (Theory)

1. Cells and organs of the immune system including B-cells, t-cells Antigen presenting cells, Natural killer cells, Haemopoiesis. Innate, acquired, active and passive immunity, Cell mediated and humoral immunity, Antibody dependent cell mediate cytotoxicity.

2. Nature, function and diversity of antibody and antigens. Fine structure of immunogloblins and T-cells receptors, Complement systems.

3. Major, histo-compatibility complex (MHC), MHC restriction antigen presentation, Lymphokines regulation of immune response, immunlogical tolerance.

4. Classical serological reaction involving agglutination and precipitation reactions Immunodiffusion assays, Macini and Ouchterlony methods, Immunoelectrophoresis, ELISA, RIA, Antibody-antigen interaction.

5. Conventional and synthetic vaccines, Auto-immunity, Hypersensitivity, Tumour immunity, Concept of idiotypes and anti-idiotypes, Immunodefficiency disease, SCID, AIDS.

6. Hybridoma technology and Production of monoclonal antibodies and their applications.

M.Sc. Biotechnology
Semester III

3S3 Immunology and Immunotechnology (Practical)

1. Preparation of human blood smear and identification of cells.
2. Determination of blood groups.
3. Determination of Rh antigen.
4. Estimation of antiserum by Mancini method.
5. Antiserum specificity determination.
6. Antiserum titer determination by ELISA.
7. DOT ELISA for the presence of specific antigen.
8. Immunization, Collection of Serum.
9. Immunoelectrophoresis.
10. Immunodiagnostics (Demonstration using commercial kits).

M.Sc. Biotechnology
Semester III
(Elective Paper)

3S4 Aquatic Biotechnology (Theory)

1. Introduction, Present scenario of aquatic biotechnology, Scope and importance.

2. Ecology of aquaculturable environment, Planktons and their relationship with aquacltute. Nutritional biotechnology for fishes.

3. Fish genetics; Polyploidy in fishes, Gynogenesis and Androgenesis, Molecular markers and their application in fisheries, Fish breeding and hybridization.

4. Fish pathology and genotoxicity caused by microbial disease and aquatic contamination, Vacciness and aquaculture, Probiotics (Prospects in aquatic biotechnology).

5. Transgenesis; Principle and production of Transgenic fishes, Genetically modified fishes for better growth and development, Therapeutic use, Disease resistance, Physico-chemical resistance in fishes.

6. Aquafarming: Basic introduction to culture techniques, Modern approach of composite fish culture, Integrated fish farming, Pearl and prawn culture.

7. Hormones and modern techniques of fish seed production, Brief account of GnRH,Ovaprim, Ovatide and induced breeding.

M.Sc. Biotechnology
Semester III
(Elective Paper)

3S4 Enzyme Biotechnology (Theory)

1. History and scope of enzyme and enzyme technology, Enzyme nomenclature, Activity units.

2. Enzyme cofactors: Structure and biological functions, Concepts of active sites and enzyme substrate complex, Active site mapping, Factors associated with catalytic efficiency, Proximity orientation, distortion and strain.

3. Enzyme kinetics: Michaelis-Menten equation, Methods to determine Km and Vmax with their merits and demerits, Briggs-Haldane steady state approach, King-Altaman patterns.

4. Arrhenius equation, Determination of energy of activation, Bisubstrate reaction kinetics including Random, Ordered and Ping-Pong mechanism.

5. Methods of immobilization of enzymes, Physical adsorption, covalent binding, Entrapment and microencapsulation, Kinetics of immobilized enzymes, Effect of solute partition and diffusion on the kinetics of immobilized enzymes.

6. Use of enzymes in analysis, Biosensors-calorimetric, Potentiometric, Amperometric, Optical piezoelectric biosensors and Immunosensors.

M.Sc. Biotechnology
Semester III
(Elective Paper)

3S4 Medical and Animal Biotechnology (Theory)

1. Concepts in vaccine development, selection of target antigens for vaccine development, identification and cloning of genes for target antigens. Whole organism and subunit vaccine Vaccines development for cholera, streptococcal infection, hepatitis B, Poliomyelitis and other bacterial and intracellular parasites.

2. Production of therapeutic agents such as antibiotics, monoclonal antibodies, DNA vaccine and development of various modes of EIAs/RIAs and other molecular diagnostics tools.

3. Development and production of transgenic animals such as sheep, mice, pig for the production of therapeutics, Transfection methods. Embryonic stem cell transfer, Targeted gene transfer, Detection of transgenic and transgene function.

4. Liquid phase and solid phase immunofluorescent assays. Direct and indirect FIA. Immunoprecipitation studies for characterization

of antigen followed by autoradiography. Western blotting, Southern and northern blotting for characterization of antigens. Radiommunoassays of sex hormones.

5. Initiation of animal cell cultures, preparation and Sterilization of substrate and medium, Isolation of explants, Sub culturing, Evolution and maintenance of cell lines.

6. Stem cell, their applications, Cell culture based vaccines, Cell death, Measurement of cell death.

Project

The Project will be based upon research and actual bench work. It will begin from the 3rd semester and will continue through the fourth one. The project report will be submitted at the end of the 4th semester and evaluated.

Student Seminar

a) Each students under the supervision of a faculty member will deliver seminars. The topic will be from an emerging area of Biotechnology or its applications
b) In the fourth semester before submitting project each student will deliver a seminar based upon its project work and it will be assessed by faculty members.

Assignments

Regular assignments will be given to each students during whole semester in each course. All assignments will be evaluated as internal assessment.

Invited lectures from eminent Scientists, Professors, Industrialists and others on recent issues related to the course contents will be organized.