MSc BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS)
DEPARTMENT OF GENETICS & BIOTECHNOLOGY, OSMANIA UNIVERSITY
Schedule for Instruction and Examination
(Proposed Scheme for Academic year 2016 onwards)

SEMESTER – I							
S No	**Syllabus Ref No**	**Subject**	**Credits**	**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**	**80**	**520**	**600**

SEMESTER – II							
S No	**Syllabus Ref No**	**Subject**	**Credits**	**Teaching Hours**	**Marks**		
					Internal Assessment	**Semester Exam**	**Total**
	THEORY						
1.	BT 201 T	Molecular Biology-The Genome	4	4	20	80	100
2.	BT 202 T	Molecular Biology-Genes to Proteins	4	4	20	80	100
3.	BT 203 T	Immunology	4	4	20	80	100
4.	BT 204 T	Microbial technology	4	4	20	80	100
	PRACTICALS						
1.	BT 251 P	Molecular Biology-The Genome	2	4		50	50
2.	BT 252 P	Molecular Biology- Genes to Proteins	2	4		50	50
3.	BT 253 P	Immunology	2	4		50	50
4.	BT 254 P	Microbial technology	2	4		50	50
		Total	**24**	**32**	**80**	**520**	**600**

T- Theory, P-Practical

SEMESTER-I
THEORY
BT 101 T- CELL BIOLOGY AND GENETICS

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

1.2 Intracellular compartmentalization– Cytosol components, pH, Endoplasmic reticulum– types and function, peroxisomes– enzymes present– photorespiration, endosomes and lysosomes– function

1.3 Structure, biogenesis and functions of mitochondria

1.4 Structure, biogenesis and functions of chloroplast

1.5 Structure & function of cytoskeleton- introduction to microfilaments, intermediate filaments, microtubules, myosin structure and role in motility

1.6 Intracellular protein transport- secretory pathway; protein transport into nucleus, chloroplast and mitochondria; endocytosis and exocytosis

Unit 2: Principles of Inheritance

2.1 Chromosome- morphology, classification, karyotyping; Chromosome theory of inheritance; 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

2.2 Law of segregation & Law of independent assortment- test cross and back cross; Extension to Mendel's Laws- Incomplete dominance (e.g. Flower Color), Co-dominance (e.g. MN Blood groups); Non allelic interactions- Types of Epistasis, modification of dihybrid ratios; Multiple Allelism (e.g. Coat color in Rabbits, eye color in Drosophila, ABO Blood groups, Rh blood groups)- 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)

2.4 Sex determination in Drosophila, Birds, Man and Bonellia; X-linked inheritance- Hemophilia, Color blindness, Lyonization; Y-linked inheritance- Holandric genes; Sex limited and sex influenced characters; Inheritance patterns in Man-Pedigree analysis

2.5 Polygenic inheritance, Additive effect- Skin color in man, Kernel color in maize

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, S-gene in Nicotiana

Unit 3: Chromatin organization, Linkage and gene mapping

3.1 Chromatin organization- Nucleosome, loops and scaffolds; Nucleosome phasing
3.2 Chromatin under transcription- euchromatin and heterochromatin
3.3 Cytological proof of crossing over- Creighton and McClintock's experiment, correlation between chiasmata and crossing over
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
3.5 Tetrad analysis- Neurospora; Mitotic crossing over- Aspergillus, Drosophila
3.6 Gene mapping- Genetic mapping, sib pairs, LOD scores, homozygosity mapping, Linkage disequilibrium and Transmission disequilibrium (TDT) test

Unit 4: Cell Division and Cell Death

4.1 Cell cycle: Phases
4.2 Check points in cell cycle, Cyclins, CDKs
4.3 Mechanics of cell division- an over view of M-Phase, different stages of mitosis (cohesins and condensins in chromosome segregation; microtubules in spindle assembly, structure of kinetochore, centrosome and its functions, sister chromatid separation; cytokinesis, actin & myosin in the generation of contractile ring) and significance
4.4 Meiosis– stages (chiasma formation- synaptonemal complex; recombination during meiosis- recombination nodules) and significance
4.5 Senescence, Necrosis– classification, morphological patterns of necrosis, causes of necrosis
4.6 Apoptosis - programmed cell death; mechanisms of apoptosis; apoptosis triggered by internal signals; apoptosis triggered by external signals; apoptosis inducing factor; apoptosis in cancer, programmed cell death in plants

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

SEMESTER-I
THEORY
BT 102 T- BIOLOGICAL CHEMISTRY

Unit 1: Biomolecules, Bioenergetics and Enzymology

1.1 Carbohydrates (Classification-monosaccharides, disaccharides, oligosaccharides & polysaccharides)
1.2 Lipids (Classification-fatty acids, steroids)
1.3 Amino acids, Proteins (Primary, secondary & tertiary structures)
1.4 Nucleic acids (Purines & pyrimidines)
1.5 Laws of thermodynamics, Gibbs free energy, Enthalpy, Entropy, Catalysis
1.6 Enzymes and enzyme kinetics, Briggs-Haldane reaction, Michaelis-Menten equation Coenzymes, Cofactors, enzyme regulation

Unit 2: Carbohydrate metabolism

2.1 Glycolysis, TCA cycle and Electron transport chain
2.2 Gluconeogenesis, Glycogenesis and Glycogenolysis
2.3 Glucuronic acid cycle
2.4 Pentose phosphate pathway
2.5 Entner-Doudoroff pathway, Cori cycle
2.6 Photosynthesis, C3 & C4 cycle

Unit 3: Metabolism of lipids and amino acids

3.1 Hydrolysis of triacylglycerols
3.2 β-oxidation, Fatty acid biosynthesis, Cholesterol metabolism
3.3 Biosynthesis of amino acids, Amino acid degradation, Urea cycle
3.4 Prostaglandin biosynthesis
3.5 Nitrogen metabolism: Nitrate and ammonium assimilation
3.6 Biosynthesis and degradation of purines and pyrimidines

Unit 4: Cell signalling

4.1 Cell communication (autocrine and paracrine)
4.2 Second messengers and their role in signal transduction– cAMP, cGMP, phosphatidyl inositol derived second messengers, calcium as second messenger, Cell surface receptors in signal transduction
4.3 G-protein coupled receptor– structure and function; GPCR signalling pathways; Ion channel receptors
4.4 Tyrosine kinase linked receptors (receptors for cytokines), JAK-STAT pathway
4.5 Receptors with intrinsic enzyme activity (RTK) and RTK signaling pathways
4.6 Wnt signalling pathway; Toll-like receptor signalling pathway

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. Myrray.
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

SEMESTER-I
THEORY
BT 103 T- MICROBIOLOGY

Unit 1: General characteristics of microorganisms

1.1. Microbiology- historical perspective
1.2. Microscopy and Applications- Principles and working of bright field, Fluorescent, Phase contrast and Electron microscopes
1.3. Classification of microorganisms
1.4. Concept and methods of sterilization and their application in industry- dry heat, moist heat, radiation methods, filtration methods, chemical methods
1.5. Concept of containment facility, sterilization at industrial level
1.6. Types of antimicrobial agents and development of resistance by microorganisms to various chemicals

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 General methods for isolation of bacteria- plating methods (streak, spread and pour plate methods); serial dilution, MPN method, contact slide technique, baiting technique, membrane filter technique
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, water activity, oxygen concentration, salt concentration, pressure and radiation
2.4 Methods of anaerobic culturing of bacteria- Brewer jar, gas pak, pyrogallic acid technique, roll tube and glove box techniques; pure cultures- concept of pure culture, methods of pure culture, Enrichment culturing techniques, single cell isolation and pure culture development.
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).
2.6 Diseases caused by bacteria in humans (Staphylococcus, Streptococcus, Mycobacterium tuberculosis)

Unit 3: Viruses and their characteristics

3.1 General characteristics of viruses
3.2 Classification of viruses and important characters of each group
3.3 Structure and replication of Bacteriophage (T2), Lambda phage- Lytic and Lysogenic cycles
3.4 Isolation and Purification of viruses by Filtration, Precipitation and Centrifugation
3.5 Methods of cultivation of viruses- in animal cell inoculation, Chick embryo, tissue culture; Bacteriophage cultivation; cell culture method, abrasion method
3.6 Structure and general characteristics of important viruses (TMV, HIV, Hepaptitis virus, Rota virus, Adenovirus, Polio virus, Prions) and Importance of viruses in biotechnology

Unit 4: Algae, fungi & protozoa and their characteristics

4.1 General characteristics, vegetative & reproductive structure of Algae (Cyanophyta, Cholorophyta, Bacillariophyta, Phacophyta, Rhodophyta)
4.2 Economic importance of algae
4.3 General characteristics of Fungi (Phycomycetes, Bacidiomycetes, Zygomycetes, Oomycetes, Ascomycetes, Deuteromycetes)
4.4 Fungi as pathogens of humans, plants and animals
4.5 General characteristics of Protozoa
4.6 Protozoan as pathogens of humans (Giardia, Entamoeba, Plasmodium)

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

SEMESTER-I
THEORY
BT 104 T- STATISTICS, LABORATORY MANAGEMENT & SAFETY, ENTREPRENEURSHIP

Unit 1: Descriptive Statistics & Probability Distribution

1.1 Sampling- Sampling procedure, homogenization of samples, samples size, Selection of Random sample, Limitation of analytical methods, classification of errors, measurement of averages and variation, minimization of errors.
1.2 Types of data, Frequency distribution, Measure of central values- Mean, median and mode, Measures of dispersion- range , mean deviation , standard deviation, coefficient of variation, moment, Skewness and kurtosis; Graphical representation of Data, Histogram, Frequency polygon, Pie Chart
1.3 Probability, Concept of Probability Theory, Events, Trials, Mutually exclusive events, Favourable events, exhaustive events, Bayesian theorem of Probability, Addition theorem, Multiplication theorem
1.4 Binomial distribution, Normal distribution, Poisson distribution & their applications.
1.5 Discriminating power, Derivation, Evaluation of evidence by discriminating powers
1.6 Combination of independent systems, Correlated attributes, transfer of evidence, Likelihood ratio

Unit 2: Statistical Inferences of Qualitative & Quantitative Variables

2.1 Concept of Test of hypothesis, Null & Alternative hypothesis, level of significance, Chi square test & its applications
2.2 Large Sample Tests- Z-test of Means & Proportions
2.3 Small sample test - T-test for Means, Paired T-test
2.4 Analysis of Variance and Co-variance, One-Way ANOVA, Two-way ANOVA
2.5 Simple regression and correlation
2.6 Test of regression 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)
3.2 Laboratory safety- good laboratory practice (GLP), Biosafety levels, Safety policies
3.3 Basic principles of quality control (QC) and quality assurance (QA)
3.4 Handling of Hazardous compounds- chemicals, solvents, poisons, isotopes, explosives and biological strains (Bacterial, Fungal etc.)
3.5 Storage of hazardous material
3.6 Disposal of biological and radioisotope wastes

Unit 4: Entrepreneurship

4.1 Concept, definition, structure and theories of entrepreneurship
4.2 Types of start-ups
4.3 Types of entrepreneurship, environment, process of entrepreneurial development
4.4 Entrepreneurial culture, entrepreneurial leadership
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
4.6 Promoting bio-entrepreneurship

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

SEMESTER- I
PRACTICALS

BT 151 P: CELL BIOLOGY AND GENETICS

1. Preparation of mitotic & meiotic chromosomes
2. Karyotyping of normal & abnormal chromosome sets
3. Study of polyploidy in onion root tips
4. Preparation of polytene chromosomes
5. Isolation of Mitochondria, Isolation of Chloroplast
6. Cell Cycle Synchronization
7. Monohybrid and dihybrid ratios ,Multiple alleles, Epistasis- Problems
8. Quantitative Inheritance– Problems
9. Inheritance patterns in man– pedigree analysis
10. Localization of genes– two & three point test crosses, Tetrad analysis– Problems
11. Localization of genes in man by sib pair method and LOD score estimations- Problems, Multipoint analysis- determining flanking loci
12. Gene mapping by Transmission Disequilibrium Test (TDT)– Problems

BT 152 P: BIOLOGICAL CHEMISTRY

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)

BT 153 P: MICROBIOLOGY

1. Microscopic observation, Staining and identification of bacteria, fungi and algae
2. Preparation of microbiological media
3. Sterilization methods (Autoclaving, Hot air oven, Radiation and Filtration)
4. Isolation of bacteria, fungi and algae
5. Isolation of bacteriophages
6. Preservation and maintenance of microbial cultures
7. Culturing of microorganisms: Tube culture (slant/broth), plate culture, flask culture
8. Measurement of microbial growth (Viable count and turbidometry)
9. Study of bacterial growth curve

BT 154 P: BIOSTATISTICS

1. Measure of central tendency– mean, median and mode
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) for sample means and proportions.
6. Small sample test (T-test) for sample means and proportions.
7. Calculation of correlation and regression coefficients
8. ANOVA- one way and two way classification

SEMESTER–II
THEORY
BT 201 T- MOLECULAR BIOLOGY-THE GENOME

Unit 1: Genome Organization

1.1 Historical perspective: DNA as a genetic material, structure of DNA, Genome size, C-value paradox
1.2 Organization of prokaryotic genome and eukaryotic nuclear genome (Chromosome number, Gene size, Gene density)
1.3 Unique sequences, repeated sequences– interspersed and tandem repeats; satellite DNA, mini satellites and microsatellites
1.4 Gene families (Clustered and Dispersive– Haemoglobin gene and Histone gene clusters)
1.5 Pseudogenes– processed and unprocessed
1.6 Organization of Mitochondrial and Chloroplast genomes

Unit 2: Genome Replication

2.1 DNA Replication- enzymes involved in the replication of DNA, origin of replication fork
2.2 Replication of Prokaryotic genome and plasmid DNA
2.3 Replication of nuclear genome of eukaryotes, mitochondrial and chloroplast
2.4 Regulation of genome replication (Prokaryotes and Eukaryotes)
2.5 Replication associated errors
2.6 Inhibitors of DNA replication

Unit 3: DNA Damage and Repair

3.1 Spontaneous and Induced mutations– physical and chemical mutagens
3.2 DNA damages (oxidative damages, depurinations, depyrimidinations, O6-methylguanines, cytosine deamination, single and double strand breaks)
3.3 Types of mutagenesis– transition, transversion, frame shifts, missense and non-sense mutations
3.4 Repair mechanisms– Photo-reactivation, Excision repair (base excision repair, nucleotide excision repair), mismatch repair, SOS repair
3.5 Double strand DNA breaks and their repair via Homologous recombination
3.6 Post replication repair

Unit 4: Genome Rearrangements and Recombination

4.1 Whole genome duplication
4.2 Segmental Duplication- insertion, deletion and translocation of sequences
4.3 Single nucleotide variations
4.4 Homologous recombination– rec pathways
4.5 Non-Homologous End Joining and site specific recombination
4.6 Transposons and repeat mediated rearrangements and Gene conversion

REFERENCE BOOKS

1. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter.
2. Molecular Biology of the Gene by J.D. Watson, N.H. Hopkins, J.W, Robertis, A. Steitz & A.M. Weiner, Benjamin Cummings Publ. California
3. Molecular Cell Biology Lodish, H., Baltimore, D; Fesk, A, Zipursky S.L., Matsudaride, P. and Darnel American Scientific Books. W.H. Freeman, NewYork
4. Genes VII. Benjamin Lewis, OxfordUniv. Press, Oxford
5. Molecular Biology by D, Freifelder Narosa Publishing house New York, Delhi
6. Advance Molecular Biology Twyman, R.M., Bios Scientific publishers Oxford
7. Molecular Biology by T.A. Brown
8. Essentials of Molecular Biology. D. Freifelder, Panima publishing co-operation

SEMESTER–II
THEORY
BT 202 T- MOLECULAR BIOLOGY-GENES TO PROTEINS

Unit 1: Prokaryotic and Eukaryotic genes

1.1 Organization of prokaryotic genes- operons (promoters & repressors)
1.2 Fine structure of eukaryotic gene (introns, exons, UTRs, core and proximal promoters & enhancers)
1.3 Number of genes in prokaryotes and eukaryotes
1.4 Essential genes– Proportion and distribution in the genome
1.5 Functional RNA genes (rRNA, tRNA, snoRNA, snRNA)
1.6 Regulatory small RNA coding genes (miRNAs)

Unit 2: Transcription and RNA processing

2.1 Transcription in prokaryotes, Structure of RNA polymerase and promoter, Transcription initiation- role of sigma, alpha sub units, abortive initiation, Elongation-core polymerase, role of β, β' subunits, proof reading, Termination-Rho independent and Rho dependent.
2.2 Transcription in eukaryotes, types of RNA polymerases (I, II, III) and promoters, transcription factors for I, II, III RNA polymerases, transcription activators, specific factors (zinc fingers, HAL4, homeodomain, leucine zipper proteins, helix-turn-helix and helix-loop-helix proteins)
2.3 Mechanism of transcription in eukaryotes, initiation, elongation and termination; synthesis of rRNA, mRNA, tRNA and inhibitors of transcription.
2.4 Post transcriptional modifications, capping and polyadenylation
2.5 RNA editing and processing, Splicing mechanism- alternate splicing, trans splicing, self splicing, Spliceosome mediated splicing, rRNA and tRNA splicing mechanisms
2.6 Gene regulation exerted at the level of translation– silk fibroin gene, regulation at splice site selection – Drosophila sex determination

Unit 3: Translation and Post translational modifications

3.1 Properties of genetic code (universal code, degeneracy, redundancy)
3.2 Correspondence of amino acid sequence with nucleotide sequence in DNA (Single letter code for amino acids)
3.3 Translation machinery in prokaryotes, initiation (IF-1, IF-2,IF-3) (t-RNA charging, disassociation & assembly of ribosomal subunits), elongation (EF-Tu, EF-Ts, EF-G) (translocation, t-RNA identity, aminoacyl t-RNA, peptide bond formation), termination (RF-1, RF-2, RF-3) (termination codons)
3.4 Translation mechanism in eukaryotes, initiation (factors, assembly of ribosomes), elongation, termination (termination codons, stop codon suppression)
3.5 Translational activators and inhibitors
3.6 Post translational modifications of proteins: glycosylation, lipidation, acetylation, ubiqutination, protein splicing, chaperones, modification of amino acids, disulfide bond formation, peptide bond cleavage and isomerization

Unit 4: Regulation of Gene expression and Epigenetics

4.1 Control of gene expression at transcription and translation level, co-ordinated regulation of gene expression in prokaryotes, regulation of lactose operon and tryptophan operon

4.2 Regulation of gene expression in eukaryotes- genes controlling yeast mating type, regulation of Xenopus 5S rRNA in oocytes, using a strategically placed enhancer as genetic switch– chicken globin genes

4.3 Gene regulation in eukaryotes (antisense RNA & RNAi)

4.4 Role of chromatin in regulating gene expression and gene silencing, DNA methylation, histone modifications (acetylation, deacetylation, analysis of epigenetic modifications, epigenetic memory)

4.5 Genome wide mapping of chromatin factors and modifications

4.6 Role of nutrition and environment in epigenetic modifications

REFERENCE BOOKS

1. Molecular Biology of the Gene by J.D. Watson, N.H. Hopkins, J.W, Robertis, A.
2. Steitz & A.M. Weiner, Benjamin Cummings Publ. California
3. Genes VII. Benjamin Lewin, Oxford Univ. Press, Oxford
4. Molecular Biology by D, Freifelder Narosa Publishing house New York, Delhi,
5. Molecular Cell Biology Lodish, H., Baltimore, D; Fesk, A, Zipursky S.L., Matsudaride, P. and Darnel American Scientific Books. W.H. Freeman, New York
6. Advance Molecular Biology Twyman, R.M., Bios Scientific publishers Oxford
7. Molecular Biology by T.A. Brown,
8. Essentials of Molecular Biology. D. Freifelder, Panima publishing co-operation

SEMESTER–II
THEORY
BT 203 T- IMMUNOLOGY

Unit 1: Basics principles of Immunology

1.1 Immunity– Types of Immunity, Innate immunity- Anatomic barriers, physiological barriers, phagocytic barriers, microbial antagonism, inflammation; Acquired Immunity– characteristics

1.2 Cells of the Immune System– lymphoid cells (B & T- Lymphocytes; T- cell sub-sets; NK cells), Mononuclear phagocytes (monocytes, macrophages), Granulocytes (neutrophils, eosinophils, basophils, mast cells, dendritic cells); haematopoiesis and differentiation

1.3 Organs of the immune system : primary lymphoid organs (Bone marrow and Thymus); secondary lymphoid organs (lymph nodes, spleen, mucosal-associated lymphoid tissue and cutaneous asscociated lymphoid tissue)

1.4 Antigens- Immunogenicity versus Antigenicity, Factors that influence immunogenicity, Epitopes- Properties of B-cell epitopes and T- cell epitopes, Haptens

1.5 Complement system– functions and components of complement system; complement activation; regulation of complement system

1.6 Deficiencies of innate immune mechanisms– Chronic Granulomatous Disease (CGD), Leukocyte-adhesion deficiency

Unit 2: B-cell development and Immunoglobulins: Structure and Functions

2.1 Basic structure of Immunoglobulins- The role of multiple myeloma in understanding Ig structure; Fine structure of Immunoglobulins - Immunoglobulin domains-variable region and constant region domains; isotypes, allotypes, idiotypes

2.2 Immunoglobulin classes- IgG, IgM, IgA, IgD and IgE; functions of Ig classes; effector functions of antibodies, Organization and expression of immunoglobulin light and heavy chain genes

2.3 B-cell activation and proliferation by Thymus Independent and Thymus Dependent antigens; invivo sites for induction of humoral response; B-cell differentiation, class-switching and generation of plasma cells and memory cells

2.4 Antigen antibody interactions and applications (immunodiffusion tests, ELISA-Sandwich, Indirect, Dot; Western Blot, Flow cytometry, immunoprecipitation, immunoelectrophoresis, immunoflourescence, immunoelectron microscopy)

2.5 Polyclonal antibodies; Monoclonal Antibodies- Production of Monoclonal Antibodies - Formation and selection of hybrid cells; Antibody engineering– human antibodies from phage display; antibodies in immunotherapy- Targeting of therapeutic immunomolecules

2.6 B-cell immunodeficiency disorders– X-linked agammaglobulinemia, selective immunoglobulin deficiency

Unit 3: Major Histocompatibility Complex (MHC) and tumor immunology

3.1 General organization and inheritance of MHC; MHC Haplotypes
3.2 The structure of MHC class I and class II molecules; organization of MHC class I and class II genes, peptide binding of MHC molecules
3.3 Polymorphism of MHC class I and class II molecules; cellular distribution of MHC molecules; MHC molecules and immune responsiveness and disease susceptibility
3.4 Types of grafts; Mechanism of graft rejection; immunological basis of graft rejection; Graft versus host reactions
3.5 Human leukocyte antigen (HLA) typing by mixed lymphocyte reaction (MLR), microcytotoxicity tests and by PCR; Role of HLA typing in organ transplantation
3.6 Tumors of the immune system– Tumor antigens, Immune response to tumors, tumor escape mechanisms; Cancer immunotherapy approaches

Unit 4: Cell-mediated Immune Responses

4.1 Antigen processing by antigen presenting cells; the structure and functions of T-cell receptors (TCR); the TCR-peptide-MHC tri-molecular complexes
4.2 Cytokines– properties; cytokine receptors; Th1 and Th2 type of cytokines; Therapeutic uses of cytokines
4.3 Cell-mediated immune response: General properties of effector T-cells; Direct cytotoxic response; experimental assessment of cell-mediated cytotoxicity;
4.4 Hypersensitivity– types; Delayed Type of Hypersensitivity (DTH) and cytokines involved in DTH
4.5 Auto-immunity- mechanisms and auto-immune diseases-Insulin Dependent Diabetes; Rheumatoid Arthritis, Auto-immune Thyroid disease, Systemic lupus erythematosus (SLE)
4.6 T cell primary immunodeficiency disorders– Severe combined immunodeficiency (SCID), Di George syndrome; Secondary immunodeficiency disorders- acquired immune deficiency syndrome (AIDS)

REFERENCE BOOKS

1. Essential Immunology - By I. Roitt, Publ: Blackwell
2. Immunology - By G. Reever & I. Todd, Publ: Blackwell
3. Immuno diagnostics - By S.C. Rastogi, Publ: New Age
4. Immunology By: Richard A. Golds by, Thomas J Kindt, Barbaraa. Osborne, Janiskuby
5. Fundamental immunology William E.Paul.
6. Basic Immunology by Bhoosreddy G.L. and Wadher B.J.
7. Text book of immunology by Baruj Benacerraf

SEMESTER–II
THEORY
BT 204 T- MICROBIAL TECHNOLOGY

Unit 1: Fundamentals of Microbial technology

1.1 General concepts of microbial technology, principles of exploitation of micro-organisms and their products, Industrial microorganisms– Bacteria, Algae, Fungi, Actinomycetes
1.2 Screening of microorganisms for industrial products
1.3 Isolation and preservation of microorganisms for industrial products, screening, isolation, selection and improvement of microbial cultures
1.4 Strain development– strategies of strain improvement, mutation, selection and recombination; Strain improvement for the selected organism: mutation and screening of improved cultures, random and strategic screening methods
1.5 Use of recombinant DNA technology and protoplast fusion techniques for strain improvement, problems associated with strain improvement programme
1.6 Improvement of characters other than products and its application in the industry

Unit 2: Processes for Microbial Fermentation

2.1 Brief history of fermentation; Fermentation- general concepts; Fermentation design– Overview of Aerobic and Anaerobic fermentation process Submerged and solid state fermentation
2.2 Factors affecting submerged and solid state fermentation (SSF); Substrates used in SSF and its advantages; Applications of fermentation; Range of fermentation process
2.3 Design of fermentation media culture media; types, components and formulations and modifications. Importance of media in fermentation and media formulation.
2.4 Plakette Burman design, Optimization parameters, Response surface methodology (RSM)
2.5 Substrates used as Carbon and Nitrogen Inoculum development. Storage of cultures for repeated fermentations, Microbial biomass production
2.6 Fermentation process and Factors affecting fermentation process

Unit 3: Microbial products and Food additives

3.1 Organic acids– Citric acid, Lactic acid, Acetic acid, Gluconic acid
3.2 Amino acids– Glutamic acid, Lysine, Aspartic acid
3.3 Enzymes– Proteases, Amylases, Lipases, Cellulases & Pectinases; Enzyme Biosensors
3.4 Food fermentations and food produced by microbes; Dairy products– Cheese, Yoghurt; Other products-bread, cheese, vinegar, fermented dairy products
3.5 Oriental fermented foods, microbial cells as food-single cell proteins; production of alcohol and fermented beverages, beer and wine
3.6 Microbial and chemical safety of food products; Food quality & control: Analysis of food

Unit 4: Applications of Microbial technology

4.1 Health care: Production of antibiotics: Penicillin, Streptomycin, Erythromycin
4.2 Production of therapeutic drugs, recombinant vaccines– BCG, Hepatitis-B
4.3 Monoclonal antibodies, Insulin, Vitamins– B_{12}, D & C, Riboflavin, Cyanocobalamin
4.4 Biofuel and Biodiesel production, methane, alcohol, hydrogen
4.5 Biomining- Extraction of Cu, Au and U from ore
4.6 Bio plastics (biopolymers), Bioremediation

REFERENCE BOOKS

1. Text Book of Biotechnology- By H.K. Das (Wiley Publications)
2. Biotechnology- By H.J. Rehm and G. Reed. VIH Publications, Germany
3. Biogas Technology- By b.T. Nijaguna
4. Biotechnology- By K. Trehan
5. Industrial Microbiology- By L.E. Casida
6. Food Microbiology- By M.R. Adams and M.O. Moss
7. Introduction to Biotechnology- By P.K. Gupta
8. Essentials of Biotechnology for Students- By Satya N. Das
9. Bioethics– Readings and Cases- By B.A. Brody and H. T. Engelhardt. Jr. (Pearson Education)
10. Bioprocess Engineering - By Shuler (Pearson Education)
11. Essentials of Biotechnology- By Irfan Ali Khan and AtiyaKhanum (Ukaaz Publications)
12. Gene, Genomics and Genetic Engineering- By Irfan Ali Khan and AtiyaKhanum (Ukaaz Publications).

SEMESTER–II
PRACTICALS

BT 251 P: MOLECULAR BIOLOGY-THE GENOME

1. Isolation of plasmid DNA from Bacteria
2. Determine purity of plasmid DNA by Agarose gel electrophoresis
3. Determining melting temperature of DNA
4. Reassociation Kinetics and estimation of c_ot values, construction of c_ot curves
5. Induction of mutations by chemical agents
6. Determination of DNA damage by Comet assay

BT 252 P: MOLECULAR BIOLOGY-GENES TO PROTEINS

1. Isolation of Genomic DNA from Bacteria
2. Isolation of Genomic DNA from Plant Cells
3. Isolation of Genomic DNA from Human blood
4. Determination of purity and concentration of DNA - Spectrophotometric method
5. Screening of SNPs- Polymerase Chain reaction and RFLP
6. Isolation of mRNA from blood/tissue
7. Gene expression by RT PCR/Real Time PCR

BT 253 P: IMMUNOLOGY

1. ABO blood typing
2. Micro-hemagglutination Test
3. Double diffusion
4. Single Radial Immunodiffusion
5. Dot ELISA
6. Western Blot by Enzyme- conjugated antibody
7. Sandwich Enzyme Linked Immuno-sorbent Assay
8. Cell-viability Test by Trypan Blue
9. Principle and procedure for Enumeration of specific cell types by Florescent Activated Cell Sorter (FACS)
10. Production of polyclonal antibodies - Techniques to raise antibodies in animal models: - selection of animals (rats, rabbits, mice), preparation of antigens, route of injection and dosage, protocol of immunization, methods of bleeding and serum collection, conventional antibody preparation.

BT 254 P: MICROBIAL TECHNOLOGY

1. Production of Organic acids- Citric acid production & Estimations
2. Production and Estimation of Alcohol
3. Screening for Amylase producing organisms
4. Production and Assay of Amylase activity
5. Production of Wine using common Yeast
6. Production of penicillin/ampicillin
7. Production of antibiotics from bacteria