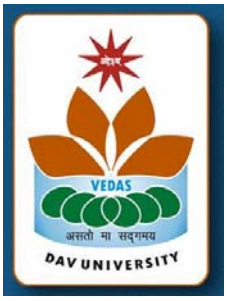
DAV University, Jalandhar
Department of Microbiology



Course Scheme & Syllabus
For
M.Sc. (Hons.) Microbiology
(Programme ID 40)
1st to 4th Semester
Examinations 2015–2016 Session Onwards

Course Scheme Applicable For Admissions in 2015
Total minimum credits required for M.Sc. (Hons.) Microbiology are 96

Scheme of Courses (Program ID 40)
Master of Microbiology

Semester 1

S. No	Course Code	Course Title	Type	L	T	P	Cr
1	MIC531	General Microbiology	Core	4	0	0	4
2	MIC533	Microbial Diversity	Core	4	0	0	4
3	BTY511	Molecular Biology	Core	4	0	0	4
4	BCH524	Principles of Biochemistry	Core	4	0	0	4
5	MIC532	General Microbiology Laboratory	Core	0	0	3	2
6	MIC534	Microbial Diversity Laboratory	Core	0	0	3	2
7	BTY512	Molecular Biology Laboratory	Core	0	0	3	2
8	BCH525	Principles of Biochemistry Laboratory	Core	0	0	3	2
Total							24

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses
Master of Microbiology

Semester 2

S. No	Course Code	Course Title	Type	L	T	P	Cr
1	MIC541	Microbial Genetics	Core	4	0	0	4
2	BTY521	Recombinant DNA Technology	Core	4	0	0	4
3	BCH515	Advanced Concepts in Metabolism	Core	4	0	0	4
4	MIC542	Microbial Genetics Laboratory	Core	0	0	3	2
5	BTY522	Recombinant DNA Technology Laboratory	Core	0	0	3	2
6	MIC540	Research Methodology & Aptitude	Core	4	0	0	4
7	Departmental Elective I						6
Total							26
Departmental Elective Courses (Choose one theory and corresponding laboratory course)							
1	MIC543	Clinical Microbiology	Elective	4	1	0	4
	MIC544	Clinical Microbiology Laboratory	Elective	0	0	3	2
2	MIC545	Soil & Environmental Microbiology	Elective	4	1	0	4
	MIC546	Soil & Environmental Microbiology Laboratory	Elective	0	0	3	2

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses
Master of Microbiology

Semester 3

S.No	Course Code	Course Title	Type	L	T	P	Cr
1	MIC631	Immunology	Core	4	0	0	4
2	BCH501	Bioanalytical Techniques	Core	4	0	0	4
3	MIC632	Immunology Laboratory	Core	0	0	3	2
4	BCH503	Bioanalytical Techniques Laboratory	Core	0	0	3	2
5	MIC701	Project Part I	Core	0	0	0	2
6	MIC630	MSc Seminar 3rd Semester	Core	0	0	0	2
7	Departmental Elective II						6
8	Open Elective I						4
Total							26
Departmental Elective Courses (Choose one theory and corresponding laboratory course)							
1	MIC633	Food & Industrial Microbiology	Elective	4	0	0	4
	MIC634	Food & Industrial Microbiology Laboratory	Elective	0	0	3	2
2	MIC635	Eukaryotic Microbiology	Elective	4	0	0	4
	MIC636	Eukaryotic Microbiology Laboratory	Elective	0	0	3	2

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses
Master of Microbiology

Semester 4

S.No	Course Code	Course Title	Type	L	T	P	Cr
1	BTY642	Genomics, Proteomics and Metabolomics	Core	4	0	0	4
2	BTY643	Genomics, Proteomics and Metabolomics Laboratory	Core	0	0	3	2
3	Open Elective II						4
4	MIC702	Project Part II	Core	0	0	0	8
5	MIC640	MSc Seminar 4th Semester	Core	0	0	0	2
Total							20

L: Lectures T: Tutorial P: Practical Cr: Credits

Course Title: General Microbiology

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC531

Unit A:
History of microbiology. Spontaneous generation *vs.* biogenesis. Germ theory of disease. Discovery of anaerobic life form. Discovery of first antibiotic penicillin. Development of key techniques for isolation and pure culture of microorganisms. History of soil microbiology and enrichment culture techniques. History of medical microbiology and immunology.
Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification system. Difference between three kingdoms.
General characteristics of acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit B:
Bacterial Cellular organization: Cell size, shape and arrangement, outer membrane, lipopolysaccharide, cell wall, inner membrane, capsule, flagella, endoflagella, fimbriae and pili, cytoplasm, ribosomes, mesosomes. Endospores. Effect of antibiotics and enzymes on the cell wall. Sphaeroplasts and protoplasts.
Basics of microscopy and observation of microbes. Light microscopy: bright field microscopy, dark field microscopy, phase contrast microscopy, fluorescence microscopy, transmission electron microscopy, scanning electron microscopy.

Unit C:
Nutritional requirements in bacteria and nutritional categories. Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media.
Physical methods involving heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation to control microbes. Chemical methods involving antiseptics, disinfectants, sanitizers, sterilizers and antibiotics to control microbes.

Unit D:
Asexual methods of reproduction, logarithmic growth of bacterial populations, phases of growth, calculation of generation time and specific growth rate. Diauxic growth. Maintenance of population in exponential phase, synchronous growth, continuous culture, fed batch culture and measurement of growth.
Catabolism vs. anabolism. Energy currency and reducing power of a living cell. Fermentation vs. aerobic and anaerobic respiration.
Bacterial cell division and genes involved in the process.

Course Title: General Microbiology Laboratory

L	T	P	Credit	Marks
0	0	3	2	50

Course Code: MIC532

1. Microbiology Good Laboratory Practices and Biosafety.
2. Study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, light microscope, pH meter, spectrophotometer) used in the microbiology laboratory
3. Preparation of general purpose culture media for bacterial cultivation
4. Sterilization of medium using Autoclave and assessment for sterility
5. Sterilization of glassware using Hot Air Oven and assessment for sterility
6. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
7. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air
8. Use of compound light microscope
9. Motility by hanging drop method
10. Simple staining
11. Negative staining
12. Study of different shapes of microorganisms under microscope.
13. Isolation of pure cultures of bacteria by streaking method
14. Preservation of bacterial cultures by various techniques
15. Gram's staining
16. Acid fast staining
17. Endospore staining
18. Spread plate technique
19. Pour plate technique
20. Estimation of CFU count by spread plate method/pour plate method.

Course Title: Microbial Genetics

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC541

Unit A:
History of DNA structure, from Miescher to Watson and Crick, Building blocks of nucleic acids. Salient features of DNA double helix. Types of DNA.
Types of genetic material. Nucleous, nucleoid and plasmid.
Denaturation and renaturation.
Bidirectional and unidirectional replication. Conservative, Dispersive and semi- conservative and semi- discontinuous replication. Mechanism of DNA replication: Enzymes and proteins involved in DNA replication. DNA polymerases, DNA ligase, primase. Various models of DNA replication including rolling circle and Θ (theta) mode of replication.

Unit B:
DNA repair (Mismatch repair, excision repair, recombination, SOS repair.)
Genotype and phenotype. Understanding of events involved in gene expression (transcription, translation, posttranslational events)
Mutation, variation and evolution. Types of mutation. Mechanism of mutation (spontaneous mutation, chemical mutagen, UV irradiation)
Isolation and identification of mutants (mutation and selection, replica plating, penicillin enrichment, molecular methods)
Phenotype restoration (reversion, suppression, complementation)

Unit C:
Gene organization. Transcriptional control (terminators, attenuators, anti-terminators, Induction and repression). Translational control. Codon usage.
Plasmids, Plasmid replication and stability.

Unit D:
Gene transfer: Transformation, Conjugation (F plasmid), Transduction (general and specialized) Insertion sequence, Transposons, Mechanism of transposition,train development, Generation of variation, Overproduction of primary metabolite, Overproduction of secondary metabolite.
Genetic methods for investigating bacteria (complementation, cross feeding, reporter genes)

Course Title: Microbial Genetics Laboratory

L	T	P	Credit	Marks
0	0	3	2	50

Course Code: MIC542

1. Study of different types of DNA and RNA using micrographs and model / schematic representations
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Isolation of genomic DNA from *E. coli*
4. Isolation of plasmid DNA from *E. coli*
5. Resolution and visualization of DNA by Agarose Gel Electrophoresis
6. Estimation of salmon DNA using UV spectrophotometer (A260 measurement)
7. Preparation of competent cells by chemical method
8. Preparation of competent cells for electroporation
9. Transformation of *Escherichia coli*
10. Transduction of *Escherichia coli* by P1 phage
11. Conjugation mating in *Escherichia coli*
12. PCR amplification of gene from *Escherichia coli* genomic DNA
13. Restriction digestion of DNA
14. Ligation of DNA fragments
15. Blue-white selection cloning of DNA

Course Title: Research Methodology and Aptitude

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC540

Unit A:
System of measurement and scaling. Units for length, area, volume, weight, concentration, temperature and time. Metric system. Imperial system. SI units. Conversion between units. Unit name, symbol and prefixes. Indian and western numbering system.
Atomic weight. Molecular weight. Equivalent weight. Avogadro number. Normality. Molarity. Molality. Understanding of pH scale.
Preparation of solution of known concentration. Stock and working solution. Dilution of solution.

Unit B:
Word processing tools: Introduction to word processing applications. Page layout. Common features, Using font, paragraph, italics, superscript, subscript. Numbering. Inserting symbol, image and table.
Spreadsheet tools : Introduction to spreadsheet applications. Common features, Using formulas and functions. Data sorting. Use of mathematical and statistical formula. Generating charts / graph.
Presentation tools : Introduction to presentation applications. Common features and functions. Customizing page layout and design. Inserting image and table. Preparing and customizing line diagrams. Showing presentation.

Unit C:
Safe web browsing and use of general web search engines. Use of specialized search engines for life sciences. Databases of scientific literature. Searching relevant research and review articles. Citing scientific information resources. Measure of impact of scientific literature. Introduction to biological data bases and their use. Search, collect, process and present the sequence and structure of biologically important macromolecules. Introduction to bioinformatics tools and their scope of use. Using standalone and server based bioinformatics tools.

Unit D:
Meaning, motivation and objectives of research. Types of research. Theoretical vs. experimental and quantitative vs. qualitative approach in research. Significance of research.
Outline of a research process: Identification of problem, Learning the background, Developing a working hypothesis, Designing the research strategy, Arranging sample/materials required, Performing the experiment and data collection, Data analysis and hypothesis testing, Interpretation and report writing. Criteria of good research and its reporting/presentation.

Course Title: Clinical Microbiology

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC543

Unit A:
Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract.
Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections.

Unit B:
Immune system. Types of immunity. Mediators of immunity.
Collection, transport and culturing of clinical samples, principles of laboratory diagnosis of infectious diseases. Staining and microscopy. Isolation and identification of causal organism. Selective and differential medium. Growth mediums specific to isolate or differentiate various pathogenic bacteria. Immunologic tests like ELISA, Immunofluorescence, Agglutination based tests, Complement fixation and western blotting. Nucleic acid analysis based tests like PCR, restriction digestion, northern and southern hybridization.

Unit C:
Control of microbes. Disinfection, pasteurization and sterilization. Physical and chemical agents to control microbes. Mechanism of action of different agents used to control microbes. Kinetics of microbial killing.
Epidemiology of infectious disease. Epidemic, endemic and pandemic with example.
Communicable diseases and modes of transmission.
Strategies to control epidemics.

Unit D:
History of antibacterial agents. Minimal inhibitory concentration. Bactericidal and bacteriostatic. Laboratory tests for checking antimicrobial activity. Trends in antibiotic and antiviral discovery.
Source and spectrum of antibacterial agents.
Cell wall biosynthesis inhibitor. Protein synthesis inhibitor. Nucleic acid synthesis inhibitors. Membrane active agents.
Antiviral agents. Inhibitors of uncoating, penetration and neuraminidase. DNA polymerase, RNA polymerase and reverse transcriptase inhibitor. Viral protease inhibitor.
Prophylactic and curative treatment.
Susceptibility and resistance to antimicrobials. Intrinsic and acquired resistance.
Mechanisms of resistance development.
Strategies to avoid development and spread of resistance.

Course Title: Clinical Microbiology Laboratory

L	T	P	Credit	Marks
0	0	3	2	50

Course Code: MIC544

1. Preparation of general purpose medium.
2. Preparation of selective medium.
3. Preparation of differential medium.
4. Use of important selective and differential media for identification of pathogenic bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
5. Identify pathogenic bacteria (any three of *E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus*) on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
6. Test of motility on agar plate and under microscope
7. Test of hemolysis. α, β hemolysis.
8. Siderophore production detection by chromo azurol sulfate agar
9. Study of bacterial flora of skin and mouth by swab method
10. Perform antibacterial sensitivity by Kirby-Bauer method

Course Title: Immunology

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC631

Unit A:
History of immunology.
Three fundamental concepts in immunology: Specificity, discrimination of self from non-self and memory
Structure, Functions and origin of Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell and Immune Organs like Bone marrow, Thymus, Lymph Node, Spleen.
Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes, Adjuvants, Structure, Types and Functions of antibodies.
Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA.

Unit B:
Immune cell receptors: Detailed structure and development of B cell (Ig) and T cell (TcR) receptors.
Structure of CD4, CD8, MHC-I, MHC-II molecules, cellular adhesion molecules (ICAM, VCAM, MadCAM, selectins, integrins); Pattern Recognition Receptors (PRRs) and Toll-like receptors (TLR).
Markers of suppressor / regulatory T cells - CD4+ CD25+

Unit C:
Genetic organization: Organization of the genes for B and T cell receptors.
Genetic organization of MHC-I and MHC-II complex, Peptide loading and expression of MHC-I and MHC-II molecules.
Molecular mechanisms responsible for generating diversity of antibodies and T cell receptors.
Hybridoma technology and monoclonal antibodies.
Complement system. Classical, lectin and alternative pathway for complement activation.

Unit D:
Major cytokines and their role in immune system: TNF, IFN, IL-1, IL-2, IL-4, 1L-6, IL-10, IL-12, IL-17, TGFβ.
Tolerance and autoimmunity and their mechanism; Mechanisms of autoimmunity; Autoimmune components of diabetes mellitus (DM), multiple sclerosis (MS), experimental autoimmune encephalitis (EAE); Infections leading to autoimmune diseases.
Hypersensitivity and allergy. Comparative study of Type I-V hypersensitivities with examples.

Course Title: Immunology Laboratory

L	T	P	Credit	Marks
0	0	3	2	50

Course Code: MIC632

1. Identification of human blood groups.
2. To separate serum from the blood sample (demonstration).
3. To perform Total Leukocyte Count of the given blood sample.
4. To perform Differential Leukocyte Count of the given blood sample.
5. To perform immunodiffusion by Ouchterlony method.
6. Agglutination of bacteria
7. Separation of IgG by ammonium sulfate precipitation of blood serum.
8. Reduction of IgG with mercaptoethanol to four chain.
9. SDS-PAGE electrophoresis of immunologic effector proteins.
10. Papain digestion of IgG
11. Pepsin digestion of IgG
12. Immunoelectrophoresis
13. Western Blotting
14. ELISA

Course Title: Microbial Diversity

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC533

Unit A: Microbial Evolution,Taxonomy, and Diversity
Microbial Evolution, Introduction to Microbial Classification, and Taxonomy, Taxonomic Ranks, Techniques for Determining Microbial Taxonomy and Phylogeny, Assessing Microbial Phylogeny, The Major Divisions of Life, Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms

Unit B: The Archaea
Introduction to the Archaea, Phylum Crenarchaeota, Phylum Euryarchaeota, Archaeal Phylogeny, Methanotrophic Archaea

Unit C: *Bacteria:* The Deinococci and Nonproteobacteria Gram Negatives-
Aquificae and *Thermotogae* , *Deinococcus-Thermus* , Photosynthetic Bacteria, The Mechanism of Gliding Motility, Phylum *Planctomycetes,* Phylum *Chlamydiae* , Phylum *Spirochaetes* , Phylum *Bacteroidetes*
Bacteria:* The *Proteobacteria- Class *Alphaproteobacteria,* Class *Betaproteobacteria,* Class *Gammaproteobacteria,* Class *Deltaproteobacteria,* Class *Epsilonproteobacteria*
The Low G +C Gram Positives-General Introduction, Class *Mollicutes* (The Mycoplasmas), Peptidoglycan and Endospore Structure, Class *Clostridia,* Class *Bacilli*
***Bacteria:* The High G+C Gram Positives-**General Properties of the Actinomycetes, *Actinomycineae, Micrococcineae, Corynebacterineae, Micromonosporineae, Propionibacterineae*

Unit D: Algae
History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultrastructure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.

Unit E: Fungi and Protozoa
Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, eterothallism and parasexual mechanism. Economic Importance of Fungi with Examples in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins
Protozoa-General characteristics with special reference to *Amoeba, Paramecium and Giardia*

Course Title: Microbial Diversity Laboratory

L	T	P	Credit	Marks
0	0	3	2	100

Course Code: MIC534

1. Preparation of different media: synthetic media, Complex media-nutrient agar, McConkey agar, EMB agar, PVK agar etc.
2. Simple staining
3. Negative staining
4. Gram's staining
5. Acid fast staining-permanent slide only.
6. Capsule staining
7. Spore staining.
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
10. Estimation of CFU count by spread plate method/pour plate method.
11. Motility by hanging drop method.
12. Isolation and growth of fungi by using potato dextrose agar/ Malt extract agar

Course Title: Soil and Environmental Microbiology

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC545

Unit A: Soil Habitat

Soil biota, Soil microbial ecology, Types of organisms in different soils, Soil microbial biomass, Microbiology and biochemistry of root-soil interface; phyllosphere, Biofertilizers, soil enzyme activities and their importance. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

Unit B: Biogeochemical Cycling

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin
Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction
Phosphorus cycle: Phosphate immobilization and solubilisation
Sulphur cycle: Microbes involved in sulphur cycle
Other elemental cycles: Iron and manganese

Unit C: Microbial Bioremediation

Biochemical composition and biodegradation of soil organic matter and crop residues. Biodegradation of pesticides, Organic wastes and their use for production of biogas and manures: Biotic factors in soil development. Genetic engineering of microbes for enhanced pesticide degradation Mechanisms of pesticide degradation by microbes. organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants

Unit D: Microbial Interactions

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation, Microbe-Plant interaction: Symbiotic and non-symbiotic interactions, Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

Unit E: Waste Management

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment, Gaseous treatment

Unit F: Water Potability

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Course Title: Soil and Environmental Microbiology Laboratory

L	T	P	Credit	Marks
0	0	3	2	100

Course Code: MIC546

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria & fungi) from soil (28ºC & 45ºC).
3. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
4. Assessment of microbiological quality of water.
5. Determination of BOD of waste water sample.
6. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
7. Isolation of *Rhizobium* from root nodules.
8. Isolation of plant growth promoting rhizobacteria i.e. P-solubilizing bacteria.

Course Title: Food and Industrial microbiology

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC633

Unit A: Foods as a substrate for microorganisms and Microbial spoilage of various foods

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general. Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.

Unit B: Principles and methods of food preservation

Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO_2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.

Unit C: Fermented foods

Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market. Food intoxications and Food infections.

Unit D: Introduction to industrial microbiology and fermentation processes

Brief history and developments in industrial microbiology Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations.

Unit E: Isolation of industrially important microbial strains and fermentation media

Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates.

Unit F: Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses)

Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12, Enzymes (amylase, protease, lipase), Wine, beer

Course Title: Food and Industrial microbiology Laboratory

L	T	P	Credit	Marks
0	0	3	2	50

Course Code: MIC634

1. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
2. Isolation of any pathogenic bacteria from food products.
3. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
4. Isolation of spoilage microorganisms from bread.
5. Preparation of Yogurt/Dahi/Sauerkraut etc.
6. Study different parts of fermenter.
7. Microbial fermentations for the production and estimation (qualitative and quantitative) of: Enzymes, Amino acid, Organic acid, Citric acid, Alcohol
8. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.

Course Title: Eukaryotic Microbiology

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC635

Unit A: Eucaryotic Cell Structure and Function

An Overview of Eucaryotic Cell Structure, The Plasma Membrane and Membrane Structure, The Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules Disease Getting Around, Organelles of the Biosynthetic-Secretory and Endocytic Pathways, Eucaryotic Ribosomes, Mitochondria, Chloroplasts, The Origin of the Eucaryotic Cell, The Nucleus and Cell Division, External Cell Coverings, Cilia and Flagella, Comparison of Procaryotic and Eucaryotic Cells

Unit B: Fungi

Physiology of growing hypha, spores, classification. The structure and composition of fungal cell, The growth and form of fungal cell, The growth sof population and colonies. The effect of environment on growth, Vegetative multihyphal system, Prevention of fungal growth. Role of spores in mycology and in the life of the organism. General characteristics of the fungal divisions i.e. Myxomycota, Oomycota, Chytridiomycota, Zygomycota, Ascomycota, Plectomycetes, Basidiomycota, Heterobasidiomycota, Urediniomycetes, Ustilaginomycetes etc.

Unit C: Algae

Basic characteristics of algae, structure of the algal cell, Nutrition, Classification, Algal fossil records. Toxic algae, Chemical defence mechanism of algae, applications of algae. The prokaryotic algae- cyanobacteria, Morphology, protoplasmic structure, pigments, heterocysts-nitrogen fixation, asexual reproduction, symbiosis, ecology of cyanobacteria, cyanotoxins, cyanophages, General characteristics of the algal divisions i.e. Glaucophyta, Rhodophyta, Euglenophyta, symbiotic dianoflagellates, Cryptophyta, Heterokontophyta, Prymnesiophyta etc.

Unit D: The Protists

Distribution, Nutrition, Morphology, Encystment and Excystment, Reproduction, Protist classification with special reference to *Amoeba, Paramecium and Giardia*

Course Title: Eukaryotic Microbiology Laboratory

L	T	P	Credit	Marks
0	0	3	2	50

Course Code: MIC636

1. Preparation of potato dextrose and malt extract agar medium.
2. Isolation of fungi from rotten bread and vegetables.
3. Gram stain slides of *Candida albicans* and *Cryptococcus neoformans*.
4. Looking at cotton blue stained *Rhizopus, Aspergillus, Penicillium, Fusarium*.
5. Looking at spores of *Rhizopus, Aspergillus, Penicillium, Fusarium*
6. Study of *Spirogyra, Nostoc, Anabena, Spirulina, Sargassum, Chara, Chlamydomonas,* and *volvox* using temporary Mounts.
7. Study of the following protozoans using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*

Course Title: Molecular Biology
Course Code: BTY511

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: A comprehensive knowledge of molecular aspects of biological function at the molecular level, particular emphasis on the structure and regulation of genes, as well as, the structure and synthesis of proteins and applications of these concepts in human medicine and health, agriculture, study evolution and other areas.

1. Introduction to molecular biology, basic techniques in molecular biology. DNA and its various forms, super coiling of DNA, DNA melting, repetitive sequences, cot and rot curves, C value paradox, DNA protein interaction, DNA super coiling. Prokaryotic & eukaryotic DNA replication, enzymes and accessory proteins involved in DNA replication, replication origin & replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, gene amplification, mobile genetic elements, homologous and site specific recombination. **12 hours**
2. Prokaryotic and eukaryotic transcription, RNA polymerase, transcription factors, regulatory elements, transcriptional activator, repressor & mechanism of transcription regulation, post-transcriptional processing of mRNA, rRNA & tRNA. **12 hours**
3. Protein synthesis and processing: Ribosome structure, genetic code, prokaryotic & eukaryotic translation, the translation machinery, mechanism and regulation of translation & translation proof-reading, translational inhibitors, Post- translational modification of proteins and intracellular protein targeting, import into nucleus, mitochondria and peroxisome. **10 hours**
4. Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing). **10 hours**
5. Genome sequencing: Genome sizes, organelle genomes, genomic libraries, YAC, BAC libraries, and strategies for sequencing genome, packaging, transfection and recovery of clones, application of sequence information for identification of defective genes. **8 hours**
6. Molecular biology of various stresses, viz. abiotic stresses like drought, salt, heavy metals and tempreture; and biotic stresses like bacterial, fungal and viral disease. Signal transduction and its molecular basis, molecular mechanism of plant hormone action mitochondrial control of fertility, structure, organization and regulation of nuclear gene concerning storage proteins and starch synthesis. **8 hours**

Books:

1. Molecular cell biology (2008) by Harvey F. Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher (W.H.Freeman).
2. Genes IX (2008) by Benjamin Lewin (Jones and Bartlett Publishers).
3. Molecular cloning: A laboratory manual (2000) by J. Sambrook, E.F.Fritish and T. Maniatis (Cold Spring Harbor Laboratory Press,New York).

Course Title: Molecular Biology-LAB
Course Code: BTY512

L	T	P	Credits	Marks
0	0	3	2	50

- Isolation of genomic DNA from bacteria.
- Isolation of genomic DNA from plant.
- Isolation of total RNA from tissue.
- Demonstration of DNA protein interaction.
- Quantitation of nucleic acids and proteins.
- Gel electrophoresis:
    - Nucleic acid
    - Protein

Course Title: Recombinant DNA Technology
Course Code: BTY521

L	T	P	Credits	Marks
4	0	0	4	100

Course objective: The basic objective of the paper is to present the principles of gene manipulation and its associated technologies. How developments in gene manipulation have revolutionized medicine, agriculture and health.

1. Introduction and scope of Recombinant DNA Technology. **2 hour**
2. DNA modifying enzymes- Terminal deoxynucleotidyl transferase, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Methylases, Ligases- *E. coli* and T4 DNA ligases, Linker, Adaptor, Homopolymer tailing, Restriction Endonucleases. **8 hours**
3. Isolation and Purification of nucleic acid: Basic techniques and considerations criteria of purity, isolation and purification of phage DNA plasmid, chromosomal DNA, RNA and mRNA. **4 hours**
4. Cloning and expression vector: Characteristics of cloning and expression vectors; plasmid, phage and cosmid vectors, multipurpose cloning vectors, shuttle vectors; bacterial, yeast, plant and mammalian expression vectors. **10 hours**
5. Cloning and expression hosts: Characteristics of cloning and expression host, bacterial, yeast, plant and mammalian host systems for cloning and expression of genes. **4 hours**
6. DNA Cloning Strategies: Preparation of genomic and cDNA libraries, criteria for selection of cloning vectors - plasmid, bacteriophage and cosmid, transformation and transfection, electroporation, screening of gene library and selection of clone. **6 hours**
7. Nucleic acid Blotting and Hybridization: Southern and northern blotting and hybridization techniques, radioactive and non-radioactive labeling of probe, western blotting. **4 hours**
8. Expression of cloned genes :Expression of cloned genes in *E. coli*, *Bacillus subtilis*, s*treptomyces*, yeast and mammalian cells, detection and analysis of proteins expression from cloned genes. **8 hours**
9. Protein-Protein interactions-Phage display (*in vivo*, *in vitro* and *in planta*, Yeast two hybrid system, Yeast three hybrid system. Bicomplementation and Florescence Resonance Energy Transfer (FRET). **3 hours**
10. Polymerase chain reaction and site directed mutagenesis: Principle and application of polymerase chain reaction, random mutagenesis, site-directed mutagenesis and protein engineering. **4 hours**
11. Impact of rDNA on human genetics: Mapping & cloning of human disease genes, DNA based diagnosis, gene targetting, human genome project history and scope. **4 hours**
12. Applications of r-DNA technology in industry, agriculture and forensic science. **3 hours**

Books:

1. Gene cloning and DNA analysis – An Introduction (2006) 5th edition, T.A. Brown, Blackwell publisher.
2. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes (1998), S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford.
3. Molecular Cloning : A Laboratory Manual (2000), J. sambrook, E.F. Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York.

4. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003) 3rd edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.
5. Principles of Genetic Engineering (2009), Mousumi Debnath, pointer publisher, Jaipur.
6. Principles of gene manipulation and Genomics (2006) 7th edition, S.B Primose and R.M Twyman, Blackwell publishing.

Course Title: Recombinant DNA Technology-LAB
Course Code: BTY522

L	T	P	Credits	Marks
0	0	3	2	50

- Preparation and purification of pUC plasmid.
- Preparation and purification of genomic DNA
- Restriction digestion of plasmid and genomic DNA and gel electrophoresis.
- Gene cloning
- Bacterial transformation
- Southern blotting and hybridization with non-radioactive probes.
- Amplification of DNA with PCR Temperature cycler.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title: Genomics, Proteomics and Metabolomics
Course Code: BTY642

Course Objective: The aim of the course is to provide students practical and bioinformatical skills in genomics, transcriptomics, proteomics and metabolomics, knowledge and the notion about how the methods are applied in real-life scientific research.

1. Introduction to –omes and –omics. Gene, Genome and Genomics. **2 hour**
2. Whole genome analysis: Preparation of genomic library in vectors, ordered cosmid libraries, BAC libraries, shotgun libraries. Genome analysis for global patterns of gene expression using fluorescent-labelled cDNA or end-labelled RNA probes. **6 hours**
3. FISH, Sequencing: Conventional sequencing (Sanger, Maxam and Gilbert methods), automated sequencing, analysis of sequence information FISH. Analysis of single nucleotide polymorphism using DNA chips. **4 hours**
4. Transcriptomics. Microarray, EST, SAGE. Bioinformatical methods in ranscriptomics.
   Application of transcriptomics. Genome sequencing projects (technology of sequencing and assembly, bioinformatics of genome annotation, current status of genome sequencing projects) Genomic browsers and databases Orthology prediction (comparative genomics), Search for transcription factor binding sites (TFBS), Computational prediction of miRNA target genes *De novo* prediction of regulatory motifs in genome, Single nucleotide polymorphisms (SNP) in medical genetics and basic research. **10 hours**
5. Next generation sequencing using new technologies. Alignment of pairs of sequences of DNA and proteins. Multiple sequence alignment. Searching databases for similar sequences. Phylogeny: Different approaches to tree construction. Analyze sequences and its role in understanding the evolution of organisms and genes. **6 hours**
6. **Proteomics.** Aims, strategies and methods. Bioinformatics tools in proteomics. Application of proteomics. Protein microarrays. Proteomics technologies: 2D-electrophoresis, MALDI-TOF mass spectrometry, yeast 2-hybrid system. Protein-protein interactions: experimental and computational methods, databases. **8 hours**
7. Types of data and databases, quality of annotation. Protein structure prediction. The proteome. High throughput proteomics and its use to the biologists. **4 hours**
8. Novel approaches to protein expression analysis: Scope of functional proteomics. Proteome analysis: 2DE based strategy. Alternatives to 2DE for protein expression analysis. **5 hours**
9. Application of proteome analysis to drug development and toxicology: Basic principle and making use of the data. **4 hours**
10. Protien-DNA interactions. Cancer profiling using DNA microarrays. Proteomics as tool for plant genetics and breeding. **5 hours**
11. Introduction to metabolomics. Technologies in metabolomics. Nutrigenomics. Nuclear Magnetic Resonance Spectroscopy and Mass Spectrometry in metabolomics. Metabolic pathways resources: KEGG, Biocarta. Nutrigenomics and metabolic health. Solved problems and future challenges. **6 hours**

Books:

1. A primer of genome science (2009) by Gibson G. and Muse S. V., (Sinauer Associates, Inc. Sunderland, MA).

2. Knowledge discovery in proteomics (2006) by Igor Jurisica, Dennis Wigle (Chapman & Hall / CRC).
3. Proteomics: From protein sequence to function (2002) edited by Pennington SR, Dunn M. J. (Viva Books Pvt. Ltd).
4. Informatics in proteomics (2005) edited by Srivastava Sudhir (Taylor & Francis Group / CRC).
5. Genomics and proteomics engineering in medicine and biology (2007) edited by Akay M. (Wiley-Interscience John Wiley & Sons, Inc. Publication, USA).
6. Essentials of genomics and bioinformatics (2002) by Christoph W. Sensen (Wiley-VCH, Weinheim).
7. Current protocols in bioinformatics (2004) by Baxevanis A.D., Davison, D.B., Page, R.D.M. & Petsko, G.A (John Wiley & Sons, Inc. Publications, New York).

Course Title: Genomics, Proteomics and Metabolomics-LAB
Course Code: BTY643

L	T	P	Credits	Marks
0	0	3	2	50

- Site directed mutagenesis. Deleting a DNA sequence from a plasmid and introduction into *E. coli.*
- Functional validation of gene expression.
- Analysis of mutants using Southern blot and PCR analysis.
- Introduction to DNA sequencing.

Course Title: Bioanalytical Techniques
Paper Code: BCH501

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: The course introduces students all the major bioanalytical techniques relevant to students of biochemistry. It covers the theoretical aspects of various techniques, along with their instrumentation and applications.

Unit A (20 hours)

Spectroscopy – Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry, Fluorescence Spectroscopy.

Chromatography – Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC and FPLC

Unit B (20 hours)

Centrifugation – Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.

Mass Spectrometry – Principle of MS, ionization modes, equipment, MS of proteins/peptides, interface of MS with other methods – MS/MS, LC/MS, and GC/MS, peptide mapping, post-translation modification analysis of proteins, protein sequencing by MS.

Unit C (10 hours)

Electrophoretic techniques – Principles of electrophoretic separation. Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, pulse field gel electrophoresis.

Immunochemical techniques – Making antibodies, Immunoassay formats, Immunomicroscopy, Lateral flow devices, Epitope mapping, Immunoblotting, Fluorescent activated cell sorting (FACS), Cell and tissue staining techniques, Immunocapture, polymerase chain reaction (PCR) Immunoaffinity chromatography (IAC), Antibody-based biosensors, Therapeutic antibodies

Unit D (10 hours)

Bioinformatics – Overview, Sequence databases – DNA, protein, genome, EST and SNP databases, BLAST programs, ClustalW, Tertiary protein structure databases, PDB, Rasmol, Pymol and Swiss-PDB viewer, Homology modeling.

Recommended books:

1. Physical Biochemistry – Principles and Applications – 2nd Edition – David Sheehan, Wiley-Blackwell (2009).
2. Analytical Biochemistry – 3rd Edition – David Holme and Hazel Peck, Pearson Education Ltd. (1998)

Course Title: Bioanalytical Techniques Laboratory

L	T	P	Credits	Marks
0	0	3	2	50

Paper Code: BCH503

Experiments:

1. Titration of a weak acid using a pH meter, preparation of buffers
2. Verification of Beer-Lambert's law and determination of absorption coefficients
3. Paper chromatography – Separation of amino acids and carbohydrates in a mixture
4. Thin layer chromatography of fatty acids
5. Column chromatography – Separation of a mixture of proteins and salt using Sephadex column
6. Electrophoresis

Course Title: Advanced Concepts in Metabolism
Paper Code: BCH515

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The course covers the concepts of bioenergetics and pathways of metabolism with emphasis on animal cells.

Unit A (15 hours)

Bioenergetics – Concept of free energy, standard free energy, determination of ΔG for a reaction. Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions. Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials & free energy change (derivations and numericals included). High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ΔG. Energy charge.

Coenzymes and Cofactors – Role and mechanism of action of NAD+/NADP+, FAD, lipoic acid, thiamine pyrophosphate, tetrahydrofolate, biotin, pyridoxal phosphate, B12 coenzymes and metal ions with specific examples.

Unit B (15 hours)

Carbohydrates – Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle, its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma aminobutyrate (GABA) shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway. Metabolism of disaccharides. Hormonal regulation of carbohydrate metabolism. Energetics of metabolic cycle.

Unit C (20 hours)

Amino Acids – General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids. Special metabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines. Urea cycle and its regulation.

Lipids – Introduction, hydrolysis of tri-acylglycerols, α-, β-, ω- oxidation of fatty acids. Oxidation of odd numbered fatty acids – fate of propionate, role of carnitine, degradation of complex lipids. Fatty acid biosynthesis, Acetyl CoA carboxylase, fatty acid synthase, ACP structure and function, Lipid biosynthesis, biosynthetic pathway for tri-acylglycerols, phosphoglycerides, sphingomyelin and prostaglandins. Metabolism of cholesterol and its regulation. Energetics of fatty acid cycle. (20)

Unit D (10 hours)

Nucleotides – Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway. Role of ribonucleotide reductase. Biosynthesis of deoxyribonucleotides and polynucleotides, including inhibitors of nucleic acid biosynthesis.

Other Molecules - Porphyrins – Biosynthesis and degradation of porphyrins. Production of bile pigments, Biochemistry of biological nitrogen fixation, plant hormones – Growth regulating substances and their mode of action, molecular effects of auxin in regulation of cell extension, effects of gibberllic, abscisic acids and cytokinins in the regulation of seed dormancy, germination, growth and development, Biosynthesis of Vitamins – Ascorbic acid, thiamine, pantothenic acid and Folic acid.

Recommended Books:

1. Nelson DL & Cox M.M., Lehninger Principles of Biochemistry, 5th Edition, WH Freeman & Company, New York, 2008.

2. Voet D & Voet JG, Biochemistry, 3rd Edition, John Wiley & Sons Inc., Singapore, 2004.
3. Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's Illustrated Biochemistry, 27th Edition, McGraw Hill Company Inc. Singapore, 2006.

Course Title: Principles of Biochemistry
Paper Code: BCH524

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The course is intended for master's course students. This course is a broad survey of all the major concepts of biochemistry with emphasis on all the important categories of biomolecules and their biochemistry.

Unit A (15 hours)

Introduction to Biochemistry

Water as a biological solvent. Weak acids and bases. pH and buffers. Henderson-Hasselbalch equation. Physiological buffers. Fitness of the aqueous environment for living organisms.

Carbohydrates

Structure of monosaccharides. Stereoisomerism and optical isomerism of sugars. Reactions of aldehyde and ketone groups. Ring structure and anomeric forms, mutarotation. Reactions of sugars due to hydroxyl groups. Important derivatives of monosaccharides, disaccharides and trisaccharides (structure, function and occurrence of important ones). Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides - cellulose, chitin, agar, algenic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, glycogen and starch. Bacterial cell wall polysaccharides. Glycoproteins.

Proteins

Introduction to proteins. Classification based on solubility, shape, composition and functions. Amino acids: common structural features, stereoisomerism and RS system of designating optical isomers. Classification and structures of standard amino acids as zwitterion in aqueous solutions. Physical and chemical properties of amino acids. Titration of amino acids. Separation of amino acids. Essential amino acids.

Structure of peptide bond. Solid-phase synthesis of peptides. Peptide sequencing. Chemical and enzymatic cleavage of polypeptide chains and separation of peptides. Levels of structure in protein architecture. denaturation and renaturation of proteins. Behaviour of proteins in solutions. Salting in and salting out of proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (haemoglobin, myoglobin), lipoproteins, metalloproteins, glycoproteins and nucleoproteins.

Unit B (15 hours)

Nucleic Acids

Nature of genetic material. Evidence that DNA is the genetic material. Composition of DNA and RNA. Generalized structural plan and Nomenclature of nucleic acids. DNA double helix. Structure and roles of different types of RNA. Size of DNA in prokaryotes and eukaryotes. Central dogma of molecular biology. Concepts of gene, genome and chromosome.

Porphyrins

Porphyrin nucleus and classification of porphyrins. Important metalloporphyrins occurring in nature. Detection of porphyrins. Bile pigments – chemical nature and physiological significance.

Lipids

Definition and classification of lipids. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, prostaglandins. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats – hydrolysis, saponification value, rancidity of fats, Reichert-Meissel Number and reaction of glycerol. Biological significance of fats. Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidylserine, phosphatidylinositol, plasmalogens), sphingomyelins, glycolipids – cerebrosides, gangliosides. Properties and functions of phospholipids, isoprenoids and sterols.

Unit C (15 hours)

Introduction to Metabolism

General features of metabolism, experimental approaches to study metabolism – intact organisms, bacterial mutants, tissue slices, radioisotopes.

Carbohydrate Metabolism

Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Reactions and energetics of TCA cycle. Gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of pentose phosphate pathway. Regulation of glycolysis and TCA cycle. Photosynthesis – a brief review.

Electron Transport Chain and Oxidative Phosphorylation

Structure of mitochondria. Sequence of electron carriers. Sites of ATP production. Inhibitors of electron transport chain. Chemiosmotic hypothesis. Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing potentials into mitochondria.

Unit D (15 hours)

Lipid Metabolism

Introduction. Hydrolysis of triacylglycerols. Transport of fatty acids into mitochondria. β-oxidation of saturated fatty acids. ATP yield from fatty acid oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of ketone bodies. Oxidation of unsaturated and odd chain fatty acids. Biosynthesis of triglycerides and important phospholipids, glycolipids, sphingolipids and cholesterol. Regulation of cholesterol metabolism.

Amino Acid Metabolism

General reactions of amino acid metabolism – transamination, oxidative deamination and decarboxylation. Urea cycle. Degradation and biosynthesis of amino acids. Glycogenic and ketogenic amino acids.

Nucleotide Metabolism

Sources of atoms in the purine and pyrimidine nucleotides. Biosynthesis and degradation of purines and pyrimidines. Regulation of purine and pyrimidine biosynthesis.

Porphyrin Metabolism

Biosynthesis and degradation of porphyrins. Production of bile pigments.

Recommended Books:

1. Nelson DL & Cox M.M., Lehninger Principles of Biochemistry, 5th Edition, WH Freeman & Company, New York, 2008.
2. Conn EE, Stumpf PK, Bruening G and Doi RH. Outlines of Biochemistry. 5th edition, John Wiley & Sons Inc, 1987.
3. Voet D & Voet JG, Biochemistry, 3rd Edition, John Wiley & Sons Inc., Singapore, 2004.
4. Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's Illustrated Biochemistry, 27th Edition, McGraw Hill Company Inc. Singapore, 2006.

Course Title: Principles of Biochemistry Laboratory

L	T	P	Credits	Marks
0	0	3	2	50

Paper Code: BCH525

Experiments:

1. Quantitative estimation of blood glucose by Folin-Wu/Anthrone/DNS/o-Toluidine/Enzymatic method
2. Estimation of proteins by Biuret method
3. Quantitative estimation of cholesterol in the blood
4. Estimation of alkaline and acid phosphatases
5. Estimation of blood glucose.
6. Estimation of cholesterol
7. Sugar Fermentation in Microorganisms.
8. Estimation of Glucose 6-P.
9. Estimation of Urea.
10. Estimation of Uric acid.
11. Estimation of Creatinine.

Course Title: MSc Seminar 3rd Semester

L	T	P	Credit	Marks
0	0	0	2	50

Course Code: MIC630

Seminar Objective:
During the course students will come to know about the general understanding of the most common problems, recent advances in microbiology research. Each student shall be allotted a topic by the instructor. Student will have to understand the topic, collect literature and prepare the presentation. Through this the students will develop habit of reading newer topics, will become inquisitive and develop confidence of presentation and discussion before audience.

The students shall submit a project report on the allotted topic, which shall be evaluated by the concerned internal faculty. He/She then would present a seminar on the concerned topic. The students will be encouraged to explore all available literature as well as the internet to prepare the seminar report and present the same using informative slides made using Power Point or projectors.

Seminar Contents:
Students will present their work on a selected topic with the following headings:

- Title
- Objectives
- Review of Literature
- Materials and Methods
- Results
- Conclusion/recommendations

Examination Scheme:

Literature study/ Preparation/ Presentation	30
Question answer session	20
Total	50

Course Title: MSc Seminar 4th Semester

L	T	P	Credit	Marks
0	0	0	2	50

Course Code: MIC640

Seminar Objective:
During the course students will come to know about the general understanding of the most common problems, recent advances in microbiology research. Each student shall be allotted a topic by the instructor. Student will have to understand the topic, collect literature and prepare the presentation. Through this the students will develop habit of reading newer topics, will become inquisitive and develop confidence of presentation and discussion before audience.

The students shall submit a project report on the allotted topic, which shall be evaluated by the concerned internal faculty. He/She then would present a seminar on the concerned topic. The students will be encouraged to explore all available literature as well as the internet to prepare the seminar report and present the same using informative slides made using Power Point or projectors.

Seminar Contents:
Students will present their work on a selected topic with the following headings:

- Title
- Objectives
- Review of Literature
- Materials and Methods
- Results
- Conclusion/recommendations

Examination Scheme:

Literature study/ Preparation/ Presentation	30
Question answer session	20
Total	50

Course Title: Project Part – I

L	T	P	Credit	Marks
0	0	0	2	50

Course Code: MIC701

Guidelines for Project Synopsis:

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-art instrumentation. Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication.

As a preparatory of project work student/s need to formulate a legible research problem and go through literature search to propose ways to address the problem. A short account of this work need to be presented by the students in written format to the advisors. A verbal presentation aided with media tools should follow the submission of written synopsis.

Course Title: Project Part – II

L	T	P	Credit	Marks
0	0	0	8	200

Course Code: MIC702

Guidelines for Project:

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be criticized by the faculty guide and corrected by the student at each stage.

The file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include:

- A short account of the activities that were undertaken as part of the project
- A statement about the extent to which the project has achieved its stated goals.
- Assessment about the outcomes of the experimentation processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

Title or Cover Page

The title page should contain the following information: Project Title; Student' name; Course; Year; Supervisor' name

Acknowledgements (optional)

Acknowledgement to any advisory or financial assistance received in the course of work may be given

Abstract

A good abstract should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

Table of Contents

Title and subtitles are to correspond exactly with those in the text

Introduction

Here brief introduction to the problem that is the central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods

This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modification if any.

Results and Discussion

Present results, discuss and compare these with those from other workers etc. In writing these section, emphasis should be given on what has been performed and was achieved in the course of the work, rather than discuss in detail what is readily available in the text books. Avoid abrupt changes in the contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter should be included in a smooth flow.

Note that in writing the various sections, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in “point” form.

Conclusion

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Future Prospects

Appendices

The appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References

This should include papers and books referred to in the body of the report.