MSc BIOTECHNOLOGY CHOICE BASED CREDIT SYSTEM (CBCS)
DEPARTMENT OF GENETICS & BIOTECHNOLOGY, OSMANIA UNIVERSITY
Schedule for Instruction and Examination
(Proposed Scheme for Academic year 2019 onwards)

SEMESTER- I							
S.No	**Syllabus Ref No**	**Subject**		**Teaching Hours**	**Marks**		
					Internal Assessment	**Semester Exam**	**Total**
	THEORY						
1.	BT 101 T	Cell Biology and Genetics	4	4	20	80	100
2.	BT 102 T	Biological chemistry	4	4	20	80	100
3.	BT 103 T	Microbiology	4	4	20	80	100
4.	BT 104 T	Statistics, laboratory management & safety,entrepreneurship	4	4	20	80	100
	PRACTICALS						
1.	BT 151 P	Cell Biology and Genetics	2	4		50	50
2.	BT 152 P	Biological chemistry	2	4		50	50
3.	BT 153 P	Microbiology	2	4		50	50
4.	BT 154 P	Biostatistics	2	4		50	50
		Total	**24**	**32**			**600**

SEMESTER- III							
S. No	**Syllabus Ref No**	**Subject**		**Teaching Hours**	**Marks**		
					Internal Assessment	**Semester Exam**	**Total**
	THEORY						
1.	BT 301 T	Recombinant DNA technology	4	4	20	80	100
2.	BT 302 T	Bioinformatics and its Applications	4	4	20	80	100
3.	BT 303 T	**Elective:** Advances in Plant Biotechnology (or) Food Biotechnology	4	4	20	80	100
4.	BT 304 T	**Elective:** Animal Biotechnology (or) Protein Engineering	4	4	20	80	100
	PRACTICALS						
1.	BT 351 P	Recombinant DNA technology	2	4		50	50
2.	BT 352 P	Bioinformatics and its Applications	2	4		50	50
3.	BT 353 P	Advances in Plant Biotechnology (or) Food Biotechnology	2	4		50	50
4.	BT 354 P	Animal Biotechnology (or) Protein Engineering	2	4		50	50
		Total	**24**	**32**			**600**

MSC BIOTECHNOLOGY-I YEAR
SEMESTER-I
THEORY PAPER-I
BT 101 T- CELL BIOLOGY AND GENETICS

1. Course Objectives (C. Obj.)
    a. Understand basic aspects of intracellular organization of a eukaryotic cell
    b. To comprehend the Mendelian Genetic principles in humans, plants and animals
    c. Obtain basic knowledge of hierarchical structure and organization of chromosomes, insight into chromosomal anomalies and learn the science behind gene mapping in eukaryotes
    d. To comprehend the biochemical and molecular processes of cell division and cell death
2. Course Outcomes (C.O)
    a. Comprehend the cellular architecture and processes
    b. Ability to apply Mendelian ineritance principles to humans, plants and animals
    c. Appreciate the importance of fidelity of chromosome organization and gain an ability to localize genes by appropriate techniques.
    d. Knowledge regarding the basic mechanisms underlying cell division and cell death

Course Plan / Schedule

Unit No.	Topics to be covered	No. of lectures
Unit-1	**Internal Organization of Cell**	
1.1	Membrane structure– lipid bilayer, properties of lipid bilayer, lipid rafts, membrane proteins– peripheral and integral proteins, electric properties of membrane	2
1.2	Structure and function of Endoplasmic reticulum, Structure and function of Golgi Complex, Structure and function of Lysosomes	3
1.3	Structure, biogenesis and functions of mitochondria	2
1.4	Structure, biogenesis and functions of chloroplast	2
1.5	Structure & function of cytoskeleton- introduction to microfilaments, intermediate filaments, microtubules, myosin structure and role in motility	3
1.6	Intracellular protein transport- secretory pathway; protein transport into nucleus, chloroplast and mitochondria; endocytosis and exocytosis	4
Unit -2	**Principles of Inheritance**	
2.1	Chromosome theory of inheritance; Mendel’s Laws - Law of segregation & Law of independent assortment- test cross and back cross	2
2.2	Extension to Mendel's Laws- Incomplete dominance (e.g. Flower Color), Codominance (e.g. MN Blood groups); Non allelic interactions- Types of Epistasis, modification of dihybrid ratios;	3

	Multiple Allelism (e.g. Coat color in Rabbits, eye color in Drosophila, ABO Blood groups, Rh blood groups, S locus in Nicotiana)- incompatibility and pseudoallelism, Complex loci- R-locus in maize	
2.3	Penetrance and Expressivity (e.g. Polydactyly, Waardenburg Syndrome), Pleiotropism (e.g. Bardet Biedel Syndrome, Marfan syndrome), Phenocopy (e.g. Microcephaly)	2
2.4	Sex determination in Drosophila, Birds, Man and Bonellia; X-linked inheritanceHemophilia, Color blindness, Lyonization; Y-linked inheritance- Holandric genes; Sex limited and sex influenced characters; Inheritance patterns in Man-Pedigree analysis	3
2.5	Polygenic inheritance, Additive effect- Skin color in man, Kernel color in maize	2
2.6	Non- Mendelian inheritance-Maternal inheritance-Variegation in leaves of higher plants- Mirabilis Jalapa, Poky in Neurospora, Maternal effect - Shell coiling in snails, Uniparental inheritance-mutations in extra nuclear genes in Chlamydomonas, Male sterility in Maize	4
Unit 3	**Chromosomes– Organization and Aberrations, Linkage mapping**	
3.1	Chromosome- morphology, classification, Karyotyping; Features of centromere and telomere; Specialized chromosomes- Polytene & lamp brush chromosomes; Variation in chromosome number- Euploidy, Aneuploidy; Variation in chromosome structure -deletions, duplication, translocations and inversions	4
3.2	Chromatin organization- Nucleosome, loops and scaffolds; Nucleosome phasing ; Chromatin under transcription- euchromatin and heterochromatin	3
3.3	Cytological proof of crossing over- Creighton and McClintock's experiment, correlation between chiasmata and crossing over	2
3.4	Phases of linkage, test cross, recombination frequency, gene mapping, determination of map distances based on two and three point test crosses, coincidence, interference (e.g. Drosophila, Maize)	2
3.5	Tetrad analysis- Neurospora; Mitotic crossing over- Aspergillus, Drosophila	2
3.6	Gene mapping and applications	3
Unit-4	**Cell Division and Cell Death**	
	Cell cycle: Phases (interphase and M phase) and Check points in cell cycle, overview of mitosis and meiosis	3
	Biochemistry of cell division cycle: cyclins and CDKs, APC and SCF complexes, spindle machinery and molecular motors	4
	Mitosis: Stages and molecular mechanisms	2
	Meiosis: Stages and molecular mechanisms	3
	Cellular processes: cell growth, cell differentiation, senescence, autophagy	2
	Cell death: Necrosis, apoptosis (intrinsic and extrinsic pathways)	2

PRACTICALS
BT 151 P: CELL BIOLOGY AND GENETICS

S.No.	Topics to be covered
1.	Preparation of mitotic chromosomes
2.	Preparation of meiotic chromosomes
3.	Study of polyploidy in onion root tips
4.	Karyotyping of normal & abnormal chromosome sets
5.	Preparation of polytene chromosomes
6.	Monohybrid and dihybrid ratios ,Multiple alleles, Epistasis- Problems
7.	Inheritance patterns in man– pedigree analysis
8.	Localization of genes– two & three point test crosses, Tetrad analysis– Problems

REFERENCE BOOKS

1. An introduction to Genetic Analysis by Anthony, J.F. J.A. Miller, D.T. Suzuki, R.C. Richard Lewontin, W.M-Gilbert, W.H. Freeman publication
2. Principles of Genetics by E.J.Gardner and D.P. Snusted. John Wiley & Sons, New York
3. The Science of Genetics, by A.G. Atherly J.R. Girton, J.F. Mcdonald, Saundern College publication
4. Principles of Genetics by R.H. Tamarin, International edtn McGrawhill
5. Theory & problems in Genetics by Stansfield, Schaum out line series McGrahill
6. Cell & Molecular Biology. E.D.D De Robertis & E.M.F De Robertis, Waverly publication.
7. Molecular Biology of the cell. Alberts, B; Bray, D, Lews, J., Raff, M., Roberts, K and Watson, J.D. Garland publishers, Oxford
8. Molecular Cell Biology Lodish, H., Baltimore, D; Fesk, A., Zipursky S.L., Matsudaride, P. and Darnel American Scientific Books. W.H. Freeman, NewYork
9. Cell and molecular biology by Gerald Karp, Wiley
10. The cell: a molecular approach by Goeffrey Cooper and Robert Hausmann

MSC BIOTECHNOLOGY-I YEAR
SEMESTER-I
THEORY PAPER-II
BT 102 T- BIOLOGICAL CHEMISTRY

1. Course Objectives (C. Obj.):

   a. To learn the basics of chemistry related to bio molecules
   b. To understand the carbohydrate classification and metabolism
   c. To comprehend metabolism of lipids, nucleic acids and amino acids
   d. To learn cellular signaling processes

2. Course Outcomes (C.O)

   a. Understanding the basics about bio-molecules, bio-energetics and enzymology
   b. Acquaintance with carbohydrate metabolism and networks
   c. Critically understanding biosynthesis of lipids nucleic acids and amino acids
   d. Understanding of how cells communicate and carryout physiological processes

Course Plan/ Schedule

Unit No.	Topics to be covered	No. of lectures
Unit-1	**Biomolecules, Bioenergetics and Enzymology**	
1.1	Importance of water in biological systems, p^H, Henderson- hasselbalch equation	2
1.2	Laws of thermodynamics, Gibbs free energy, Enthalpy, Entropy, Catalysis	3
1.3	Carbohydrates (Classification-monosaccharides, disaccharides, oligosaccharides & polysaccharides	3
1.4	Lipids (Classification-fatty acids, Nucleic acids, Amino acids, Proteins (Primary, secondary & tertiary structures)	3
1.5	Proteins (Primary, secondary & tertiary structures)	3
1.6	Enzymes and enzyme kinetics, Briggs-Haldane reaction, Michaelis-Menten equation Coenzymes, Cofactors, enzyme regulation	2
Unit -2	**Carbohydrate metabolism and networks**	
2.1	Glycolysis, TCA cycle and Electron transport chain	3
2.2	Gluconeogenesis, Glycogenesis and Glycogenolysis, Glucuronic acid cycle	3
2.3	Pentose phosphate pathway	2
2.4	Entner-Doudoroff pathway, Cori cycle	3
2.5	Photosynthesis, C3 & C4 cycle	3
2.6	Overview of Carbohydrates networks	2
Unit 3	**Biosynthesis and metabolism of lipids, Nucleic acids and amino acids**	
3.1	Hydrolysis of triacylglycerols	2

3.2	β-oxidation, Fatty acid biosynthesis, Cholesterol metabolism	3
3.3	Biosynthesis of amino acids, Amino acid degradation, Urea cycle	3
3.4	Prostaglandin biosynthesis	3
3.5	Nitrogen metabolism: Nitrate and ammonium assimilation	2
3.6	Biosynthesis and degradation of purines and pyrimidines	3
Unit-4	**Cell communication and Singnalling pathways**	
4.1	Cell communication (autocrine and paracrine), Cell surface receptors in signal transduction	2
4.2	Second messengers and their role in signal transduction– cAMP, cGMP, phosphatidyl inositol derived second messengers, calcium as second messenger	3
4.3	G-protein coupled receptor– structure and function; GPCR signalling pathways; Ion channel receptors	3
4.4	Tyrosine kinase linked receptors (receptors for cytokines), JAK-STAT pathway	3
4.5	Receptors with intrinsic enzyme activity (RTK) and RTK signaling pathways	3
4.6	Wnt signalling pathway; Toll-like receptor signalling pathway	2

PRACTICALS

BT 152 P: BIOLOGICAL CHEMISTRY

S. No.	**Topics to be covered**
1.	Qualitative tests of sugars, amino acids and lipids
2.	Estimation of total sugars by DNS method
3.	Estimation of proteins by Lowry's method
4.	Separation of amino acids by paper chromatography, thin layer chromatography (TLC)
5.	Separation of proteins by SDS-PAGE
6.	Enzyme assay- Catalase or Invertase
7.	Estimation of cholesterol by Zak and Henly's method
8.	Amylase activity assay
9.	Plate assay for enzymes
10.	Column chromatography- Gel filtration (size exclusion)

REFERENCE BOOKS

1. Lehninger Principles of Biochemistry By: David L. Nelson and Cox
2. Biochemistry:-By: Rex Montgomery.
3. Harper's Biochemistry. By: Robert K. Murray.
4. Enzymes. By: Trevor Palmer.
5. Enzyme structure and mechanism By: AlanFersht
6. Principles of Biochemistry. By: Donald J. Voet, Judith G.Voet, Charlotte W.Pratt
7. Analytical Biochemistry By Cooper
8. Principles and techniques of Biochemistry and Molecular Biology Edited by Keith Wilson and John Walker
9. Experimental Biochemistry: A Student Companion by Sashidhar Beedu et al.
10. Practical Biochemistry By Plummer

MSC BIOTECHNOLOGY-I YEAR
SEMESTER-I
THEORY PAPER -III
BT 103 T- MICROBIOLOGY

1. **Course Objectives (C.Obj)**
   a. To learn about the General characteristics of microorganisms, microscopy, sterilization and containment
   b. To learn about general characteristics of Bacteria; bacterial isolation, growth, culturing and preservation
   c. To learn about Viruses and their general characteristics
   d. To learn about Algae, fungi & protozoa and their general characteristics

2. **Course Outcomes (C.O)**
   a. Understanding the basics of microbiology and microbial classification
   b. To culture different bacteria and know how to preserve them
   c. Acquaintance with culturing of viruses and viral pathogenesis
   d. Critical understanding of general characteristics and classification of algae, fungi and protozoa

Course Plan/Schedule

Unit No.	**Topics to be covered**	**No. of lectures**
Unit-1	**General characteristics of microorganisms**	
1.1	Microbiology- historical perspective	3
1.2	Microscopy and Applications- Principles and working of bright field, Fluorescent, and Electron microscopes	2
1.3	Classification of microorganisms	2
1.4	Concept and methods of sterilization and their application in industry- dry heat, moist heat, radiation methods, filtration methods, chemical methods	3
1.5	Concept of containment facility	3
1.6	Types of antimicrobial agents and development of resistance by microorganisms to various chemicals	3
Unit-2	**Bacteria and their characteristics**	
2.1	General characteristics of bacteria Identification methods for bacteria- conventional (simple staining methods, differential staining, structural staining and special staining method), molecular based approaches	2
2.2	General methods for isolation of bacteria- plating methods (streak, spread and pour plate methods); serial dilution.	2
2.3	Bacterial growth- typical growth curve- batch and continuous cultures, synchronous cultures; Measurement of bacterial growth- measurement of cell number and cell mass; factors influencing bacterial growth- temperature, pH.	3
2.4	Pure cultures- concept of pure culture, methods of pure culture, Enrichment culturing techniques, single cell isolation and pure culture development	3

2.5	Methods of preservation of microbial cultures– repeated subculturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deep freezing and liquid nitrogen preservation, freeze-drying (lyophilization).	3
2.6	Diseases caused by bacteria in humans (Staphylococcus, Streptococcus, Mycobacterium tuberculosis)	3
Unit-3	**Viruses and their characteristics**	
3.1	General characteristics of viruses	2
3.2	Classification of viruses and important characters of each group	3
3.3	Structure and replication of Bacteriophage (T2), Lambda phage-Lytic and Lysogenic cycles	3
3.4	Isolation and Purification of viruses by Filtration, Precipitation and Centrifugation	3
3.5	Methods of cultivation of viruses- in animal cell inoculation, Chick embryo, tissue culture; Bacteriophage cultivation; cell culture method.	2
3.6	Structure and general characteristics of important viruses (TMV, HIV, Hepaptitis virus, Polio virus, Prions) and Importance of viruses in biotechnology	3
Unit-4	**Algae, fungi & protozoa and their characteristics**	
4.1	General characteristics, vegetative & reproductive structure of Algae (Cyanophyta, Cholorophyta, Phacophyta, Rhodophyta)	3
4.2	Economic importance of algae	3
4.3	General characteristics of Fungi (Phycomycetes, Bacidiomycetes, Ascomycetes, Deuteromycetes)	3
4.4	Fungi as pathogens of humans, plants and animals	3
4.5	General characteristics of Protozoa	3
4.6	Protozoan as pathogens of humans (Entamoeba, Plasmodium)	1

PRACTICALS
BT 153 P: MICROBIOLOGY

S.No.	Topics to be covered
1	Microbiology- historical perspective
2	Microscopy and Applications- Principles and working of bright field, Fluorescent, and Electron microscopes
3	Classification of microorganisms
4	Concept and methods of sterilization and their application in industry- dry heat, moist heat, radiation methods, filtration methods, chemical methods
5	Isolation and Culturing of bacteria, fungi and algae: Tube culture (slant/broth), plate culture, flask culture Measurement of microbial growth (Viable count and turbidometry) Study of bacterial growth curve
6	Concept of containment facility, sterilization at industrial level
7	Types of antimicrobial agents and development of resistance by microorganisms to various chemicals

REFERENCE BOOKS

1. Microbiology by M.J. Pelzar, E.S.N. Cfan and N.R. Kreig, McGraw Hill Publ.
2. Introductory Microbiology by J. Heritage, E.G.V. Erans, R.A. Killington, Cambridge University Press.
3. General Microbiology by H.G.Schlegel Cambridge University Press.
4. General Microbiology by Stanier, R.Y, J.L. Ingrahm, M.L. Wheel is & P.R. Painter.
5. Microbiology– Concepts and Application. John Wiley and Sons, New York

MSC BIOTECHNOLOGY-I YEAR
SEMESTER-I
THEORY PAPER - IV
BT 104 T- BIOSTATISTICS, LABORATORY MANAGEMENT & SAFETY, ENTREPRENEURSHIP

1. **Course Objectives (C.Obj.)**
   a. To understand the significance of sampling & data alignment
   b. To understand the concept of applying appropriate test statistics
   c. To learn Laboratory Management & Safety
   d. To know the importance of Entrepreneurship

2. **Course Outcomes (C.O)**
   a. Learn to estimate appropriate descriptive measures for a data in a given study design
   b. Help in derive inferences based on the statistical comparisons
   c. Good laboratory practice
   d. How to be a successful entrepreneur

Course Plan/Schedule

Unit No.	Topics to be covered	No. of lectures
Unit-1	**Descriptive Statistics**	
1.1	Random sample- Methods of sampling, study design, sample size, effect of sampling bias	2
1.2	Types of variables (qualitative, quantitative and categorical)-data alignment and representation-Frequency distribution-Histogram, Frequency polygon, Pie Chart-Bar diagram	3
1.3	Measures of central tendency- mean, median, mode	2
1.4	Point and interval estimates - Measures of Dispursion – coefficients – moment – skewness - curtosis	3
1.5	Concepts of probability – types of events (dependent, independent and Mututally exclusive) – laws of probability (Addition & multiplication) – Bayesian theorem & its applications	3
1.6	Probability distributions & applications – Normal, Binomial and Poisson	3
Unit-2	**Inferential Statistics**	
2.1	Concept of Test of hypothesis, Null & Alternative hypothesis, level of significance, p-value, Class limits, Class intervals	3
2.2	Large Sample Tests- Z-test of Means	2
2.3	Small sample test - T-test for Means	2
2.4	Chi square test & its applications	3
2.5	Analysis of Variance and Co-variance, One-Way ANOVA, Two-way ANOVA	3
2.6	Simple regression and correlation - Test of regression	3

	coefficient and correlation Coefficient	
Unit-3	**Laboratory Management & Safety**	
3.1	Administration of Laboratories, Laboratory design, Security measures, laboratory bio security concepts, Laboratory Information management system (LIMS)	2
3.2	Laboratory safety- good laboratory practice (GLP), Biosafety levels, Safety policies	3
3.3	Basic principles of quality control (QC) and quality assurance (QA)	3
3.4	Handling of Hazardous compounds- chemicals, solvents, poisons, isotopes, explosives and biological strains (Bacterial, Fungal etc.)	3
3.5	Storage of hazardous material	2
3.6	Disposal of biological and radioisotope wastes	3
Unit-4	**Entrepreneurship**	
4.1	Concept, definition, structure and theories of entrepreneurship	3
4.2	Types of start-ups	3
4.3	Types of entrepreneurship, environment, process of entrepreneurial development	3
4.4	Entrepreneurial culture, entrepreneurial leadership	3
4.5	Product planning and development -Project management, Search for business idea, Concept of projects, Project identification, Formulation, Design and network analysis, Project report and project appraisal	3
4.6	Promoting bio-entrepreneurship.	1

PRACTICALS:
BT 154 P: BIOSTATISTICS

S.No.	Topics to be covered
1.	Estimation of mean, median and mode for grouped and ungrouped data
2.	Variance, standard deviation and standard error
3.	Problems on Probability distribution- Binomial, Normal, Poisson distributions
4.	Problems on Chi square test
5.	Large sample test (Z-test)
6.	Small sample test (T-test)
7.	Calculation of correlation and regression coefficients
8.	Problems on ANOVA

REFERENCE BOOKS

1. Quantitative Genetics By Falconer
2. Biostatistics By Vishweswara Rao
3. Biostatistics By Khan and Khanum
4. Fundamentals of Biostatistics By P.H. Rao and Janardhan
5. Population Genetics By V. Venugopal and Pratibha Nallari
6. Biostatistical Methods in Agriculture Biology and Medicine By Khan and Khanum
7. Guides to entrepreneurship in biotechnology by P. Ponnumurugan, J Robinson and B. Kalpana
8. Guidelines for entrepreneurship development program for biotechnology graduates by P. Ponnumurugan and Nithya. B
9. CRC handbook of laboratory safety by A. Keith Furr