Syllabus for
M. Sc. Five Year Integrated Course (CBCS)
w.e.f. Academic Session 2019-2020 (in a phased manner)

Semester-I

Paper BTI-101
Introduction to Biotechnology

Max Marks: 65
Internal assessment: 10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No. 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. Each question will carry 13 marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit I

Definition & scope of Biotechnology; introduction of genetic engineering; plant and animal tissue culture; fermentation technology; immobilized enzymes; monoclonal antibodies and hybridoma technology; embryo transfer technology; introduction to gene and genomes, Proteins and proteome, history of genetic manipulations; recombinant DNA technology, DNA fingerprinting and forensic analysis.

Unit II

Application of biotechnology in agriculture; animal and veterinary sciences, pharmaceutical industry, food industry and chemical industry. Bioremediation and waste treatment biotechnology. Biotechnology research in India. Biotechnology in context of developing world. Brief account of safety guidelines and risk assessment in biotechnology. Ethics in Biotechnology, Intellectual property rights.

REFERENCES

1. Elements of Biotechnology - PK Gupta
2. Gene Biotechnology - S.N. Jogdand
3. Biotechnology 5th Edition (Cambridge) - John E. Smith
4. Biotechnology for beginners - Reinhard Renneberg Academic Press

Paper BTI-102
Biomolecules

Max Marks: 65
Internal assessment: 10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
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3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit I

Biomolecules: Introduction, important features, covalent and non-covalent interactions.

Carbohydrates: Introduction and Biological Significance.
Definition and classification: Monosaccharides; families of monosaccharides; simple aldoses and ketoses, Configuration and Conformation, Stereoisomerism/ Asymmetric centres, Fischer and Haworth projection formula, pyranose and furanose ring forms, reducing and non-reducing sugars, sugar derivatives viz. sugar alcohols, amino sugars, deoxy sugars, acidic sugars, Glycosidic bond Disaccharides and Oligosaccharides: Definition, structure and function of important di and oligosaccharides viz. lactose, sucrose, maltose, raffinose, stachyose, verbascose etc.
Polysaccharides: Homo and Hetero polysaccharides, storage polysaccharides: Starch and Glycogen. Structural polysaccharides: Cellulose and Chitin. A brief account of structure and function of mucopolysaccharides/Glycosaminoglycans (Hyaluronic acid, Chondroitin sulphate), Glycoproteins and Proteoglycans.

Amino acids and Peptides: Classification and structure of amino acids, essential amino acids, rare and non-protein amino acids, optical and chemical properties of amino acids; acid-base behaviour/zwitterions; pKa value and titration curve. Peptide bond – nature and characteristics. Definition; structure and function of some biologically important peptides.

Unit II

Proteins: Classification based on structure and function. Structural organization of proteins: Primary structure; Secondary structure-α-Helix, β- pleats and β - turn Tertiary structure – myoglobin and lysozyme etc. Quaternary structure-hemoglobin. Forces stabilizing different structural levels. Amino acid analysis/N-terminal amino acid analysis- Sanger's method, Edmann's degradation, dansyl chloride and dabsyl chloride

Lipids: Introduction and Classification – simple and complex lipids, Fatty acids - structure and nomenclature, soap value, acid value, iodine number, rancidity. Essential fatty acids. A general account of structure and function of triacylglycerols, phospholipids, glycolipids, sphingolipids, steroids, bile acids, bile salts and terpenes

Nucleotides and Nucleic acids:
Building blocks: bases, sugars and phosphates. Structure and nomenclature of nucleosides and nucleotides; polynucleotides, DNA (A, B, Z-DNA) and RNA (rRNA, mRNA, tRNA). Properties of DNA - absorption, denaturation, renaturation, hybridization, Tm/Cot values. Biologically important nucleotides and their functions - ATP, GTP, Coenzyme A, NAD, FAD and cAMP.

REFERENCES

1. Principles of Biochemistry - Albert L. Lehninger, CBS Publishers & Distributors
2. Biochemistry - Methews and Methews
3. Biochemistry - Voet and Voet
4. Biochemistry - Keshav Trehan Wiley Eastern Publications
5. Fundamentals of Biochemistry - J.L. Jain, S. Chand and Company

Paper BTI-103
Cell Biology

Max Marks: 65
Internal assessment: 10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. Each question will carry 13 marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit- I

Basics of Cell Biology - Discovery of cell and Cell Theory; Comparison between plant and animal cells;

Cell Structure - Protoplasm; cell wall; plasma membrane; modification of plasma membrane and intracellular junctions; cytoskeleton; mitochondria; chloroplast; ER; golgi complex; lysosome, endosome and microbodies; ribosome; centriole; nucleus; chromosomes, chemical components of a cell; catalysis and use of energy by cells.

Biogenesis of Cellular organelles - Biogenesis of mitochondria, chloroplast, ER, Golgi complex; Biosynthetic process in ER and golgi apparatus; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.

Unit- II

Structure and function of prokaryotic cell & its components - The slime and the cell wall of bacteria containing peptidoglycan and related molecules; the outer membrane of gram-negative bacteria, the cytoplasmic membrane. Water and ion transport, mesosomes, flagella, pilus, fimbriae, ribosomes,carboxysomes, sulfur granules, glycogen, polyphosphate bodies, fat bodies, gas vesicles; endospores,exospores, cysts. Mycelia of fungi and actinomycetes, cytoskeleton filament, heterocysts and akinets of cyanobacteria, gliding and motility.

Membrane structure & transport - Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion and Active transport

Cell cycle - An overview of cell cycle; Components of cell cycle control system; Intracellular and Extra-cellular control of cell division, Programmed cell death (Apoptosis).

REFERENCES

1. Molecular Biology of cell – Bruce Alberts et al, Garland publications
2. Molecular Cell Biology – Daniel , Sceintific American Books.
3. Cell Biology – Jack D.Bruke, The William Twilkins Company.
4. Cell Biology – Ambrose & Dorouthy M Easty, ELBS Publications.
5. Fundamentals of Cytology – Sharp, Mc Graw Hill Company
6. Cell Biology & Molecular Biology – EDP Roberties & EMF Roberties, Sauder College.

Paper BTI-104
Genetics

Max Marks: 65
Internal assessment: 10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. Each question will carry 13 marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit- I

Genetics - Definition, history and scope

Mendelism & Chromosome Theory – Mendel's principles, applications of Mendel's principles,Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked, Autosomal, Mitochondrial, Unifactorial , Multi-factorial). Deviation from Mendel's Dihybrid phenotype, Linkage, Sutton's view on linkage, Morgan's view on linkage, Bateson & Punnet's Coupling & Repulsion hypothesis.

Linkage & Crossing over - Chromosome theory of Linkage, kinds of linkage, linkage groups, types of Crossing over, mechanism of Meiotic Crossing over, kinds of Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.

Allelic Variation & Gene function – Multiple allele, Genetic interaction, Epistatic interactions, Non-Epistatic inter-allelic genetic interactions, Atavism/Reversion, Penetrance (complete & incomplete), Expressivity, Pleiotropism, Modifier/Modifying genes.

Non-Mendelian inheritance – Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast)

Unit- II

Chromosomal variation in Number & Structure – Euploidy, Non-disjunction & Aneuploidy,Aneuploid segregation in plants, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy, Chromosomal Mosaics, Giant chromosome, Deletion, Duplication, Inversion, Translocation, Position Effect, Centromeric & Non-centromeric breaks in chromosomes, chromosomal rearrangements in Human being, Chromosomal aberrations & evolution. Gene Mutation

Chromosome Mapping - Haploid mapping (2 point & 3 point cross), Diploid mapping (Tetrad analysis), determination of linkage groups, determination of map distance, determination of gene order, cytological mapping.

Human Cyto-Genetics – Human karyotype, Banding techniques, classification, use of Human Cyto-genetics in Medical science, Chromosomal abnormalities in spontaneous abortions, viable monosomies & trisomies, chromosomal deletions & duplications, genetics of chromosomal inversions & translocations, human traits, Genomic position effects on Gene expression, In born diseases

Pedigree analysis – Symbols of Pedigree, Pedigrees of Sex-linked & Autosomal (dominant & recessive), Mitochondrial, Incomplete dominance & Penetrance.

REFERENCES

1. Principles of Gene Manipulations – Old & Primrose, Black Well Scientific Publications.
2. Principles of Genetics – E.J.Gardener, M.J.Simmons and D.P.Snustad, John Wiley & Sons Publications
3. Elements of Genetics – PK Gupta, Rastogi Publications
4. Molecular Biology and Genetic Engineering – PK Gupta
5. Cytogentics, Evolution and Plant Breeding – PK Gupta

Paper BTI-105
Inorganic Chemistry

Max Marks: 33
Internal assessment: 4
Time: 3 hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting at least two questions from each section. As far as possible questions will be short answer type and not essay type

Unit- I (23 Periods)

Atomic Structure: Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, , quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge, Slater's rules.

Periodic Properties: Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, methods of determination or evaluation, trends in periodic table (in s & p block elements).

Unit- II (22 Periods)

Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7 SO_4^{2-}, ClO_4^-)Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, CIF_3, ICI_2^- and H_2O. MO theory of heteronuclear (CO and NO) diatomic molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Ionic Solids: Ionic structures (NaCl, CsCl, ZnS (Zinc Blende), CaF_2) radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy (methamtical derivation excluded) and Born-Haber cycle, solvation energy and its relation with solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.

Paper BTI-106
Physical chemistry

Max Marks: 33
Internal assessment: 4
Time: 3 hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

Unit- I (22 Periods)

Gaseous States: Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity and most probable velocity. Collision diameter, collision number, collision frequency and mean free path. Deviation of Real gases from ideal behaviour. Derivation of Vander Waal's Equation of State, its application in the calculation of Boyle's temperature (compression factor) Explanation of behaviour of real gases using Vander Waal's equation.

Critical Phenomenon: Critical temperature, Critical pressure, critical volume and their determination. PV isotherms of real gases, continuity of states, the isotherms of Vander Waal's equation, relationship between critical constants and Vander Waal"s constants. Critical compressibility factor. The Law of corresponding states. Lequifaction of gases.

Unit- II (23 Periods)

Liquid States: Structure of liquids. Properties of liquids – surface tension, viscosity vapour pressure and optical rotations and their determination.

Solid State: Classification of solids, Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements of crystals. Definition of unit cell & space lattice. Bravais lattices, crystal system. X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl.

Liquid crystals: Difference between solids, liquids and liquid crystals, types of liquid crystals. Applications of liquid crystals.

Paper BTI-107
Organic Chemistry

Max Marks: 33
Internal assessment: 3
Time: 3 hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Unit- I (23 Periods)

Structure and Bonding: Localized and delocalized chemical bond, van der Waals interactions, resonance: conditions, resonance effect and its applications, hyperconjugation, inductive effect, Electromeric effect & their comparison.

Stereochemistry of organic compounds: Concept of isomerism. Types of isomerism. Optical isomerism - elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, R & S systems of nomenclature. Geometric isomerism - determination of configuration of geometric isomers. E & Z system of nomenclature. Conformational isomerism - conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds,. Newman projection and Sawhorse formulae, Difference between configuration and conformation.

Unit- II (22 Periods)

Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents – electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates - carbocations, carbanions, free radicals, carbenes, (formation, structure & stability).

Alkanes and Cycloalkanes: IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity. Cycloalkanes - nomenclature, synthesis of cycloalkanes and their derivatives –photochemical (2+2) cycloaddition reactions, , dehalogenation of α,ω-dihalides, pyrolysis of calcium or barium salts of dicarboxylic acids, Baeyer's strain theory and its limitations., theory of strainless rings.

Paper BTI-108
(Lab. Course -1 based on Paper- BTI-101 &102)

Max Marks: 40
Internal assessment: 10
Time: 3 hrs.

1. Qualitative tests for Carbohydrates
2. Qualitative tests for Proteins and Amino acids
3. Qualitative tests for Lipids
4. Separation of Lipids by TLC method
5. Separation of sugars/amino acids by Paper Chromatography
6. Determination of saponification value of Lipids.
7. Determination of acid value of Lipids
8. Verification of Beer's Lambert law.
9. Protein estimation by Lowry's method.
10. Estimation of Lactose in given sample.
11. Isolation of DNA from Onion peel.
12. Estimation of DNA by diphenylamine method.

Paper BTI-109
Lab. Course - II based on Paper- BTI-103 & 104

Max Marks: 40
Internal assessment: 10
Time: 3 hrs.

1. Cell division: Permanent slides of animal and plant cells and cell division;
2. Mitotic and meiotic studies in grasshopper testes, onion root tips and flower buds
3. Chromosomes: Mounting of polytene chromosomes
4. Effect of different osmotic concentration solutions on animal and plant cells
5. Buccal smear – Barr bodies
6. Karyotype analysis – Man and Onion
7. Man – Normal and Abnormal – Down and Turner's syndromes (with the help of slides)
8. Simple genetic problems (Problems and Interaction of genes)
9. Chromosome mapping using three point test cross; tetrad analysis,
10. Induction and detection of mutations through genetic tests;
11. Demonstration of genetic principles using laboratory organisms;
12. Pedigree analysis in humans,

Semester II

Paper BTI-201
Microbiology

Max Marks: 65
Internal assessment: 10
Time: 3 hrs.

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Unit I

Introduction and Scope of Microbiology: Definition and history of microbiology, contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Importance and scope of Microbiology as a modern Science Branches of microbiology.

Microscope: Construction and working principles of different types of microscopes – compound, dark field, Phase contrast, Fluorescence and Electron (Scanning and transmission)

Microbial techniques Sterilization: Principles and Applications of a. Physical Methods. Autoclave, Hot air oven, Laminar airflow, Seitz filter, Sintered glass filter, and membrane filter.

Chemical Methods: Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents.
Radiation Methods: UV rays and Gamma stains. Stains and staining techniques: Principles of staining, types of stains – simple stains, structural stains and Differential stains.

Unit II

Microbial Taxonomy: Concept of microbial species and strains, classification of bacteria based on – morphology (shape and flagella), staining reaction, nutrition and extreme environment.

General Account of Viruses and Bacteria

A. Bacteria – Ultrastructure of bacteria cell (both Gram positive and Gram negative) including endospore and capsule
B. Viruses – Structure and classification
   Plant viruses – CaMV
   Animal viruses – Hepatitis B
   Bacterial Virus – Lamba Phage

Pathogenic Microorganisms

A. Bacterial diseases of man – tetnus, Tuberculosis, Pneumonia and Cholera
B. Viral diseases: AIDS (HIV)

Microbial Growth and Metabolism: Kinetics of microbial growth, growth curve, synchronous growth, factors affecting bacterial growth Respiration: EMP, HMP and ED Pathways, Kreb's cycle, Oxidative Phosphorylation. Bacterial Photosynthesis: Photosynthetic apparatus in prokaryotes, Photophosphorylation & Dark reaction.

REFERENCES

1. **Microbiology – PD Sharma**

Paper BTI-202
Biophysics

Max Marks: 65
Internal assessment: 10
Time: 3 hrs.

NOTE

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2. As far as possible the question will be of short answer type.
3. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit- I

Measurement of pH: Principles of glass and reference electrodes.

Hydrodynamic Methods: Sedimentation: sedimentation velocity including factors affecting it, preparative and analytical centrifugation techniques, ultracentrifugation, determination of molecular weight by hydrodynamic methods (derivations excluded and numericals included).

Chromatographic techniques- General principles and applications of adsorption, ion-exchange, molecular-sieve, thin layer, hydrophobic, affinity & paper chromatography.

Unit- II

Electrophoresis- Basic principles of electrophoresis; Native & SDS-PAGE; Agarose gel electrophoresis and Isoelectric focussing.

Radioisotopic Techniques: Types of radiations, radioactive decay, units of radioactivity, detection and measurement of radioactivity (methods based on gas ionization and liquid scintillation counting) and Quenching. Autoradiography: overview, nuclear emulsions used in biological studies, isotopes commonly used in biochemical studies (^{32}P, ^{35}S, ^{14}C and ^{3}H), track length of emitted particles and physical arrangements between emitting source and emulsion. Biological hazards of radiations and safety measures in handling radioisotopes. Biological applications of radioisotopes.

Spectroscopic Techniques: Beer-Lambert law, light absorption and its transmittance, extinction coefficient, a brief account of instrumentation and applications of visible and UV spectroscopic techniques (structure elucidation excluded).

REFERENCES

1. Physical Biochemistry, 2nd edition, by D Friefelder (1983). W.H. Freeman & Co., U.S.A.

2. Biophysical Chemistry: Principles and Techniques, 2nd edition, by A. Upadhyay, K. Upadhyay and N.Nath. (1998). Himalaya Publishing House, Delhi.
3. Principles & Techniques of Practical Biochemistry, 5th edition, by Keith Wilson and John Walker (2000). Cambridge University Press.
4. Introductory Practical Biochemistry by S.K. Sawhney and Randhir Singh (2000). Narosa Publishing House, New Delhi.

Paper BTI-203
Animal Diversity

Max Marks: 65
Internal assessment: 10
Time: 3 hrs.

.**NOTE**

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3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit- I

General classification of animal kingdom.

Non-chordates:

Study of phylum Protozoa, Porifera, Ceolenterata

Platyhelmenthes, Nemathelmenthes, Arthropoda, Mollusca &

Echinodermata – General characters, biodiversity with economic importance

Unit- II

Chordates:

Study of Urochordates , Cephalochordates and Vertebrates-General

characters ,biodiversity with economic importance

Paper BTI-204
Plant Diversity

Max Marks: 65
Internal assessment: 10
Time: 3 hrs.

NOTE

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2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. Each question will carry 13 marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit- I

General Classification of Plant Kingdom: Aims, objectives and functions of taxonomy. Binomial nomenclature and its significance; Principles of ICBN, Study of outline of Bentham and Hooker's system of classification

Algae – General characters and economic importance
Fungi – General characters and economic importance
General account of Lichens and its importance
Bryophytes – General characters and economic importance

Unit- II

Pteridophytes – General characters and economic importance
Gymnosperms – General characters and economic importance
Angiosperms – General characters and economic importance

Paper BTI-205
Inorganic Chemistry

Max Marks: 33
Internal assessment: 4
Time: 3 hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting at least two questions from each section. As far as possible questions will be short answer type and not essay type

Unit- I (23 Periods)

Hydrogen Bonding & Van der Waals Forces

Hydrogen Bonding – Definition, Types, effects of hydrogen bonding on properties of substances, application

Brief discussion of various types of Vander Waals Forces

Metallic Bond and Semiconductors

Metallic Bond- Brief introduction to metallic bond, band theory of metallic bond

Semiconductors- Introduction, types and applications.

s-Block Elements

Comparative study of the elements including , diagonal relationships, salient features of hydrides (methods of preparation excluded), solvation and complexation tendencies including their function in biosystems.

Chemistry of Noble Gases

Chemical properties of the noble gases with emphasis on their low chemical reactivity, chemistry of xenon, structure and bonding of fluorides, oxides & oxyfluorides of xenon.

Unit- II (22 Periods)

p-Block Elements

Emphasis on comparative study of properties of p-block elements (including diagonal relationship and excluding methods of preparation).

Boron family (13th gp):-

Diborane – properties and structure (as an example of electron – deficient compound and multicentre bonding), Borazene – chemical properties and structure Trihalides of Boron – Trends in fewis acid character structure of aluminium (III) chloride.

Carbon Family (14th group)

Catenation, pה– d הbonding (an idea), carbides, fluorocarbons, silicates (structural aspects), silicons – general methods of preparations, properties and uses.

Nitrogen Family (15th group)

Oxides – structures of oxides of N,P. oxyacids – structure and relative acid strengths of oxyacids of Nitrogen and phosphorus. Structure of white, yellow and red phosphorus.

Oxygen Family (16th group)

Oxyacids of sulphur – structures and acidic strength H_2O_2 – structure, properties and uses.

Halogen Family (17th group)

Basic properties of halogen, interhalogens types properties, hydro and oxyacids of chlorine – structure and comparison of acid strength.

Paper BTI-206
Physical Chemistry

Max Marks: 33
Internal assessment: 4
Time: 3 hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type.

Unit- I (22 Periods)

Kinetics: Rate of reaction, rate equation, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction. Half life period of a reaction. Methods of determination of order of reaction, effect of temperature on the rate of reaction – Arrhenius equation. Theories of reaction rate – Simple collision theory for unimolecular and bimolecular collision. Transition state theory of Bimolecular reactions.

Unit- II (23 Periods)

Electrochemistry: Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, molar conductance,equivalent conductance and relation among them, their vartion with concentration. Arrhenius theory of ionization, Ostwald's Dilution Law. Debye- Huckel – Onsager's equation for strong electrolytes (elementary treatment only) Transport number, definition and determination by Hittorfs methods, (numerical included), Kohlarausch's Law, calculation of molar ionic conductance and effect of viscosity temperature & pressure on it. Application of Kohlarausch's Law in calculation of conductance of weak electrolytes at infinite diloution. Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids determination of solubility product of sparingly soluble salts, conductometric titrations. Definition of pH and pK_a, Buffer solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action.

Paper BTI-207
Organic Chemistry

Max Marks: 33
Internal assessment: 3
Time: 3 hrs.

Note: Eight questions will be set, four questions from each section. The candidate will be required to attempt five questions in all, selecting atleast two questions from each section. As far as possible questions will be short answer type and not essay type

Unit- I (23 Periods)

Alkenes

Nomenclature of alkenes, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes - mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration–oxidation, oxymercuration-reduction, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$

Arenes and Aromaticity

Nomenclature of benzene derivatives:. Aromatic nucleus and side chain.

Aromaticity: the Huckel rule, aromatic ions, annulenes up to 10 carbon atoms, aromatic, anti - aromatic and non - aromatic compounds.

Aromatic electrophilic substitution - general pattern of the mechanism, mechansim of nitration, halogenation, sulphonation, and Friedel-Crafts reaction. Energy profile diagrams. Activating , deactivating substituents and orientation.

Unit- II (22 Periods)

Dienes and Alkynes

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of butadiene. Chemical reactions - 1,2 and 1,4 additions (Electrophilic & free radical mechanism), Diels-Alder reaction, Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation of alkynes,

Alkyl and Aryl Halides

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms and stereochemistry of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams.

Methods of formation and reactions of aryl halides, The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.

Paper BTI-208
Lab. Course -III based on Paper- BTI-201 &BTI-202

Max Marks: 40
Internal assessment: 10
Time: 3 hrs.

1. To study the safety measure in microbiology laboratory
2. To study various staining techniques
3. Isolation of bacterial culture from Soil, Water and Air Samples
4. Techniques of spreading and streaking.
5. Different microscopic techniques
6. Identifications of different characteristics of bacteria
7. Preparation of buffers using buffer tables
8. Isolation of cellular components by differential centrifugation
9. Verification of Beer's Lambert law
10. Preparation of standard curve and determination of protein concentration by Lowry's method
11. Separation of amino acids by paper chromatography.
12. Agarose Gel electrophoresis

Paper BTI-209
Lab. Course -IV based on Paper- BTI-203 & BTI-204

Max Marks: 40
Internal assessment: 10
Time: 3 hrs.

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- Study of museum specimens and field visits to study animal biodiversity
- Study of museum specimens and field visits to study plant biodiversity

Paper BTI-210

Lab. Course -V based on Paper- BTI-105, BTI-106, BTI-107, BTI-205, BTI-206 & BTl-207

Max Marks: 65
Internal assessment: 15
Time: 6 hrs.

Unit- I (Inorganic)

Volumetric Analysis

1. **Redox titrations**: Determination of Fe^{2+} , $C_2O_4^{2-}$ (using $KMnO_4$, $K_2Cr_2O_7$)
2. **Iodometic titrations:** Determination of Cu^{2+} (using standard hypo solution).
3. **Complexometric titrations:** Determination of Mg^{2+} , Zn^{2+} by EDTA.

Paper Chromatography

Qualitative Analysis of the any one of the following Inorganic cations and anions by paper chromatography (Pb^{2+} , Cu^{2+} , Ca^{2+} , Ni^{2+} , Cl^- , Br^- , I^- and PO_4^{3-} and NO_3^-).

Unit- II (Physical)

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetatecatalyzed by hydrogen ions at room temperature.
2. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.
3. To determine the surface tension of a given liquid by drop number method.
4. To determine the viscosity of a given liquid**.**
5. To determine the specific refractivity of a given liquid

Unit- III (Organic)

1. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point
   (i) Iodoform from ethanol (or acetone)
   (ii) *m*-Dinitrobenzne from nitrobenzene (use 1:2 conc. HNO_3-H_2SO_4 mixture if fuming HNO_3 is not available)
   iii) p-Bromoacetanilide from acetanilide
   iv) Dibenzalacetone from acetone and benzaldehyde
   v) Aspirin from salicylic acid
2. To study the process of) sublimation of camphor and phthalic acid,

Semester –III

Paper BTI-301
Biomathematics

Max. Marks: 65
Internal assessment: 10
Time: 3 hrs

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

Unit I

Complex Numbers: Introduction, Operations on complex numbers, Complex conjugate, Modules and argument of complex number and simple examples on it.,.4 DE MOIVRE'S Theorem., Simple examples on above theorem ,th n roots of a complex number and simple examples on it.

Matrices: Definition and types of Matrices, Algebra of Matrices (addition, subtraction, scalar multiplication and multiplication of matrices), Examples on operation of Matrices, Inverse of a matrix by a ad joint method, Rank of a Matrix (Definition) and examples, System of Linear equation, Non homogenean, Homogenean with examples, Eigen values and eigen vectors with simple examples

Unit II

Differential equation: Definition of ordinary differential equation and degree, order of differential equation Exact differential equation with simple examples, Linear differential equation dy/dx+py =Q method of solution with simple examples. Bernoulli's differential equation with examples, Application of differential equation i) Growth and decay problems ii) Newton's law of cooling with examples.

Partial differentiation: Introduction, Simple examples on evaluation of partial derivatives, Composite function with examples, Homogenous function (Definition), Euler's theorem for first and second order., Simple examples on above theorems., Extreme values with examples., Lagrange's method of undetermined multipliers (with proof), Examples on above method.

REFERENCES:

1. Partial Differential Equation by IN Sneiden
2. Matrices by Shanti Narayan
3. Complex Variables by Shanti Narayan
4. Ordinary Differential Equation by Saplay & Ross

Paper BT1-302
Enzymology

Max. Marks: 65
Internal assessment: 10
Time: 3 hrs

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

Unit- I

Enzymes: Historical perspectives, general characteristics, nomenclature & classification, significance of numbering system, holoenzyme, apoenzyme, coenzymes, cofactors, activators, inhibitors, active site, metallo-enzymes, isoenzymes, monomeric enzymes, oligomeric enzymes, multifunctional enzyme and multi-enzyme complexes. Enzyme specificity. Measurement and expression of enzyme activity: Enzyme assay, enzyme units, enzyme turn over number and specific activity.

Role of cofactors in enzyme catalysis: NAD/NADP, FMN/FAD, coenzyme A, biocytin, Vitamin B12 Coenzyme, lipoamide, TPP, pyridoxal phosphate, tetrahydrofolate and metal ions with special emphasis on coenzyme functions

Enzyme catalysis:
Reaction co-ordinate diagram, transition state, Acid-base catalysis, covalent catalysis, proximity and orientation effects, strain and distortion theory. Mechanism of action of chymotrypsin, carboxypeptidase,and ribonuclease.

Enzyme Purification:
Methods of isolation of enzymes, purification of enzymes - ammonium sulfate precipitation, molecular-sieving, ion-exchange chromatography, affinity chromatography, criteria of homogeneity and determination of molecular weight of enzyme.

Unit- II

Enzyme Kinetics:
Factors affecting enzyme activity- enzyme concentration, substrate concentration, pH and temperature. Derivation of Michaelis - Menten equation for uni-substrate reactions. Km and its significance. Lineweaver-Burk plot. Importance of Kcat/Km. Bi-substrate reactions- brief introduction of sequential and ping-pong mechanisms with examples. Reversible (competitive, non-competitive and uncompetitive inhibitions) and irreversible inhibition. Determination of Km & Vmax in the presence and absence of inhibitor.

Enzyme regulation:

Feed back inhibition, Allosteric enzymes. Covalently modulated enzymes. Zymogen activation.

Immobilized enzymes:
Advantages, methods of immobilization - Adsorption, ionic binding, covalent coupling, cross-linking, entrapment, microencapsulation etc. Applications of immobilized enzymes (A brief account). Industrial applications of enzymes (Production of glucose from starch, cellulose and dextran; use of lactase in dairy industry; production of glucose-fructose syrup from sucrose; use of protease in food, detergent and leather industry).

REFERENCES:

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry by Trevor Palmer (2001) Horwood Publishing.
2. Fundamentals of Enzymology, 3rd edition, by Nicholas C. Price and Lewis Stevens (1999) Oxford U.
3. The Chemical Kinetics of Enzyme action by K.J. Laidler and P.S. Bunting, Oxford University Press London.
4. Structure and mechanism in Protein Science, 2nd edition, by Alan Fersht (1999). W.H. Freeman and Co., NY

Paper BT1-303
Animal Physiology

Max. Marks: 65
Internal assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

Unit- I

Digestive system: Types of nutrition, ingestion, digestion, absorption, and assimilation, BMR.

Cardiovascular System: Types of circulatory systems, Composition of Blood, blood coagulation, Haemopoiesis, blood volume, blood pressure, control of blood pressure, cardiac cycle, origin and conduction of heart beat, control of heart beat, ECG – its principle and significance

Respiratory system: transport of gases, exchange of gases, neural and chemical regulation of respiration.

Excretory system: excretory products, kidney, structure of nephron, urine formation, urine concentration, micturition, osmoregulation

Unit- II

Nervous system: Neurons, generation and transmission of nerve impulse neurotransmitors

Muscle physiology: Types of muscular tissue, ultrastructure of myofibrillar filaments, neuro muscular junctions, physical and chemical changes in muscle contraction, energy for muscle contraction, Cori's cycle

Endocrinology: Endocrine glands and their functions, basic mechanism of Peptide and steroid hormones,

Reproduction: Menstrual and oestrual cycle, implantation, gestation, parturition

REFERENCES:

1. Guyton Medical Physiology Textbook By Guyton and Hall
2. C. C. Chatterji**,** Human Physiology
3. Human physiology: the basis of medicine V Higgins Edited by Gillian Pocock, Christopher D Richards. Published by Oxford University Press, 2004, ISBN
4. Ross & Wilson, Anatomy & Physiology in Health & Illness, Churchill
5. Livingstone.Tortora GJ, & Anagnodokos NP, Principles of Anatomy & Physiology, Harper & Rave Publishers, New Delhi.
6. Keele, C.A., Niel, E and Joels N, Samson Wright's Applied Physiology, Oxford University Press

Paper BTI-304
Plant Physiology

Max. Marks: 65
Internal assessment: 10
Time: 3 hrs

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

Unit I

Photosynthesis: Introduction and significance, structure of chloroplast, photosynthetic pigments, Light and dark reaction

Respiration: Introduction and significance, Aerobic and anaerobic respiration, Glycolysis, Citric acid cycle; plant mitochondrial electron transport and ATP synthesis.

Mineral Nutrition: Essential micro and macro elements and their role in plant growth, nitrogen metabolism-a brief account

Unit II

Growth and development: Introduction and phases of growth, role of growth hormones (Auxins, Gibberellins, Cytokinins, Ethylenes, Abscisic acid) Photoperiodism and Physiology of Flowering.

Plant water relation: Importance of water and its physical properties, diffusion, osmosis**,** absorption and transport of water in plants, transpiration and physiology of opening and closing of stomata.

Stress physiology: Abiotic (water, temperature and salt) stresses; An introduction to responses of plants to biotic (pathogen and insects) stresses.

REFERENCES:

1. Buchanan BB,Gruissem,W and Jones RL (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Physiologists, Maryland, USA
2. Davies, Peter J(1995) Plant Hormones: Physiology, Biochemistry and Molecular Biology.2nd edition, Kluwer Academic Publishers, The Netherlands
3. Noggle, GR and Fritz GJ (1983) Introductory Plant Physiology, Prentice-Hall of India Pvt Ltd, New Delhi,2nd Ed 7th reprint 1993
4. Salisbury, FB and Ross CW (1992) Plant physiology.4th ed, Wadsworth Publishing Co Belmont, California, USA
5. Taiz L and Zeiger,E (1998) Plant Physiology,2nd ed Sinauer Associates, Inc.,Publishers,Massachusetts,USA.
6. Wilkins,MB (1987) Advanced Plant Physiology,ELBS,Longman,England.

Paper BTI-305
Introduction to Computer

Max. Marks: 65
Internal assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

Unit-I

Operating System: Definition, Functions, Process Management, Multiprogramming, Multitasking, Multiprocessing, Time sharing, Memory Management, Uni-programming, Memory model, Multiprogramming Memory Model, Virtual Memory, Security, Some popular O.S., Ms-DOS, Microsoft Windows, Unix

Office Operation: Microsoft Word-concept of toolbar, character, paragraph & document formatting, drawing toolbar, Header, Footer, Document editing, Page setup, short cut Keys, Text and graphics

Microsoft Excel-Concept of spreadsheet, Creating worksheet, Well formatted documents, concept of row, column, cell and formula bar, using function, using shortcuts, charts, conditional formatting

PowerPoint- Slide presentation, slide layout, Design, custom animation

Unit-II

Database Management System-Need of database, data models-Hierarcical, Network, Relational, Object Oriented, Main components of DBMS-DDL, DML.

Introduction to Programming- Algorithm, Flowchart, Pseudocode, Fundamentals of C Character set, keywords, identifiers, data types, constants, symbolic constants, escape sequences, variables. Arithmetic, relational & logical operators, type conversions in expressions.

Input/output-
Printf(), scanf(), getchar(), putchar(), gets(), puts(), enum, sizeof() operator
Formatting input/output
Control Structures & Array
If, if..else, nested if, switch statement, while loop , do.. while loop , for loop, continue & break statement

Array- declaration, initialization of One dimensional & two dimensional array, character array, strlen(), strcpy(), strcmp(), strcat().

REFERENCES:

1. Let us C by Yashwant
2. Ms Office BPB publications
3. Operating System by Galvin
4. C-Language by Gotfried Schwan's series

Paper BTI-306
Lab. Course-VI based on Paper -BTI-301 &BTI-305

Max. Marks: 40
Internal assessment: 10
Time: 6 hours
(Two sessions)

1. Three Exercise based on each of the following as per theory syllabus:
   - Complex numbers
   - Matrices
   - Differential equation
   - Partial differentiation

2. Exercises based on C and MS office

Paper BTI-307

Lab. Course -VII based on Paper - BTI-302, BTI-303 & BTI-304

Max. Marks: 60
Internal assessment: 15
Time: 6 hours
(Two sessions)

1. Estimation of acid phosphatase activity from germinating mungbean seeds.
2. Estimation of specific activity of acid phosphatase.
3. Effect of enzyme concentration on enzyme activity.
4. Effect of substrate concentration on acid phosphatase activity and determination of its Km value.
5. Effect of pH on enzyme activity and determination of optimum pH.
6. Effect of Temperature on enzyme activity.
7. RBC Count by hemocytometer
8. Determine TLC/DLC/ESR
9. Estimation of Hb by Sahli's method
10. Qualitative analysis of sugar, protein, ketone bodies and bile pigments in urine.
11. Effect of temperature, pH on the activity of salivary amylase
12. Demonstration of osmosis and plasmolysis and imbibition
13. Isolation of photosynthetic pigments by chromatography
14. Study of effects of conc. of CO_2 and quality of light on the rate of photosynthesis
15. Demonstration of aerobic and anaerobic respiration
16. Demonstration of rate of plant growth by Arc Auxanometer method
17. Study of transpiration by Four leaf method and Cobalt chloride method
18. Demonstration of Transpiration by Ganong's Potometer method.

REFERENCES:

- Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
- Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
- Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
- Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.
- A Lab. Manual in Biochemistry by J. Jayaraman (1996) New Age International (P) Ltd.

Semester-IV
Paper BTI-401
Cytochemistry & Histochemistry

Max. Marks: 65
Internal assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

Unit-I

Scope of cytochemistry
Principles, Instrumentation and application of microscopy

1. Light microscopy
2. Phase contrast microscopy
3. Fluorescence microscopy
4. Confocal microscopy
5. Transmission Electron microscopy
6. Scanning Electron microscopy

Unit-II

Scope of histochemistry
Methodology and instrumentation

1. Fixatives Types and choice
2. Tissue processing techniques for light microscope
3. Tissue processing techniques for election microscopy (SEM and TEM).
4. Classification and chemistry of biological stains. General and specific vital stains and fluorochromes
5. Types of microtomes-Rotary, Sledge, Freezing Cryostat and Ultratomes
6. Detection and localization of primary metabolites- Carbohydrates (PARS reaction), Proteins (Coomassie brilliant blue staining), Lipids (Sudan Black method). Brief mention about other methods also.
7. Enzyme histochemistry (General design and applications)

REFERENCES:

1. Gary, P. 1964. Hand Book of basic microtechnique, John Wiley & Sons, New York.
2. Harris, Electron microscopy in Biology
3. Kierman, J.A. 1999. Histological and Histochemical Methods. Butterworth Publications, London
4. Pearse, histochemistry, Vol. I and Vol.II.

Paper BTI-402
Metabolism

Max. Marks: 65
Internal assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

UNIT-I

Bioenergetics: Concept of free energy, standard free energy, relation between equilibrium constant and standard free energy change and coupled reactions. Biological oxidation-reduction : redox potentials, relation between standard reduction potentials and free energy change (numericals included). High-energy compounds: phosphate group transfer potential, free energy of hydrolysis of ATP, PEP and glucose-6 phosphate along with reasons for high ΔG.

Carbohydrate Metabolism: Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Feeder pathways, Entry of fructose into glycolysis. Reactions and energetics of TCA cycle. Regulation of glycolysis and TCA cycle. Gluconeogenesis. Glycogenesis and glycogenolysis. Reactions and physiological significance of pentose phosphate pathway.

Electron Transport Chain and Oxidative Phosphorylation: Structure of mitochondria, organization and sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain. Oxidative phosphorylation: chemiosmotic theory, structure of ATP synthase, Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing equivalents from cytosol into mitochondria.

UNIT-II

Lipid Metabolism: Introduction, hydrolysis of triacylglycerols, activation of fatty acids, transport of fatty acyl CoA into mitochondria, beta-oxidation of saturated, and odd chain fatty acidss. ATP yield from fatty acid oxidation. Biosynthesis of saturated fatty acids. triglycerides. Metabolism of ketone bodies.

Amino acid Metabolism: General reactions of amino acid metabolism: transamination, oxidative and non-oxidative deamination and decarboxylation. Urea cycle. Glycogenic and ketogenic amino acids. Biosynthesis of aromatic amino acids. Glucose-Alanine cycle.

Nucleotide Metabolism: Sources of the atoms in the purine and pyrimidine molecules, denovo biosynthesis and degradation of purine and pyrimidine nucleotides, Regulation of purine and pyrimidine biosynthesis. Salvage pathways of purines and pyrimidines.

REFERENCES:

1. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
2. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999). John Wiley & Sons, NY
3. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999). Saunders College Publishing, NY.
4. Outlines of Biochemistry by E.E.Conn, P.K.Stumpf, G. Bruenimg and Ray H.Doi (1987). John Wiley & Sons, NY
5. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.

Paper BTI-403
Anatomy

Max. Marks: 65
Internal assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

UNIT-I

Comparative account of various systems in chordates (with particular reference to Labeo, Frog, Lizard, Pigeon and rat)

Integument and its derivatives: general structure and function of skin and its derivatives: Glands, scales, horns, claws, nails, hoofs, feathers and hairs

Circulatory system: General plan of circulation in various groups, Comparative account of heart

Respiratory system: Comparative account of respiratory organs

UNIT-II

Urinogenital system: Evolution of urinogenital system in vertebrate series, Comparative account of urinogenital system

Nervous system: Comparative anatomy of the brain. Nerves-cranial, peripheral and autonomous nervous systems

Sense organs: Eye, ear, Lateral line system, Jacobsons' organ

REFERENCES:

1. Alexander, R.M. The Chordata. Cambridge University Press,London.
2. Carter, G.S. Structure and habit in vertebrate evolution. Sedwick and Jackson, London.
3. Kingsley, J.S. Outlines of comparative autonomy of vertebrates.Central Book Depot, Allahabad.
4. Kent, C.G. Comparative anatomy of vertebrates.
5. Smith, H.S. Evolution of chordate structure. Hold Rinehart and Winstoin Inc., New York.
6. Romer, A.S. Vertebrate Body, III Ed. W.B. Saunders Co.,Philadelphia
7. Young, J.Z. Life of vertebrates. The Oxford University Press,London
8. Weichert, C.K. and Presch, W. Elements of Chordate anatomy.4th Edn. McGraw Hill Book Co., New York.
9. Kent, G. C. and R.K. Carr. 2001. Comparative anatomy of the vertebrates. 9th edition. McGraw Hill Publ., Boston, MA. 524 pp.

Paper BTI-404
Microbial Genetics

Max. Marks: 65
Internal assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each unit. All questions carry equal marks.

Unit-I

Prokaryotic Genomes: Physical organization of bacterial genomes (Structure of the bacterial nucleoid, Replication and partitioning of the bacterial genome).

DNA replication: Mechanism of DNA replication-conservayive, semiconservative and dispersive types, experimental evidence for semiconservative replication, enzymes and accessory proteins, proof reading, inhibitors in prokaryotic replication.

Mutations: Spontaneous and induced (physical and chemical mutagens), DNA repair mechanisms Direct repair- photolyase and Ada, Mismatch repair- *mutSLH*, Recombinational repair- *recA, recFOR, recBCD,* SOS and translation synthesis- *umuCD*, Mutator genes. Molecular mechanisms of mutations: Point mutations, base substitution-transition and transversion (framshift mutations deletion, addition),

Unit-II

Genetic Transformation: Griffith's Experiment, Genetic change: transformation, transduction, conjugation, plasmids.

Mechanism of genetic exchange: Plasmid and bacterial sex, Types of plasmids (F Plasmid : a Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes. Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu–virus);

Bacteriophages: Stages in the Lytic Life Cycle of a typical phage, Properties of a phage infected bacterial culture, Specificity in phage infection, E. coli PhageT4, E.coli Phage T7, E.coli phage lambda, Immunity to infection, Prophage integration, Induction of prophage, Prophage excision, Repressor, Structure of the operator and binding of the repressor and the Cro product, Decision between the lytic and lysogenic Cycles, Transducing phages, E.coli phage phiX174, filamentous DNA phages, Single stranded RNA phages, The lysogenic Cycle.

REFERENCES:

1. Maloy et al 1994, Microbial genetics, Jones & Barlett publishers

2. Dale JW 1994, Molecular Genetics of Bacteria, John Wiley & sons
3. Lewin 2002, Gene IX oxford University Press
4. Hayes W, Bacterial & Viral Genetics
5. General microbiology (Vth edi) Stanier, Ingraham, Wheelis & Painter
6. Dubey & Maheshwari , Text book of Microbiology

Paper BTI-405
English

Max. Marks: 65
Internal assessment: 10
Time: 3 hours

Text Book **35**

The following text is prescribed for intensive study:

1. Following essays from Ideas Aglow edited by Dinesh Kumar and V.B. Abrol (Publication Bureau, Kurukshetra University, Kurukshetra)
    a) C.E.M. Joad : Our Civilization
    b) Jayant V. Narlikar: It's Question Time
    c) N.Ram :An Interview with Christiaan Barnard
    d) B.R. Ambedkar: Untouchability and the Caste System
    e) Huck Gutman: In humanisation of War
    f) Amartya Sen: Seven Types of Gender Inequality

General English **30**

1. Translation from English to Hindi
2. Precis
3. Official Correspondence: Letter Writing

Scheme of question paper

The paper will have seven questions as per details given below

Q.1. The candidate will be asked to answer comprehension questions based on an extract from the text book. There will be internal choice. **1 x 10=10**

Q.2. The candidate will be asked to explain with reference to the context an extract from the text book. There will be internal choice. **5**

Q.3. There will be five short answer type questions based on the text book. The candidates will be asked to give answers in about 30 words each. There will be internal choice. **2 x 5 =10**

Q.4. There will be two essay type questions based on the text book with internal choice. **10**

Q.5. Translation of a passage of about 10 sentences from English to Hindi **10**

Q.6. Précis: The candidates will be required to summarize a given passage in contemporary English of about 250 words to one-third of its length and also give it a suitable heading. **10**

Q.7. The candidate will be asked to write an official letter. There will be internal choice. **10**

Paper BTI-406
Lab. Course –VIII based on Paper BTI-401 & BTI-403

Max. Marks: 40
Internal assessment: 10
Time: 6 hours
(Two sessions)

1. Tissue fixation, processing and sectioning to prepare histological slides
2. Staining (H&E) and permanent slide preparation
3. Detection of carbohydrates/ lipids/ muco polysaccharides/ nucleic acids /proteins in the tissues by histochemical techniques
4. To study the anatomy of various mammalian organs.
5. To study the skin derivatives i.e. hair, feather, claws,

REFERENCES:

- Gary, P. 1964. Hand Book of basic micro technique, John Wiley & Sons, New York.
- Harris, Electron microscopy in Biology
- Kierman, J.A. 1999. Histological and Histochemical Methods. Butterworth Publications, London
- Pearse, histochemistry, Vol. I and Vol.II.
- Fishbeck, D. W. and A. Sebastiani. 2001. Comparative Anatomy Manual of Dissection. Morton Publ. Co., CO.

Paper BTI-407
Lab. Course IX based on Paper BTI -402 & BTI-404

Max. Marks: 40
Internal assessment: 10
Time: 6 hours
(Two sessions)

1. Estimation of nitrogen by micro-Kjeldahl method/Nessler`s reagent.
2. Estimation of blood glucose by o-toludine method.
3. Estimation of ascorbic acid by titrimetric method.
4. Preparation of starch from potato and its hydrolysis by salivary amylase
5. Determination of achromatic point for salivary amylase.
6. Isolation of total lipids by Folch method.
7. Titration of amino acids and determination of pKa value
8. Preparation of Nutrient Agar Media
9. Different Method of Plating and preparation of agar slant.
10. Preparation of pure culture
11. Culture of E.coli in Luria Bertani Media and Study of Bacterial Cell Count by using spectrophotometer
12. Isolation of DNA from E.coli and analysis by agarose gel electrophoresis
13. Isolation of RNA from E.coli
14. Isolation of Plasmid from E.coli and analysis by agarose gel electrophoresis

REFERENCES:

- Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
- Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
- Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.

Semester V

Paper BTI 501
Immunology-1

Max Marks: 65
Internal Assessment: 10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit I

Introduction to immune system: Memory, specificity, diversity, innate and acquired immunity, self vs non-self-discrimination, structure and functions of primary and secondary lymphoid organs

Cells involved in immune responses: Phagocytic cells and their killing mechanisms; T and B lymphocytes, differentiation of stem cells and idiotypic variations

Nature of antigen and antibody: Antigens vsimmunogen, haptens, structure and functions of immunoglobulins; isotypic, allotypic and idiotypic variations

Humoral and cell mediated immune responses: kinetics of primary and secondary immune responses, complement activation and its biological consequences, antigen processing and presentation, cytokines and costimulatory molecules- role in immune responses, T and B cell interactions.

Major Histocompatibility Complex (MHC) genes and products: polymorphism of MHC genes, role of MHC antigens in immune responses, MHC antigens in transplantation

Unit II

Generation of diversity in immune system: Clonal selection theory- concept of antigen specific receptor, organization and expression of immunoglobulin genes- generation of antibody diversity, T cell receptor diversity.

Measurement of antigen –antibody interaction: Production of polyclonal and monoclonal antibodies- principles, techniques and applications; Agglutination and precipitation techniques; Radio immunoassay; ELISA; Immunofluorescence assays- Fluorescence activated cell sorter (FACS) technique.

Immunization: Active & passive immunization, vaccines and their types, role of vaccines in the prevention of diseases

Tolerance vs activation of immune system: Immune tolerance, immunosuppression, hypersensitivity (Types I, II, III and IV).

Immune responses in diseases: Immune responses to infectious diseases- viral, bacterial and protozonal; cancer and immune system, immunodeficiency disorders and autoimmunity

REFERENCES:

1. Immunology, 4th ed. by Roitt et al., Mosby Publications
2. Cellular and Molecular Immunology, 5th ed. by Abbas and Litchman (2003), Saunders Publication.
3. Kuby Immunology, 4rd ed. by R.A. Goldsby et al, W.H. Freeman & Co.
4. Immunology: an introduction, 4th Edition by Ian R Tizard, (1995), Saunders College Publishing

Paper BTI 502
Molecular Biology-1

Max Marks: 65
Internal Assessment: 10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit I

Basic Concepts of Genetic Information: Structure of DNA, various forces responsible for stability of DNA, various forms of DNA, DNA topology, topological and geometric properties, DNA supercoiling, Topoisomerases in prokaryotes and eukaryotes, DNA organization in prokaryotes and eukaryotes, C-value paradox, denaturation: different ways for carrying out denaturation, renaturation: requirements, kinetics, significance, various classes of DNA: highly repetitive, moderately repetitive and unique sequence, RNA: structure and types.

DNA replication, mutations and DNA repair: Possible modes of DNA replication, Meselson-Stahl experiment, DNA polymerases and other enzymes involved in DNA replication, Okazaki fragments, Mechanism of replication in prokaryotes and eukaryotes, inhibitors of DNA replication, molecular basis of mutations, DNA repair mechanisms like direct, base-excision, nucleotide-excision, mismatch, SOS and recombinational repair.

Unit II

Transcription and post-transcriptional modifications: RNA polymerase/s in prokaryotes and eukaryotes, DNA footprinting technique, initiation, elongation and termination of transcription in prokaryotes and eukaryotes, inhibitors of transcription, RNA replicase, reverse transcriptase, post-transcriptional modifications: different types of introns and their splicing mechanisms, processing of mRNA, rRNA and tRNA precursors, overlapping genes and split genes.

Protein synthesis, targeting and degradation: Characteristics of the genetic code, biological significance of degeneracy, decoding the code, Wobble hypothesis, ribosomes structure and function in prokaryotes and eukaryotes, AminoacyltRNA-synthetases various factors and steps involved in protein synthesis in prokaryotes and eukaryotes, polyribosomes, post-translational processing, signal hypothesis and protein targeting to

lysosomes, Plasma membrane, extracellular matrix and different compartment of mitochondria and chloroplast, protein degradation.

REFERENCES:

1. Molecular Cell Biology, 5th edition H Lodish et al. (2004) W H Freeman and Company.
2. Genes VIII, B Lewin (2004) Pearson Education International.
3. Freifelder's Essentials of Molecular Biology, 4rd edition, D Freifelder. (2005) Narosa publishing house
4. Biochemistry, 2nd edition, Moran. Neil Patterson Publishing.
5. Fundamentals of Biochemistry, 2nd edition, D Voet& G J Voet. John-Wiley & sons.
6. Biochemistry, 5th edition, JM Berg et al. W H Freeman & Co. N York.
7. Lehninger's Principles of Biochemistry, 4nd edition, D L Nelson and M M Cox. (2005) W H Freeman & Co. N York.
8. The Biochemistry of Nucleic acid, 11th edition, R L Adams et al, Chapman and Hall.
9. Molecular Biology of the Gene, 5th Edition, Watson et al (2004) Pearson Education International.

Paper BTI 503
Developmental Biology

Max Marks: 65
Internal Assessment:10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

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Unit I

Development Biology: Scope & historical perspective
Gametogenesis-Spermatogenesis, Metamorphosis of spermatid, Oogenesis
Fertilization-Definition, mechanism, types of fertilization
Cleavage-definition, types, patterns, Mechanism
Gastrulation- Morphogenetic movements-epiboly, emboly, extension, invagination, Convergence, de-lamination.
Formation and differentiation of primary germ layers
Fate maps in early embryos

Unit II

Differentiation: Cell commitment and determination-epigenetic landscape: a model of determination and differentiation at the level of genome, transcription and post transcriptional
Concept of embryonic induction: Primary ,secondary and tertiary embryonic induction. Neuronal induction and induction of vertebrate lens
Pathway selection, target and address selection
Extra embryonic membranes, placenta in mammals
Neurulation, notogenersis, Development of vertebrate eye
Fate of primary germ layers
Development of behaviour: constancy and plasticity
Aging & Senescence

REFERENCES:

1. **Developmental Biology** by Scott Gilbert

Paper BTI-504
Neutraceuticals

Max Marks: 65
Internal Assessment:10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit 1:

Concept, Biochemistry of nutrition and dietetics

Classification of food components based on nutritional value, nutritional assessment of carbohydrates, proteins and fats, recommended dietary intake, acceptable dietary intake, nitrogen balance, protein efficiency ratio, net protein utilisation. Basics of energy balance - Basal Metabolic Rate (BMR), Body Mass Index (BMI) and Standard Dynamic Action (SDA) with special reference to nutraceutical industry.

Nutrition related diseases and disorders

Malnutrition and factors responsible for nutritional disorders and anti-nutritional factors (cyanogens, lectins, enzyme inhibitors, phytoallexins and phytates); Metabolic disorders - types, nutritional factors, prevention and treatment using nutraceuticals with special reference to diabetes mellitus, hypertension, hypercholesterolemia and others. Concept of antioxidants - use of antioxidants as dietary supplements in prevention and treatment of cancer, obesity and stress. Role of nutraceuticals and functional foods in pediatrics, geriatrics, sports, pregnancy and lactation.

Unit 2

Nutraceuticals of plant and animal origin

Plant secondary metabolites, classification and sub-classification - Alkaloids, phenols, Terpenoids. Extraction and purification, applications in general health and as stimulants. Role of medicinal and aromatic plants in nutraceutical industry

Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment.

Microbial and algal nutraceuticals

Concept of prebiotics and probiotics - principle, mechanism, production and technology involved, applications - examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora - extraction from plant sources. Synbiotics for

maintaining good health. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment.

REFERENCES:

1. Handbook of nutraceuticals and functional foods by Robert E C. Wildman, CRC/Taylor&Francis
2. Handbook of nutraceuticals Vol I by Yahwant Vishnupant Pathak, CRC press.2009
3. Handbook of nutraceuticals Vol II by Yahwant Vishnupant Pathak, CRC press,2011
4. Handbook of Prebiotics, Glenn R. Gibson, Marcel Roberfroid, CRC press, 2008.
5. Swaminathan M., Essentials of Food and Nutrition, 2nd Ed, 1985, Ganesh and Co.
6. Understanding Nutrition, 8''' Edition, by Whitney, E.N. & Rolfes, S.R.. (1999): WesV Wadsworth, An International Thomson Publishing Co.
7. Nutrition in Health and Disease 17th Edition; Anderson, Dibble, Turkki, Mitchell, Rynbergen J.B. Lippincott Company, 1982
8. Nutritional Quality Index of Foods; R.G. Hansen, B.W. Wyse, A.W. Sorenson AVI Publishing Co., Inc., 1979.
9. Dietary Supplements of Plant Origin, M. Maffei (Ed.), Taylor & Francis, 2003.
10. Bioprocesses and Biotechnology for Functional Foods and Nutraceuticals, Jean – Richard Neeser & J. Bruce German, Marcel Dekker, Inc., 2004.
11. Herbal Products –Timotht S. Tracy, Richard L. Kingston.
12. Herbal beauty products with formulation & processes-H. Panda
13. Medicinal Plants (Traditional Knowledge)-P C Trivedi
14. Nutritional Biochemistry, II edition by Tom Brody
15. Nutraceuticals in health and disease prevention, Klaus Krämer, Peter-Paul Hoppe, Lester Packer
16. Zubay, Geoffrey L., Biochemistry, 4th Ed, Dudagye, IAWCB Wm. C. Brown Publishers, 1988, London.
17. Nutraceutical beverages Chemistry, Nutrition and health Effects, Shahidi and Weerasinghe (Ed.), American Chemical Society, 2004.
18. Functional Foods: Principles and Technology, M. Guo, CRC press, 2009.
19. Marine Products for Healthcare, Vazhiyil Venugopal, CRC press, 2008
20. Phytochemicals, Mark S. Meskin, Wayne R. Bidlack, R. Keith Randolph, CRC press, 2008.

M.Sc. integrated Biotechnology
(5-years course)
w.e.f. session 2015-16

BTI- 505 (5th Semester)
HINDI

Max Marks: 65
Internal Assessment: 10
Time: 3 h

पाठ्यग्रंथ :
अभिनव काव्य गरिमा, महर्षि दयानंद विश्वविद्यालय, रोहतक का प्रकाशन
इस पाठ्यपुस्तक से निम्नलिखित चार कवि और उनका काव्य निर्धारित किए गए हैं–
मैथिलीशरण गुप्त, जयशंकर प्रसाद, सूर्यकान्त त्रिपाठी 'निराला' और रामधारी सिंह 'दिनकर'।

निर्देश–

खण्ड : एक (काव्य)

1. पाठ्यपुस्तक से दिए गए चार अवतरणों में से दो की सप्रसंग व्याख्या करनी होगी। प्रत्येक सप्रसंग व्याख्या के लिए 8 अंक निर्धारित हैं। पाठ्यग्रंथ में दिए गए कवियों में से दो का साहित्यिक परिचय पूछा जाएगा, परीक्षार्थी को किसी एक कवि का साहित्यिक परिचय लिखना होगा। इसके लिए 8 अंक निर्धारित हैं। इस प्रकार, इस खण्ड के लिए कुल 24 अंक निर्धारित किए गए हैं।

खण्ड : दो (निबन्ध-लेखन)

2. पाठ्यक्रम में निर्धारित निम्नलिखित आठ विषयों में से पूछे गए पाँच विषयों में से किसी एक विषय पर निबन्ध लिखना होगा। इसके लिए 13 अंक निर्धारित हैं।
विषय– (1) मानवाधिकार, (2) नैतिक शिक्षा, (3) भ्रष्टाचार, (4) विज्ञान और औद्योगिकरण, (5) वैज्ञानिक प्रगति में भारत का योगदान, (6) वैश्वीकरण और विज्ञान, (7) दूरदर्शन, (8) वैश्वीकरण और विज्ञान।

खण्ड : तीन (पत्र-लेखन)

3. सरकारी पत्रों में से पूछे गए दो पत्रों में से एक पत्र लिखना होगा। इसके लिए 13 अंक निर्धारित किए गए हैं।

खण्ड : चार (वैज्ञानिक शब्दावली)

4. पाठ्यक्रम में निर्धारित निम्नलिखित 50 अंग्रेजी शब्दों में से पूछे गए किन्हीं दस शब्दों के हिन्दी-तकनीकी-अर्थ लिखने होंगे। इनके लिए 15 अंक निर्धारित हैं।

1.	[illegible]	जैवमात्रिकी
2.	[illegible]	सम्वरोधन
3.	[illegible]	मिश्र धातु
4.	[illegible]	प्रबन्धक
5.	[illegible]	विश्लेषक
6.	[illegible]	प्रतिजैविक
7.	[illegible]	वायुमंडल
8.	[illegible]	उभयातल ताल
9.	[illegible]	परिकलन यंत्र
10.	[illegible]	अंशन
11.	[illegible]	निस्तापन
12.	[illegible]	कोशिका
13.	[illegible]	उत्प्रेरक
14.	[illegible]	दाहकक्षार
15.	[illegible]	केन्द्रीय अक्ष
16.	[illegible]	प्रमात्रिक
17.	[illegible]	गुणसूत्र
18.	[illegible]	गुच्छ
19.	[illegible]	गुणांक
20.	[illegible]	मित्र
21.	[illegible]	संघनन

22.	ख्वदअसदजपवद	संवहन
23.	ख्वदअमग	अवताल
24.	ख्वठमज	धूमकेतु
25.	क्मबवउखवेपजपवद	आसवन
26.	क्मसिमबजपवद	परिस्थिति विज्ञान
27.	क्पीलकतंजपवद	प्रत्यास्थता
28.	क्पतिपवद	विद्युत परासण
29.	क्पेजपससंजपवद	संतुलन
30.	म्बक्मबहल	तुल्यांक
31.	म्सेंजपबपजल	उष्मारोधी
32.	म्मबजनबत बेजबतपमे	निष्कर्ष
33.	मुपससपक्षापतल	किण्वन
34.	मुपअीमसदज	निषेचन
35.	भ्कवजीठपब	जमना
36.	माजतंजपवद	खंडन
37.	ब्याठमदजंजपवद	सूत्र
38.	ब्याजपससंजपवद	जीवाश्म
39.	ब्यमन्नपदह	घर्षण
40.	ब्येपवद	धारामापी
41.	ब्यतठमसे	जीवाणुभापी
42.	ब्यपबजपवद	ग्रंथि
43.	ब्रींसअंदबठमजमत	समरोपना
44.	ब्रींसअंदबठमजमत	तापक
45.	ब्रमतजपबपकम	क्रमजात
46.	ब्रसंदक	संकर
47.	ब्रतंडि	जलयोजन
48.	भांजमत	ज्वलन
49.	भ्वठत्मबहने	सूचक
50.	भ्वइतापक	जड़ता व

पाठ्यग्रंथ–

1. अभिनव काव्य गरिमा, महर्षि दयानंद विश्वविद्यालय, रोहतक।

सहायक ग्रंथ–

1. प्रतियोगात्मक निबंध संचय : डॉ० चमनलाल गुप्त, मिनर्वा बुक हाउस, शिमला।
2. निबन्ध सौरभ : तनसुखराम गुप्त, सूर्यभारती प्रकाशन, दिल्ली।
3. पत्र-व्यवहार निर्देशिका : डॉ० भोलानाथ तिवारी, वाणी प्रकाशन, दिल्ली।
4. पत्र-कौशल : तनसुखराम गुप्त, सूर्यभारती प्रकाशन, दिल्ली।

M.Sc. integrated Biotechnology
(5-years course)
w.e.f. session 2015-16

BTI- 505 (5th Semester)
Sanskrit

Max Marks: 65
Internal Assessment: 10
Time: 3 h

विशेष निर्देश–

1. प्रश्न-पत्र अधिकतम 65 अङ्कों का होगा। **10** अङ्क आन्तरिक मूल्यांकन के लिये निर्धारित हैं।
2. प्रश्न-पत्र में कुल **पाँच** प्रश्न दिये जाएँगे। प्रत्येक प्रश्न 13 अङ्कों का होगा। **प्रथम प्रश्न** पाठ्यक्रम में निर्धारित चारों घटकों पर आधारित तथा अनिवार्य होगा।

घटक-I : संस्कृत-चयनिका (कुरुक्षेत्र विश्वविद्यालय प्रकाशन):
पद्यभाग : पाठ 1 से पाठ 5 तक–
(1) ईशस्तवः, (2) वयं त्वां भजामः, (3) धर्मज्ञो रामः,
(4) साधुव्रतं चर, (5) विभीषणस्य विलापः।

घटक-II : संस्कृत-चयनिका :
गद्यभाग : पाठ 1 से पाठ 5 तक–
(1) अनुशासनम्, (2) सद्वृत्तम्, (3) बुद्धिर्यस्य बलं तस्य,
(4) नीलवर्णः शृगालः, (5) शशकस्य चातुर्यम्।

घटक-III : संस्कृत-व्याकरण :
शब्द-रूप : राम, देव, लता, फल, मुनि, साधु, मातृ, तद् (तीनों लिङ्गों में), अस्मद्, युष्मद्।

घटक-IV : अच्सन्धि : गुण, वृद्धि, यण्, अयादि।

Paper BTI-506
Lab. Course -X based on Paper BTI-501 & BTI-502

Max. Marks: 40
Internal assessment: 10
Time: 6 hours
(Two sessions)

1. To identify blood group

2. To estimate Hb by cyan-meth haemoglobin method

3. To isolate γ-globulins by ammonium sulfate fractionation

4. To separate globulins and estimate albumin globulin ratio in blood

5. To perform Radial immunoassay

6. To perform Widal test to detect antigen

7. To isolate genomic DNA from plant/animal tissue.

8. Quantification of isolated DNA by UV-spectrophotometer and check its purity.

9. To study DNA denaturation by using UV-spectroscopy.

10. To isolate proteins from chloroplast-enriched fraction of spinach leaves.

11. To perform native and denaturing PAGE

Paper BTI-507
Lab. Course -XI based on Paper- BTI-503 & BTI-504

Max. Marks: 40
Internal assessment: 10
Time: 6 hours
(Two sessions)

1. To perform candling experiment to find out fertilization status of egg.
2. To prepare window in chick egg
3. To study development stages of chick embryo
4. Life cycle of Mosquitoes/ Frog
5. Determination of blood urea
6. Determination of blood uric acid.
7. Determination of blood creatinine.
8. Estimation of blood cholesterol.
9. Determination of free radical scavenging activity and IC50 value for ascorbic acid
10. Determination of reducing capability and IC50 value for ascorbic acid by phosphomolybdate reagent.
11. Determination of superoxide radical scavenging activity and IC50 value for standard antioxidant

Semester VI

Paper BTI 601
Medical Biotechnology

Max. Marks: 65
Internal Assessment:10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit I

Classification of genetic diseases:

Chromosomal disorders – Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions, Chromosomal instability syndromes. Gene controlled diseases – Autosomal and X-linked disorders, Mitochondrial disorders and Multifactorial conditions. Identification of disease genes, Functional cloning –Eg. haemophilia gene. Positional cloning - eg. DMD and CGD genes. Candidate gene approach – Eg. Marfan's syndrome, Alzeimer's disease. Molecular basis of human diseases - Pathogenic mutations. Gain of function mutations: Oncogenes, Huntingtons Disease, Pittsburg variant of alpha 1 antitrypsin. Loss of function - Tumour Suppressor Genes, PAX- 3 gene; Gene Dosage Effect - PMP22 , Collagen gene; Genomic Imprinting -Mechanisms, Praderwilli / Angelman syndrome, WAGR syndrome, Beckwith Weidemann Syndrome; Dynamic Mutations - Fragile- X syndrome, Myotonic dystrophy; Mitochondrial diseases: MELAS, LHON, MERRF
Immuno Pathology, Hepatitis, HIV, Autoimmune Disorders-SLE, RA

Diagnostics

Prenatal diagnosis - Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques - Ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood; Diagnosis using protein and enzyme markers, monoclonal antibodies. DNA/RNA based diagnosis Hepatitis, CML – bcr/abl, HIV - CD 4 receptor; Microarray technology- genomic and c DNA arrays, application to diseases

Unit II

Therapeutics

Clinical management and Metabolic manipulation - PKU, Familial Hypercholesterolemia, Rickets, ADA, Congenital hypothyroidism; Gene therapy Ex-vivo, Invivo, Insitu gene therapy Stratagies of gene therapy: gene augmentation – ADA defeiciency, CFTR Prodrug therapy/ suicide gene – glioma, evoking immune response – melanoma TFO, Antisense therapy, Ribozymes, Protein Aptamers, Intrabodies

Vectors used in gene therapy Biological vectors – retrovirus, adenoviruses, Herpes Synthetic vectors– liposomes, receptor mediated gene transfer; Gene therapy trials – Familial Hypercholesterolemia, Cystic Fibrosis, Solid tumours. Cell and tissue engineering: Encapsulation technology and therapeutics - Diabetes, Hypothyroidism, HaemophiliaBioartificial organs, Artificial Cells- For Haemophilia, Phenylkeptonuria, Diabetes

Stem cell therapy - Embryonic and adullt Stem Cells, Totipotent, Pluripotent and Mulltipotent Cells; Testing and generation of embryonic stem cells, Testing for adult stem cells and differentiation; Potential use of stem cells – Cell based therapies; Nanomedicine - Nanoparticles, Nanodevices-medical microrobotics, nanorobotics Microbiovers, Nanomedicine and Nanosurgery – for cancers, neurological disorders.

Gene products in medicine: Functional cloning – anti-haemophilic factor; Positional cloning- Dystrophin; Gene products in medicine - Humulin, Erythropoietin, Growth Hormone/Somatostatin, tPA, Interferon; DNA based vaccines
subunit vaccines – Herpes Simplex Virus
Attenuated Vaccines– Cholera
Vector vaccines – Cholera and Salmonella

Paper BTI 602
Recombinant DNA Technology

Max Marks: 65
Internal Assessment:10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit I

SALIENT FEATURES OF CLONING VECTORS: Types of cloning vectors viz. Plasmids, cosmids, ssDNA Phages, Yeast cloning vectors, Animal viruses, Ti plasmids and Cauliflower Mosaic Virus.

PLASMID BIOLOGY: Structural and Functional Organization of Plasmids, Plasmid Replication, Stringent and Relaxed Plasmids, Incompatibility of Plasmid Maintenance.

BIOLOGY OF BACTERIOPHAGE LAMBDA: Lambda Phage as a natural in vivo vector, in vitro construction of lambda vector, Classes of vectors and their use.

ENZYMES IN GENETIC ENGINEERING: DNA polymerase, Polynucleotide kinase, T4 DNA ligase, Nick translation system, Terminal deoxynucleotidy1 transferase, Reverse transcriptase Restriction endonucleases Type I & II.

ISOLATION OF GENOMIC AND NUCLEAR DNA: DNA digestion and restriction fragment analysis and sequencing by chemical, enzymatic and big-bye terminator methods.

Unit II

CLONING AND SUBCLONING STRATEGRY: Construction of recombinant DNA: Preparation of competent cell-Transformation, transfection – Recombinant selection and screening; Genomic DNA library; cDNA synthesis strategies – Linkers – Adapters – Homopolymer tailing; Making genomic and cDNA libraries in plasmids and phages. PCR product cloning (TA cloning). Cloning strategies in yeast, E. coli and B. subtilis

SELECTION OF RDNA CLONES AND THEIR EXPRESSION PRODUCTS:

Direct and indirect methods.Drug resistance, gene inactivation, DNA hybridization, colony hybridization and in-situ hybridization (Southern, Northern and Dot blots and immunological techniques Western blotting).

GENE MODIFICATION & APPLICATION OF RECOMBINANT DNA TECHNOLOGY: Mutagenesis - Deletion mutagenesis, Oligonucletoide derived mutagenesis, Site directed mutagensis – Its applications; Applications of rDNA technology in Diagnistics; Pathogensis; Genetic diversity; Therapeutic proteins-Vaccines. Molecular probes (Production, labelling and uses), P.C.R.

REFERENCES

1. "Principles of Gene Manipulation" by R.W.Old and S.B.Primrose Third Edition Blackwell Scientific Publication
2. "Genes VI" by B. Lewin
3. "From Genes to Clones" by E. L. Winnecker.
4. "Gene Cloning " by T. A. Brown

Paper BTI 603
Animal cell culture

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit I

Biology of the Cultured Animal Cells
Cell culture environment, cell adhesion, initiation of the culture, evolution of cell lines, development of continuous cell lines, dedifferentiation, cultured cell, functional environment

Culture Media
Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements, Serum & protein free defined media and their application.

Primary Cell Cultures
Establishment and evolution of primary cultures, characteristics of limited life-span cultures

Continuous Cell Lines
Establishment and properties of continuous cell lines

Unit-II

Cell Line Characterization
Species identification, lineage or tissue markers, unique markers, transformation, morphology, chromosome content, DNA content, RNA and protein, enzyme activity, antigenic markers, differentiation

Cell Cloning
Development of cloning techniques, uses of cloning, special requirement of cells growing at very low densities, cell cloning methods

Stem Cell Cultures
Embryonic and adult stem cells and their applications. Totipotent, Pluripotent and Multipotent stem cells.

Applications of Animal Cell Culture

In vitro toxicity testing, production of viral vaccines, production of high value therapeutics

REFERENCES

1. Animal Cell Culture - Practical Approach, Ed. John R.W. Masters, OXFORD.
2. Animal Cell Culture Methods In: Methods in Cell Biology, Vol. 57, Ed. Jenni P Mather and David Barnes, Academic Press.
3. Animal Cell Culture Techniques. Ed. Martin Clynes, springer.
4. Biotechnology, Vol. 7b 1993 Rehm. H.J. and Reed, G.(eds) VCH Publications.
5. Cell Culture Lab Fax. Eds. M Butler & M. Dawson, Bios Scientific Publications Ltd. Oxford.
6. Cell Growth and Division: a Practical Approach. Ed. R. Basega, IRL Press.
7. Culture of Animal Cells, (3rdedition), R. Ian Freshney. Wiley-Liss.

Paper BTI 604
Plant Cell Culture

Max Marks: 65
Internal Assessment:10
Time: 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit - 1

Plant cell, tissue and organ culture; Introduction to plant cell and tissue culture and historical perspective. Concept of cellular differentiation and totipotency; Laboratory organization, aseptic manipulations and culture media – composition, preparation and development.

Micropropagation – technique, factors affecting micropropagation (physical, chemical, genotypic and others), applications and limitations of micropropagation.
Somaclonal variations, molecular basis of variation and their significance in plant breeding. In vitro germplasm conservation and cryopreservation.

Unit II

Callus culture; Initiation and maintenance of suspension culture- batch and continuous culture, assessment of growth and viability; Organogenesis, somatic embryogenesis and synthetic seeds. Meristem(shoot tip)culture & production of virus free plants
In vitro production of haploid plants – Androgenesis (anther and pollen culture) and Gynogenesis (ovary and ovule culture).Significance and uses of haploids in agriculture.

Wide hybridization and embryo rescue technique.
Protoplast culture and somatic hybridization – Isolation, culture and fusion of protoplast, selection of fusion products and plant regeneration, assessment of somatic hybrid plants, production of cybrids, applications of protoplast culture and somatic hybridization in the improvement of crop plants.

Paper BTI-605
Microbial Biotechnology

Max. Marks : 65
Internal Assessment:10
Time : 3 hrs.

NOTE

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit – I

Microbial Biotechnology : Scopes application and challenges. Isolation preservation and improvement of industrially important microorganisms.Kinetics of microbial growth and product formation.Fermentation system; batch and continuous system, fed batch system, multistage system.Solid state fermentation.

Fermentation raw materials : Media for industrial fermentations; criteria used in media formulation. Fermenter/bioreactor design and operation; types of fermenter, stirred tank reactor, bubble column reactor, airlift reactor, packed bed reactor, fluidized bed reactor and trickle bed reactor, agitation and aeration in a reactor, mass transfer. Foam formation and control.

Unit - II

Industrial production of alcohol (ethanol, wine and beer) and improvement by genetic engineering.Overproduction of primary and secondary metabolites.Microbial production of acids (citric, acetic and gluconic acid) solvents (glycerol acetone and butanol) aminoacids (lysine and glutamic acid).

Microbial polysaccharides : fermentative production of xanthan gums, dextrins and cyclodextrins. Bacterial bioplastics, genetic engineering of micro-organisms and plants for the production of poly-3 hydroxyalkanoates. Biomass production : single cell protein (SCP) production; microbial inoculants; Microbial transformation of steroids and sterols.

REFERENCES:

1. Stansbury P.F. et al. (1997), Principles of Fermentation Technology, Pergmon Press Oxford.
2. Ward O.P., (1998), Fermentation Biotechnology – Principles, Process and Products. Prentice Hall Publishing, New Jersey.
3. Rehm H.J. Reed G.B. Punler A and Stadler (1993), Biotechnology, Vol. 1-8, VCH Publication.
4. Prescolt and Dunn (1992), Industrial Microbiology, 4th Edition CBS Publication, New York.

5. Arnold I. Demain and Julian E. Davies (1999), Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press, Washington D.C.
6. Glazer and Nikaido (1998) Microbial Biotechnology By WH Freeman & Company, New York.
7. Cruger and Cruger (2002), Biotechnology – A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishing Corporation, New Delhi.

Paper BTI-606

Lab. Course -XII based on Paper- BTI-601 & BTI-602

Max. Marks : 40
Internal Assessment:10
Time : 6 hours
(Two sessions)

1. To perform DOT-ELISA.
2. To perform experiment of DNA isolation from blood and its quality determination by agarose gel electrophoresis.
3. Determination of growth inhibition Zone
4. Study in vitro DNA damage and analysis by agarose gel electrophoresis.
5. To study chromosomal aberrations
6. Designing primers in Gene Runner for PCR.
7. To perform PCR with given template and primers.
8. To perform Restriction digestion of given DNA sample.
9. Exploration of Restriction Enzyme Database REBASE
10. Drawing vector DNA map with specified features.

Paper BTI-607

Lab. Course -XIII based on Paper - BTI-603, BTI-604 & BTI-605

Max. Marks : 60
Internal Assessment:15
Time : 6 hours
(Two sessions)

1. Preparation and sterilization of different types of cell culture media *i.e.* RPMI 1640, Balanced Salt solutions, MS basal media, NAM.
2. To isolate lymphocytes from whole blood by gradient centrifugation
3. To culture lymphocytes using RPMI1640 media.
4. To check cell viability by cell counting
5. To check cell viability by MTT staining
6. To study stained preparation of lymphocytes from whole blood
7. To identify the starch/cellulose-degrading bacteria from soil/ termitarium sample(s).
8. Biomass production under solid state fermentation conditions.
9. Surface sterilization of plant explants
10. To induce callus culture from different explants.
11. Seed germination and growth of plantlet by tissue culture.
12. Transfer of the plantlet to hardening medium.
13. To synthesize artificial seeds.

Semester -VII

Paper BTI-701
Biostatistics

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objectives of this course are to introduce basic principles of statistics and mathematics and their applications in relation to Biological system. The aim of the course is to make students able to analyze the experimental data and design scientific proposal.

Outcomes: The students will be aware about importance of statistics; they will also be familiar to various statistical methods to analyze their experimental data.

NOTE:

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Statistics, its meaning and objectives. Population samples, frequency tables and their graphs, measures of central tendency (mean, mode, median) and their dispersion. Concepts of moments, Skewness and kurtosis, Intuitive definition of random variables, probability mass function and probability density function, expectation and variance .Standard distribution; binomial, Poisson and normal distribution with their important properties and significance.

UNIT-II

Fitting of main distributions and testing of goodness –of – the –fit with special reference to $\chi 2$- test, t –test, Z-test. Fitting of trends; linear and quadratic with least square method. Lines of regression, coefficient of correlation, coefficient of variation and their significance. Analysis of variance; one way and two way classification. Learn applications of statistics in the field of biology

REFERENCES:

1. Biostatistics; Arora PN, Malhotra PK, Himalaya Publishing House.
2. Introduction to Biostatistics; Sokal S & Rohit S, Toppan Publication.

Paper BTI-702
Molecular Biology-II

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objective of the course is to make the students understand the diverse mechanisms of regulation of gene expression in prokaryotic and eukaryotic organisms. The role of regulatory RNA molecules and molecular biology of transposons and cancer are also introduced to the students.

Outcomes: After the completion of the course, the students will learn the regulatory mechanisms at molecular level, which control the processes related with metabolism, development and differentiation in bacterial, phage and eukaryotic systems. The pivotal role of RNA in regulation will also be appreciated. The nature and spread of transposable elements as well as molecular basis of cancer will also be learnt.

NOTE

1. Seven questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Gene regulation in prokaryotes: Inducer, repressor, co-repressor and activator concept, +vely and –vely regulated genes, description of various levels of control of gene expression in prokaryotes, operon concept, lac operon: regulation by +ve and –ve mechanisms, trp operon: regulation by -ve and attenuation mechanisms, regulon, regulation of gene expression in lambda phages.

Gene regulation in eukaryotes: Regulatory sequences in eukaryotes like promoter, enhancers, response elements, insulators and silencers, short-term and long term regulation of gene expression, molecular aspects of regulation of gene expression at transcription level like transcription repression by nucleosomes, histone modification by ubiquitination, acetylation, and phosphorylation, at post-transcriptional level like regulation of RNA splicing, RNA transport, RNA stability, at translational, post-translational and protein degradation level in eukaryotes.

UNIT-II

Transposable genetic elements: Discovery, mechanism of nonreplicative and replicative transposition, bacterial transposable genetic elements: simple transposons, complex transposons- the composite family and Tn3 transposon family and mechanisms of

transposition, bacteriophage Mu elements. Eukaryotic transposable genetic elements - Ty elements of yeast, various autonomous and non autonomous elements of maize and mechanism of transposition.

RNA world: RNA world hypothesis, messenger RNA (mRNA), transfer RNA (tRNA), ribosomal RNA (rRNA), antisense RNA, RNA as an Enzyme, as a regulator.
MicroRNA (miRNA)- History of microRNA, definition, composition, Dicer, RNA induced
silencing complex (RISC), modern concepts on their roles in translation inhibition.
Small interfering RNA or silencing RNA (siRNA) - History of siRNA, composition and structure, roles in post-transcriptional gene silencing and potential as therapeutics

Molecular Biology of Cancer: Benign and malignant tumors, types of cancers, cancer causing agents- radiations, chemical compounds, DNA and RNA viruses, mechanism of carcinogenesis, important characteristics of cancerous cells, proto-oncogenes and oncogenes, promoter insertion, enhancer insertion, chromosomal translocation, gene amplification and point mutation as mechanism for activation of proto-oncogenes.

REFERENCES:

1. The Biochemistry of the Nucleic Acids; Adams RLP, Knowler JT and Leader DP,
2. Chapman and Hall Publication.
3. Genetics; Peter JR and Benjamin S, Cummings Publication.
4. Recombinant DNA; Watson JD, Tooze T, Kurtz DT, Scientific American Books.
5. Principles of Gene Manipulation; Old RW and Primose SB. Blackwell Scientific
6. Publication.
7. Molecular Biotechnology; Glick and Pasternack, ASM press.

Paper BTI-703
Animal Biotechnology-1

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objective of this course is to familiarize the students to the potential applications of animal cell transfection along with various methods of foreign gene transfer into the animal cells. It discusses all the fields, insects to humans, where animal cell transfection is used for human and animal welfare.

Outcomes: This program will make the students familiar with different zones of animal biotechnology. After completing the course, the students will have the knowledge of all possible applications of animal biotechnology for the welfare of society.

NOTE:

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Biotechnology in Pest control, Aquaculture and sericulture, Role of biotechnology in biodiversity conservation

Gene Transfer into Animal Cells

DNA transfer techniques into mammalian cells: calcium phosphate precipitation, DEAE-dextran procedure, polycation DMSO, microinjection, electroporation; Selectable markers, viral vectors for gene transfer into mammalian cells: SV40, adenovirus, baculovirus, retrovirus

Transgenic animals

Transgenic mice: Methodology and applications; Transgenic cattle, sheep and fish. Use of mouse embryonic stem cells in gene targeting and gene trapping

UNIT-II

Biotechnology for Animal Improvement

Conventional methods of animal improvement, predominantly selective breeding and cross breeding, Superovulation, Embryo collection, evaluation, and transfer, *In vitro* maturation of oocytes, In vitro fertilization and embryo culture, Embryo preservation, Embryo sexing, Marker-assisted selection and genetic improvement of livestock.

Gene therapy and other molecular genetics-based therapeutic approaches

Principles of molecular genetics-based therapies and treatment with recombinant proteins or genetically engineered vaccines, Technology of classical gene therapy, Therapeutics based on 4 targeted inhibition of gene expression and mutation correction in vivo, Gene therapy for inherited disorders, Gene therapy for neoplastic disorders and infectious disease, Ethics of human gene therapy

Animal and Human cloning

Concepts of animal cloning, Principles and techniques of cloning, Applications of animal cloning, Ethical of animal cloning Reproductive and therapeutic cloning, Ethical of human cloning

REFERENCES:

1. Animal Cell Biotechnology; Spier, RE and Griffiths JB (eds), Academic Press.
2. Animal Cell Culture - Practical Approach; John RW (eds) Oxford, Academic Press.
3. Animal Cell Culture - Methods in Cell Biology; Jenni PM and David B (eds),
4. Academic Press.
5. Biotechnology; Rehm HJ and Reed G (eds), VCH Publications.
6. Comprehensive Biotechnology; Murray MY (ed.) Academic Press.

Paper BTI-704
Plant Biotechnology-1

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objective of this course is to make the students aware of the potential applications of plant genetic tranformation along with various techniques of foreign gene transfer into the plant cells. It discusses all the fields where plant biotechnology is used for human welfare.

Outcomes: This program will make the students familiar with different areas of plant biotechnology. After completing the course, the students will have the knowledge of all possible applications of transgenic plants as well as plant cell cultures.

NOTE:

1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Plant genetic transformation:

Organization of plant genome – Nuclear, Chloroplast and Mitochondrial Genome, T-DNA Tagging; Chloroplast transformation – vector designing, method and advantages *Agrobacterium* mediated transformation-Ti and Ri plasmids, role of virulence genes, mechanism of T-DNA transfer, vectors based on Ti and Ri plasmids – co-integrate and binary vectors, technique and factors affecting *Agrobacterium* mediated transformation of plants. Direct gene transfer – particle bombardment, PEG-mediated, electroporation, microinjection and alternative methods. Screenable and selectable markers, molecular characterization of transformants

Marker free methodologies, methods for multiple gene transfer in plants.

Applications of Plant Transformation for Productivity and performance: Herbicide resistance - phosphoinothricin, glyphosate, sufonyl urea, atrazine Insect resistance, Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor Virus resistance, coat protein mediated, nucleocapsid gene Disease resistance- chitinase, 1-3 beta glucanase, RIP, antifungal proteins, thionins, PR Proteins Nematode resistance, Abiotic stress – drought tolerance, salt tolerance

UNIT-II

Plant cells as biofactories for the production of secondary metabolites:

Production of useful secondary metabolites through plant cell cultures, Strategies used for high yield of product – development and selection of high yielding cell line cultures,

optimization of factors affecting yield of plant cells (physical culture conditions, media and other biochemicals), bioreactors and immobilized plant cell culture, permeabilization of cells and removal of secreted products. Biofuel and Bioremediations

Molecular pharming in plants - Production of therapeutic proteins, antibodies, edible Vaccines

Molecular Marker-aided Breeding: RFLP maps, AFLP, RAPD markers, SCAR (Sequence Characterized Amplified Regions), SSCP (single strand conformational polymorphism). Green house and Green-Home technology

REFERENCES:

1. Plant Genetic Engineering; Singh RP and Jaiwal PK (eds), Sci tech Publishing LLC.
2. Elements of Biotechnology; Gupta PK, Rastogi Pub.
3. Plant Tissue Culture -Theory and Practice; Bhojwani SS and Razdan MK, Elsevier
4. Publication.
5. Plant Biotechnology; Hammond J, McGarvey P and Yusibov V (eds), Springer
6. Verlag.
7. Plant Gene Isolation – Principles and Practice; Foster GD and Twell D, John Wiley &
8. Sons.
9. Plant Biotechnology – The Genetic Manipulation of Plants; Slater A, Scott N and
10. Fowler M, Oxford Publications.
11. Practical Application of Plant Molecular Biology; Henry RJ, Chapman and Hall.

Paper BTI-705
Bio-entrepreneurship

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objectives of this course are to introduce the students to the basics of entrepreneur which include introduction of bio-entrepreneur with different characteristics. The purpose of this course is to teach the students about the role of entrepreneur in field of biotechnology.

Outcomes: The end of the course, the students will have good understanding of various aspects of bio entrepreneur and role of entrepreneur in field of biotechnology. The course will work as interface between technology and entrepreneur.

NOTE:

• Seven Questions will be set in all.
• Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
• As far as possible the question will be of short answer type.
• Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology
Organizational structure & Management
Capital Management
Product innovation and management
Government schemes for commercialization of technology (Eg. Biotech Consortium)
Basics of production management: Methods of manufacturing-Project/Jobbing, Batch Production, Flow/Continuous production, process production-Characteristics of each method. Plant location-Importance-Factors affecting location-factory Building-Plant layout-Installation of Facilities.

UNIT-II

Operational Research: Linear Programming, PERT and CPM; Production Planning & Control-Scheduling-Gantt Charts-Documentation-Production Work Order.
Kaizen (Continuous improvement in product & management)
Biotech enterprises: Small, Medium & Large
Quality control in Biotech industries
Govt. regulations for biotech products
Public policy, regulatory and ethical challenges facing the biotechnology entrepreneurship
Business development for medical products

REFERENCES:

1. Innovation and Entrepreneurship in Biotechnology: Concepts, Theories & Cases;
2. Hyne D and Kapeleris J.
3. Entrepreneurship in Biotechnology: Managing for growth from start-up; Martin Gross Mann.
4. Best Practices in Biotechnology Education; Friedman Y, Logos Press.

Paper BTI-706

Lab. Course -XIV based on Paper- BTI-701, BTI-702 & BTI-705

Max. Marks : 60

Internal Assessment:15

Time : 6 hours

(Two sessions)

1. For the given ungrouped data, construct the exclusive and inclusive type frequency distribution.
2. Draw the multiple and subdivided bar diagram for the given data.
3. To find the various measures of central tendency for the given frequency distribution.
4. To find the quartiles, deciles and percentiles for the given frequency distribution.
5. Calculate the mean deviation, variance, standard deviation and coefficient of variation for the given data.
6. Fit a binomial distribution for the given data.
7. Fit a Poisson distribution for the given data.
8. Fit a normal distribution for the given data.
9. To test a given null hypothesis using Chi-square test of goodness of fit.
10. To test the single mean using t-test.
11. To test if there is any significance difference between means from two different samples.
12. To test the single proportion using t-test.
13. To fit a straight line using principle of least squares.
14. To fit a parabola for the given bivariate data using principle of least squares.
15. Isolation and quantification of Histone proteins from dark-grown wheat coleoptiles.
16. Separation of various Histone proteins using denaturing PAGE.
17. Finding promoter sequence of given animal gene and determining its sequence elements using CISTER.
18. Finding promoter sequence of given plant gene and determining its sequence elements using PlantCare.
19. To analyze your entrepreneurial personality and creativity
20. To analyze your entrepreneurial potential by performing online Bill Wager's self assessment test.
21. To analyze your personality type by performing online Jung & Myer Brigg's assessment test.
22. To analyze personality type by performing online DISC self assessment test.
23. To make a business plan.
24. To study Biotech Enterprises.

Paper BTI-707

Lab. Course-XV based on Paper- BTI-703 &B TI-704

Max. Marks : 40
Internal Assessment:10
Time : 6 hours
(Two sessions)

1. Anther culture
2. Protoplast isolation using enzymes.
3. Test of various medicinal plant extracts for their antibiotic activity.
4. To perform node culture.
5. To perform suspension culture of different explants.
6. To perform embryo culture.
7. To perform the experiment of Polymerase chain reaction and confirm the result by an experiment of agarose gel electrophoresis.
8. To study the restriction digestion pattern of *Eco*R I on λ DNA (substrate).
9. To determine the molecular size of DNA fragments in test sample by agarose gel electrophoresis.
10. To carry out an experiment of DNA fingerprinting using RAPD technique.

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Semester VIII

Paper BTI-801
Bioinformatics

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: This course aims at training the students to understand and retrieve data from biological databases and analyze it according to their needs. It also focuses on phylogenetic analysis of gene families as well as gene predicting, nucleic acid and protein structure predictions using probabilistic methods.

Outcomes: After completing the course, the students will become acquainted with several biological databases and will be able use of bioinformatics in interpreting biological data. The student will inculcate the skill of sequence alignment, editing, and construction of dendrograms and their statistical validation. Students will learn to predict the location of genes in the genome, and secondary structural elements in RNA and protein sequences.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

Unit I

Introduction to bioinformatics, Classification of biological databases, Biological data formats, Application of bioinformatics in various fields. Introduction to single letter code of aminoacids, symbols used in nucleotides, data retrieval- Entrez and SRS.Introduction to Sequence alignment. Substitution matrices, Scoring matrices – PAM and BLOSUM. Local and Global alignment concepts, Dot plot. Dynamic programming methodology: Needleman and Wunsch algorithm. Smith–Waterman algorithm. Statistics of alignment score.

Multiple sequence alignment. Progressive alignment. Database search for similar sequences using FASTA and BLAST Programs. Evolutionary analysis: distances, Cladistic and Phenetic methods. Clustering Methods. Rooted and unrooted tree representation. Bootstrapping strategies, Use of Clustal and PHYLIP.

Unit II

Gene finding methods. Gene prediction: Analysis and prediction of regulatory regions. Fragment assembly. Genome sequence assembly, Restriction Mapping, Repeat Sequence finder.
Concepts of secondary structure prediction of RNA and Protein. Probabilistic models: Markov chain, Hidden Markov Models-other applications.

Suggested reading:

1. Bioinformatics – Concepts, Skills, Applications". S.C. Rastogi, NamitaMendiratta, ParagRastogi.
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Andréa's D. Baxevanis, B.F. Francis Ouellette.
3. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Richard Durbin et al.
4. Computer Methods for Macromolecular Sequence Analysis. Doolittle R.F. (Ed.) (Methods in Enzymology, Vol. 266).
5. Shanmughavel, P. 2005. Principles of Bioinformatics, Pointer Publishers, Jaipur, India.
6. DNA and Protein Sequence Analysis. A Practical approach. Bishop M.J.Rawlings C.J. (Eds.).
7. Introduction to Bioinformatics. Teresa. K. Atwood and David J. Parry-Smith.
8. (http://www.imtech.res.in/raghava/gpsr/).

Paper BTI-802
Immunology-II

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objective of the course is to introduce the students to the elements of immune system, different stages of development and differentiation of T-cells and B-cells. Different pathways of complement system, cytokines and their actions, inflammatory responses and immune responses to various kinds of diseases other aspects of autoimmunity, hypersensitivity, transplantation immunity and cancer will also be introduced.

Outcomes: After the completion of the course, students will be aware of activation and differentiation of the cells of immune system. Role of cytokines and complement proteins in generating a robust immune response will also be learnt. The students will also understand the basics of immune responses against diseases caused by bacteria, viruses and worms. They will gain insight into complications of graft rejection, autoimmunity, hypersensitivity and cancer.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

T-cell maturation activation and differentiation: Different stages of T-cell maturation in Thymus, positive and negative selection, elements of positive and negative selection, T-cell activation, signal transduction pathways involved in T-cell activation and T-cell differentiation.

T cell Receptor B-cell generation, activation and differentiation: B-cell maturation, B-cell activation and proliferation, Role of T helper cells in B-cell response, class switching and regulation of B-Cell development.

Complement system: Classical, Alternate and lectin pathways; Function, activation, regulation and deficiencies of complement.

Cytokines: Chemokines and co stimulatory molecules: Role in regulation of immune response.

Leukocyte migration and Inflammation: Cell adhesion molecules, neutrophil extravasations, lymphocyte extravasations, mediators of inflammation, inflammatory process and anti-inflammatory agents.

UNIT-II

Immune response to infectious diseases: Bacteria, viruses, Intracellular parasites and helminthes, AIDS & other immunodeficiencies: Primary & secondary immunodeficiencies.

Auto immunity: Organ specific, cellular damage, evidences implicating the CD4+, T-cells, MHC & TCR in autoimmunity, induction & treatment of autoimmunity. Hypersensitivity reactions.

Transplantation immunity: Immunological basis of graft rejection, clinical manifestations of graft rejection, immunosuppressive therapies, immune tolerance to allograft, clinical transplants.

Cancer and immune system: Malignant transformation of cells, oncogenes and cancer induction, tumour antigens, cancer immunotherapy.

Vaccines: Designing vaccines for active immunization, purified macromolecules as vaccines, recombinant vaccines, DNA vaccines and multivalent vaccines.

REFERENCES:

1. Immunology- Roitt et al, Mosby Publications
2. Cellular and Molecular Immunology- Abbas and Litchman, Saunders Publication.
3. Kuby Immunology- Tizard RI, Saunders College Publishing.
4. Roitt's Essential Immunology- Roitt I, Blackwell Publishing.

Paper BTI-803
Animal Biotechnology-II

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objective of this course is to teach students the different aspects of animal cell culture. Also it is desired to make them understand that how a culture is established, propagated and characterized and what are the applications of animal cell cultures, gene therapy and stem cells.

Outcomes: At the end of the course, the students are expected to understand the establishment, maintenance, characterization as well as applications of animal cell cultures. Students will also learn the use of animal cells for production of high value therapeutics as well as for various *in vitro* tests. The students would be aware of the applications such as transgenic animals, stem cells and role in biodiversity conservation.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Maintenance of cell culture: cell separation. Scaling-up of animal cell culture Cell synchronization. Cell cloning and micromanipulation. Organ and histotypic cultures. Three dimensional culture and tissue engineering

Transfection of animal cells: transfection methods. Methods for cell fusion, Selectable markers, HAT selection and Antibiotic resistance. Cloning and expression of foreign genes in animal cells: Expression vectors

Over production and preparation of the final product i.e. expressed proteins. Production of vaccines in animal cells

Hybridoma Technology: Production of monoclonal antibodies and their applications. Embryo transfer technology- technique, its applications

UNIT-II

Transgenic Animals: transgenic sheep, cow, pig, goat etc. Production of transgenic mice, ES cells can be used for gene targeting in mice, applications of gene targeting. Biotechnology in Pest control, Aquaculture and sericulture

Role of biotechnology in biodiversity conservation

Therapeutic products through genetic engineering – blood proteins, insulin, growth hormone etc

Gene Therapy: introduction, types of gene therapy, vectors in gene therapy, major achievements, problems and prospects.
Stem Cells: Applications, Ethical issues.

REFERENCES:

1. Culture of animal cells; Freshney RI, John Willey & Sons.
2. Basic Cell Culture protocols, Methods in Biotechnology Series, Helgason CD & Mille, CL, Humana Press.
3. Animal Cell Biotechnology; Partner R, Humana Press.
4. Cell Culture; Butler M & Dawson M, Lab Fax, Bios Scientific Publications Ltd. Oxford.

Paper BTI-804
Plant Biotechnology- II

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: This course deals with the various methodologies of plant cell culture. Different methods of plant cell transformation and their applications like transgenic plants, production of secondary metabolites by plant cell cultures are discussed. Further the applications of plant biotechnology for the betterment of environment are given in the course.

Outcomes: The students gain the knowledge of different aspects of plant biotechnology after completing the course. They have gone through all types of plant cell cultures, their genetic engineering, transgenic plants and the potential applications to address various issues related to health and environment.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Plant transformation technology: basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of TI and RI as vectors, binary vectors, use of 35S and other promoters, use of reporter genes, methods of nuclear transformation, viral vectors and their applications, multiple gene transfers, Vectors-less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots. Transgene stability and gene silencing
Application of Plant Transformation for productivity and performance: herbicide resistance, phosphoinothricin, glyphostate, sufonyl urea, atrazine, insect resistance, Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated nucleocapsid gene, disease resistance chitinase. Transformation: advantages, vectors, success with tobacco and potato.

UNIT-II

Metabolic Engineering and industrial products: Plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, terpenoids, Industrial enzymes, Plantibodies, Edible vaccines
Molecular Marker-aided Breeding: RFLP maps, linkage analysis, RAPD markers, STS, Microsatellites, SCAR (sequence characterized amplified regions), SSCP (single strand

conformational polymorphism), AFLP ,Biofuel, Bioremediations & Biosensors.

REFERENCES:

1. Plant Genetic Transformation and Gene Expression – A Laboratory Manual; Scott JR,
2. Armitage P, Walden R, Blackwell Scientific Publications, Oxford.
3. An Introduction to Biotechnology; Gupta PK, Rastogi Publications.
4. Principles of Gene Manipulation: An Introduction to Genetic Engineering; Old RW,
5. and Primrose SB, Blackwell Scientific Publications, Oxford.
6. Plant Molecular Biology – A Practical Approach; IRL Shaw C. H. Press Oxford.
7. Plant Biochemistry and Molecular Biology; Lea PJ and Leegood RC, Wiley Publishing.

Paper BTI-805
Environmental Biotechnology

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The course will provide a basic knowledge of applications of biotechnology in field of environmental studies. The objectives of the course is to understand a general overview, concepts and basic principles in the subject of environment science with emphasis on how to apply techniques of biotechnology to clean up contaminated environment and to generate/save valuable resources for future use.

Outcomes: On the successful completion of the course, the students will get sufficient scientific knowledge of different types of biotechnological methods to improve/save environment. The learners will get an insight into the techniques used in environment monitoring and remediation.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Ecology & Biodiversity

Introductory concepts, The biological world and Ecology: Ecological balance and consequences of change, Biological word and eco-systems; Biochemical Diversity in ecosystem development; Diversity indices; Cellular diversity and the classification of living system – Prokaryotic & Eukaryotic organisms, General physical properties and Tolerance to environmental conditions; Microbial Biodiversity – strategies – bio-prospecting and recovery.

Air Pollution Control Methods and Equipment

Primary and secondary air pollutants, standards, sampling, basic ideas of air pollution control equipments, Bag Filter, Electrostatic Precipitators, cyclone separators, Wet-scrubbers, Bioscrubbers, Electrostatic precipitators, High volume sampler, RSPM Sampler, Control of specific gaseous pollutants.

UNIT-II

Wastewater Treatment by Biotechnological Processes

Water pollution; sources and classification of pollutants, B.O.D, C.O.D, D.O, T.D.S, Oil and grease, Metals etc. Standards, sampling and method of analysis, Bacteriological measurements. Overview of treatment principles and theory of aeration, Municipal Sewer and Industrial Wastewater Treatment –Principles, operation and design aspects of:

Activated Sludge process, Extended Aeration, Nitrification-denitrification, Trickling Filter, Mechanically aerated lagoons, Concepts of Waste stabilization ponds, Aquatic plant systems, Ranking of waste water treatment processes, common effluent treatment plant.

Environmental Biotechnology: Specialized aspects

Oil pollution – treatment with micro-organisms, Bioremediation—recovery of metals from waste water and sludge, xenobiotics, degradative capabilities of microorganisms with reference to toxicology, pesticides, herbicides, polyaromatic hydrocarbons, Anaerobic and aerobic composting, Vermiculture, Wetland Management, Membrane based waste water treatment processes – case studies.

REFERENCES:

1. Fundamentals of Ecology; Odum EP.
2. Wastewater Engineering – Treatment, Disposal and Reuse; Metcalf & Eddy, Tata McGrawhill
3. Environmental Pollution Control Engineering, Rao CS, New Age International Publication.
4. Wastewater treatment for pollution control; Arceiwala SJ, TMH Publication.

Paper BTI-807
Stem Cell Technology

Max.**Marks: 40**
Internal Assessment: 10
Time: 3 hrs

Objectives: The course will provide a basic knowledge of applications of Biotechnology in the field of stem cell science.

Outcomes: After the completion of the course, the students would learn the basics of tools and techniques of animal cell culture. The student will have the knowledge of stem cell biology with special reference to the techniques used and the applications of Stem cell culture

NOTE:
Nine questions will be set in all
Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with four questions from each unit. The candidates will be required to attempt Question No. 1 and four others selecting two questions from each unit.
All questions will carry equal marks

Unit-I

Basics of cell culture and related techniques: Cell and Tissue culture; Animal, Plants and Microbial Culture; Sterilization (Physical methods: Autoclave, Hot Air Oven, Laminar Airflow, Sintered glass filter and Membrane filter; Chemical and Radiation methods); Stains and staining techniques: simple stains, structural stains and Differential stains including Cell Viability stain, MTT assay; Microscope: Compound and System, Inverted and Upright, Dark field, Phase contrast, Fluorescence and Electron (Scanning and Transmission); BOD incubator, CO2 incubator, Orbital shaker, Cell Counter; Culture Media: General Media preparation (Plating, Broth preparation)

Unit-II

Stem Cell Biology: Animal Cell culture media: Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide, Role of serum and supplements, Serum & protein free defined media and their application; Primary Cell Cultures and Continuous Cell Lines; Embryonic and adult stem cells and their applications. Totipotent, Pluripotent and Multipotent stem cells. Induced Pluripotent stem cells (iPS); Scope of Stem Cell Biology; Ethics: Ethical issues associated with stem cell biology in industrial and medical biotechnology.

Paper BTI-808
Lab Course based on BTI-801&BTI-802

Max.**Marks: 40**
Internal Assessment: 10
Time: 6 hrs
(Two sessions)

1. To perform BLAST for sequence alignment

2. To perform FASTA for sequence alignment

3. To perform CLUSTAL W for sequence alignment

4. To perform GLIMMER for gene prediction

5. To perform GENMARK for gene prediction

6. To view structure in RASMOL

7. To view 3D structures in cn3d

8. To perform prosite for domain perdiction

9. To perform Pfam for motif prediction

10. To perform RNA FOLD for rna structure prediction

11. T perform jpred

12. To perform GENSCAN

Paper BTI-809
Lab Course based on BTI-803/ BTI-804**&BTI-805**

Max.**Marks: 40**
Internal Assessment: 10
Time: 6 hrs
(Two sessions).

- Isolation of DNA from different varieties of wheat /rice and analyze biomarker by RFLP
- Preparation of primary tissue culture
- DNA Barcoding of available fauna
- To study pH and moisture content of soil
- To study carbonate and nitrate content of soil
- To determine dissolved oxygen (DO) of given water sample.
- Determination of COD of given water sample.
- DNA isolation from soil microbial community
- Isolation of azotobacter species from soil
- Perform Western Blotting using β-actin as an internal control
- Perform ELISA
- Perform Immunostaining depending on availability of tissues/cells

Semester IX

Paper BTI-901
Food Biotechnology

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: Food biotechnology has great scope in present and future. The course is designed to teach students about the use of biotechnology in food sciences. The objectives of the course is to make students learn about the different food additives and preservation techniques, various food packaging materials and their functioning sterilization techniques of food and packaging materials.

Outcomes: On completion of the course students get training and skill development in field of food biotechnology such as basic food and supplements as GM food, food from fungi, algae and bacteria and their large scale production

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

- History background
- Composition of food
- Growth of microorganisms in food: Intrinsic and extrinsic factors
- Traditional fermented foods: Bread, cocoa, coffee, tea, sauerkraut, cheese, butter, yoghurt, meat, fish, etc.
- Alcoholic beverages: Beer, wine and whisky
- Value addition products: High fructose syrup, invert sugars etc.
- Edible fungus: Mushrooms

UNIT-II

- Single cell proteins: Spirulina, yeast etc. as food supplements
- Improvement of food resources: Golden rice, Potato etc.
- Food and water borne disease: Gastroenteritis, Diarrhea, Shigellosis, Salmonellosis,
- Typhoid, Cholera, Polio, Hepatitis etc.
- Food borne intoxications: Staphylococcal, Bacillus, Clostridium etc.

- Detection of food borne pathogens.
- Food preservation and storage.

References:

1. Food Sciences and Food Biotechnology, Lopez GFP, Canas G, Nathan EV, CRC Publications
2. Genetically Modified Foods; Ruse M, Castle D, Prometheus Book publication.
3. Biotechnology and Food Process Engineering; Schwartzberg HG, Rao MA, Marcel Dekker.
4. Modern Food Biotechnology; Jay JM, Lossner MJ, Golden DA.
5. Food Science; Potter NN, Hotchkiss JH.

Paper BTI-902
Nano Biotechnology

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objective of this course is to make students understand the concept of nano particles and associated technology followed by application in biological system.

Outcomes: After successful completion of this course the students will imbibe the knowledge of formation and functioning of various nano particles. They will be aware of its uses in various sectors like health care, tissue engineering, targeted drug delivery and other associated sectors.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Introduction to BioNanotechnology - Cellular nanostructures, self-assembly of colloidal nanostructures of biological relevance, bioactive nanoparticles (respiratory surfactants, magnetic nanoparticles), Nanoparticles for drug delivery (including solid lipid nanoparticles, synthetic and biopolymeric nanoparticles), carbon nanotubes, polymeric nanofibers, Implications in neuroscience, tissue engineering and cancer therapy, and Environmental and safety aspects of bio-nanotechnology

UNIT II

Introduction to Nanotechnology (Definitions, history and current practice), Multilayer Thin Film: Polyelectrolyte multilayers, coated colloids, smart capsules, LbL self-assembly, Colloids and Colloid Assemblies for Bio-nanotechnology, Nanoengineered biosensors, Fiber Optic Nano-sensors in medical care, Semiconductor and Metal Nanoparticles: Synthesis and Applications, Nanotechnology in Tissue Engineering, Microemulsions and Drug Delivery in Nanotechnology. Overview of current industry applications; nanoscale science and engineering principles

References:

1. Multilayer Thin Films; Decher G, Schlenoff JB, Wiley-VCH Verlag GmbH & Co.
2. Bionanotechnology : Lessons from Nature; Goodsell DS, Wiley-Liss.
3. Nanotechnology - A Gentle Introduction to the Next Big Idea; Ratner and Ratner, Prentice Hall PTR.

Paper BTI-903
Research Methodology

Max. Marks: 40
Internal Assessment: 10
Time: 3 hrs.

Objectives: The aim of the course is to elaborately discuss various approaches of data sampling, data collection and data analysis. The course aims at making the learner aware of concepts and principles of scientific report writing, research paper, thesis writing etc.

Outcomes: After the students understand this course they will be able to explore various available resources in a much efficient manner and to present and conserve the results and other findings in much organized and formalized. The student will be ready to implement the techniques more accurately in formal manner.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Research: Meaning –Purpose, Types and significance of research in basic/applied sciences. Steps in Research: Identification, selection and formulation of research problem- Research questions-Research design- Formulation of hypothesis- Literature collection, Review of literature. Sampling Technique: Sampling theory-Types of sampling-Steps in sampling- Sampling and Non-sampling error-Sample size –Advantages and limitations of sampling. Web browsing for information search; search engines and their mechanism of searching; Hidden Web and its importance in scientific research; Internet as a medium of interaction between scientists; Effective email strategy using the right tone and conciseness.

UNIT-II

Data for Research: Primary data-Meaning-Collection methods-Observation–Interview-Questionnaire-Schedule-Pretest-Pilot study –Experimental and case studies- Secondary data- Meaning – Relevance, limitations and cautions. Processing Data: Checking-Editing-Coding- transcriptions and Tabulation-Data analysis- Meaning and methods-Quantitative and Qualitative analysis Structuring the Report: Chapter format- Pagination-Identification- Using quotations- Presenting footnotes – abbreviations- Presentation of tables and figures- Referencing- Documentation-Use and format of appendices- Indexing

Preparation of Research report- Thesis - dissertation -Manuscript/research article – monograph/review, Oral and poster presentation of research papers in conferences/symposia.

REFERENCES:

- MS office; Sexena S, Vikas Publishing House.
- Statistical methods; Snedecor GW and Cohran WG, Oxford and IBH publishing CO Pvt.
  Ltd.
- Biometry; Sokal RR and Rohlf FJ, Freeman WH publishing House.
- Biostatistical analysis; Zar JH, Prentice Hall Publishing House.

Paper BTI-904
IPR, Biosafety & Bioethics

Max. Marks: 40
Internal Assessment: 10
Time: 3 hrs.

Objectives: The course enable students to know about the legal and safety enigmas concerned with various ancient achievements and latest biotechnological upcoming developments or products.

Outcomes: After the students gone through this course will be able to understand and follow issues and norms regarding bioethics, biosafety, types of intellectual property and its protection accordingly in various manner.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

General Introduction to intellectual property rights and its different forms. Farmers Rights, Animal and Plant breeders rights. Development of patent system in India. WTO agreement and TRIPS Patent Cooperation treaty, Basic requirements of patentability, patentable subject matter, novelty and the Public Domain; Non obviousness Compulsory licensing, Patent infringements and revocation. Special issues in Biotechnology Patents: Disclosure Requirements, Collaborative research, competitive research, Patent Litigation:. Recent Development in Patent System and Patentability of Biotechnology invention, Budapest treaty.

UNIT-II

Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication. Brief account of bioethics in Biotechnology

REFERENCES:

- Elements of Biotechnology; Gupta PK, Rastogi Publications, Meerut.
- Intellectual Property rights in the WTO and Developing countries; Watal J, Oxford

- University Press.
- Intellectual Property Bulletin, New Delhi

Paper BTI-905
Fermentation Technology

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objective of this course is to let students know about different types of fermentations, strains used, their preservation and production of metabolites and their purification.

Outcomes: As outcome of this course the students will become familiar with different methods and techniques being used in fermentation industries. The students will have understanding of use and preservation of microbial cultures for better and efficient production of desired metabolites.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

- Isolation and screening of microbes of industrial importance.
- Strain improvement: mutation and genetic manipulations.
- Culture preservation techniques
- Primary and Secondary metabolites
- Feedback inhibition & repression
- Fermentative processes:
    - Sub-merged
    - Solid state,
    - Fed Batch
- Continuous etc.
- Inoculums development, fermentation media
- Types of industrial fermenters, Fermentation equipment: Design of fermenters, tank construction materials, control panels, antifoam, autoclaving

UNIT-II

- Energetics of microbial growth in fermenters: Reaction rates, heat and mass transfer, transport phenomenon in reactors, macrscopic balances of energy and energy flow etc.
- Upstream and downstream processing of industrial fermentations.
- Cell disruptions, Flocculation, Filterations, Ultrafilteration, ultracentrifugation, gel filtration, chromatographic methods, two phase aqueous separations. Cells and

- enzyme immobilizations Fermentation of :
    - Antibiotics (Penicillin, Streptomycin)
    - Organic acids (Citric acid, Lactic acid)
    - Enzymes (Penicillin G Acylase, Streptokinase) d. ethanol.
- Recombinant Proteins (Insulin).
- Hygiene and safety in fermentation laboratory

REFERENCES:

- Biotransformations and Bioprocesses (Biotechnology and Bioprocessing Series); Doble
  M, Kruthiventi AK and Gaikar VG, CRC Publisher.
- Bioprocess Engineering Basic Concepts; Prentice Hall Publisher
- Principles of Fermentation Technology; Stanbury PF, Whitaker, A Hall S.
- Bioprocess Engineering: Basic Concepts; Shuler ML and Kargi F, Prentice Hall PTR
  Publisher.
- Solid-State Fermentation Bioreactors: Fundamentals of Design and Operation; Mitchell
- DA, Krieger N, and Berovic M, Springer Publisher.

Paper BTI-906
Bioinstrumentation

Max. Marks: 65
Internal Assessment: 10
Time: 3 hrs.

Objectives: The objective of this course is to introduce students with principles, instrument and application of various techniques like spectroscopy, centrifugation, biosensors; DNA/RNA based techniques and immunotechniques.

Outcomes: As an outcome of the present course students will be capable of using the instruments with in-depth knowledge of working and principles of the various techniques in future research for better elucidation of living world and its best usage in betterment of life.

NOTE:
1. Seven Questions will be set in all.
2. Q. No 1 which will be objective/short answer type covering the entire syllabus, will be compulsory. The remaining questions will be set section wise with questions 3 from each section. The candidates will be required to attempt Q. No. 1 & four others selecting 2 questions from each section. All questions will carry equal marks.
3. As far as possible the question will be of short answer type.
4. Each question should be divided into parts & the distribution of marks be indicated part wise.

UNIT-I

Spectroscopy: Raman, Fluorescence and NMR spectroscopy; ORD & CD; Mass spectrometry, MALDI-TOF, LC-MS; X-ray diffraction; Atomic absorption spectroscopy Applications of these spectroscopic techniques in the study of Biomolecules
Centrifugation: Basic principles of sedimentation; types of centrifuge (Bench top, high speed & ultracentrifuges); types of rotor; Preparative & analytical centrifugation. Separation methods-Differential centrifugation, Density gradient centrifugation
Subcellular fractionation- Disruption of cells, isolation of subcellular organelles from liver & plant cells and marker enzymes
Advanced purification techniques: FPLC, HPLC

UNIT-II

Nucleic acid based techniques – Northern, Southern, Sequencing of proteins and nucleic acids, PCR, RT-PCR, QRT-PCR, DNA microarray, DNA fingerprinting (RFLP, RAPD, AFLP, SSR)
Immunotechniques - Flow cytometry, Immuno-cytochemistry, immune-fluorescence and Western & Dot blots, Florescence activated cell sorter (FACS) technique, Cytotoxicity assay
Biosensors - Principle and application

REFERENCES:

- Bioinstrumentation, Student; John GW, John Wiley & Sons Ltd.
- Practical Biochemistry Principles and Techniques; Wilson K and Walker J, Cambridge University Press.
- Essentials of Molecular Biology; Malacinski GM, Freifelder D, Jones & Bartlett Publishers.
- Proteins-Structure and Molecular Properties; Creighton TE, Freeman and Company.
- Genes IX; Benjamin L, Jones and Bartlett Publishers.

Paper BTI-908

DNA Barcoding

Max. Marks: 40
Internal Assessment: 10
Time: 3 hrs

Objectives: The objective of the course is to impart the knowledge of biodiversity with reference to genetic matrial variations. The course aims at the use of technology for the study and conservation of biodiversity

Outcomes: On the completion of the course the student will be aware of the diversity at molecular level and will be able to explore the use of Molecular Techniques, Bioinformatics and Biostatistics in Genomics study.

NOTE:

Nine questions will be set in all

Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit-wise with four questions from each unit. The candidates will be required to attempt Question No. 1 and four others selecting two questions from each unit.

All questions will carry equal marks

Unit-I

Biodiversity, Organisms & Molecular Biology in systematic study: Brief about Species, Speciation and Biological Evolution; Taxonomy, Classification, nomenclature and Identification; Biological Sampling and Vouchering, Cell, Gene, Genomic DNA, Mitrochondrial DNA, DNA barcoding basics and opportunities

Unit-II

Molecular Techniques, Bioinformatics and Biostatistics in Genomics study: DNA isolation, electrophoresis, DNA Sequencing; Primer designing; Polymerase Chain Reaction (PCR) & its role in DNA barcoding; PCR-RFLP; RT-PCR; Bioinformatics: An essential tool for DNA barcoding; Basics of Databases, tools; DNA, Protein sequence formatting and alignment, Gene characterization and genetic traits, Online database and retrieval of Biological information; Data analysis and Phylogenetic study and Genetic distance, Brief on Biostatistics and various tests

Paper BTI-909

Lab Course based on Paper-BTI-901, BTI-902, &BTI-905/BTI-906

Max. Marks: 60

Internal Assessment: 15

Time: 6 hrs

(Two sessions)

1. To test the quality of milk by Methylene Blue Reduction Test (MBRT)
2. Determination of quality of milk samples by Methylene Blue Reduction Test (MBRT)
3. Isolation of casein protein from milk
4. Preparation of glue from milk protein
5. To synthesize silver nano particles by *E.coli*
6. To synthesize silver nanoparticles by chemicals
7. To study ellipsometry
8. To study ninthi software
9. To study nanotube modeler software
10. To study XRD.
11. Isolation of important amylase producing bacteria from soil
12. Preservation of amylase producing bacterial strain on agar slant.
13. Production of Sauerkraut by microorganisms
14. To study the acidity of sauerkraut

Fermentation Technology

15. Production of red wine.
16. Estimation of acids formed during wine production.
17. Estimation of alcohol produced in wine by dichromate titration method.

Bioinstrumentation

15. To prepare absorption spectrum of plant pigments by UV- Vis spectroscopy

16. Isolation of subcellular organells from animal tissue and identification by marker enzymes

17. Isolation of subcellular organells from plant tissue and identification by marker enzyme.

18. PCR

19. Western blot

20. Determination of cytotoxic concentration (IC50)

Paper BTI-910
Lab Course based on Paper-BTI-903 & BTI-904

Max. Marks: 20
Internal Assessment: 5
Time: 3 hrs
(One Sessions)

Practicals will be based on theory papers.

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