B.Sc. (HONORS/CORE) BIOTECHNOLOGY

UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

PROPOSED BY UNIVERSITY GRANTS COMMISSION (UGC)-2015

SEMESTER -I		**SEMESTER -II**	
C1	Biochemistry and Metabolism	C3	Mammalian Physiology
C2	Cell Biology	C4	Plant Anatomy and Physiology
AECC1	English/EVS/MIL Communication	AECC2	English/EVS/MIL Communication
GE	GE1 (Developmental Biology)	GE	GE2 (Bioethics and Biosafety)
SEMESTER -III		**SEMESTER -IV**	
C5	Genetics	C8	Molecular Biology
C6	General Microbiology	C9	Immunology
C7	Chemistry – 1 (Physical chemistry)	C10	Chemistry -2 (Organic and Inorganic chemistry)
SEC	SEC1 (Ehzymology)	SEC	SEC2 (Molecular Diagnostics)
GE	GE3 (Biotechnology and Human Welfare)	GE	GE4 (Entrepreneurship Development)
SEMESTER -V		**SEMESTER -VI**	
C11	Bioprocess Technology	C13	Bio Analytical Tools
C12	Recombinant DNA Technology	C14	Genomics and Proteomics
DSE	DSE1 (Dissertation)	DSE	DSE3 (Bioinformatics)
DSE	DSE2 (Biostatistics)	DSE	DSE4 (Plant Biotechnology)

C: Core Courses; **GE:** Generic Elective Course; **AECC:** Ability Enhancement Compulsory Course; **SEC:** Skill Enhancement Courses; **DSE:** Discipline Specific Elective Course.

Note: Generic Elective courses (GE1-GE4) offered by Biotechnology department is for the students of other science departments.

PATTERN OF INTERNAL ASSESSMENT (INT):

1. Attendance:	**05 Marks** (Semester I-VI)
Below 75%=	0 Marks
75%-80%=	1 Marks
81%-85%=	2 Marks
86%-90%=	3 Marks
91%-95%=	4 Marks
96%-100%=	5 Marks
2. Mid Semester Examination:	**10 Marks** (Semester I-VI)
3. Assignment:	**10 Marks** (Semester I-VI)

Total Marks of Internal Assessment: **25 Marks** (For Core Course only in Semester I-VI)

PATTERN OF PRACTICAL EXAMINATION

Full marks: 25 Time: 4 Hrs

One major experiment of 10 marks	10
Two spottings of 2.5 marks each	05
Viva	05
Practical record	05

GENERIC ELECTIVE SUBJECTS: (any one per semester in semesters 1-4)

- Entrepreneurship Development
- Bioethics and Biosafety
- Biotechnology and Human Welfare
- Developmental Biology

SKILL ENHANCEMENT COURSES: (any one per semester in semesters 3-4)

- Molecular Diagnostics
- Enzymology
- Industrial Fermentations
- Drug Designing
- Basics of Forensic Science

DISCIPLINE SPECIFIC ELECTIVE SUBJECTS: (any two per semester in semesters 5-6)

- Bioinformatics
- Animal Biotechnology
- Medical Microbiology
- Animal Diversity I
- Plant Diversity I
- Animal Diversity II
- Plant Diversity II
- Plant Biotechnology

- Environmental Biotechnology
- Intellectual Property Rights
- Microbial Physiology
- Biostatistics
- Ecology and Environment Management
- Evolutionary Biology
- Chemistry 3
- Chemistry 4
- Dissertation

Suggestions of members of Board of Studies:

1. No choice can be given in discipline specific elective and skill enhancement courses due to limited number of faculty members and laboratory supportive staffs (lab technician & lab boy). For CBCS at least two extra faculty members and one extra lab technician must be given to the department.
2. Approximate cost of instruments, chemicals, labwares and books to develop infrastructure for CBCS will be 50 lakhs.

B.Sc. (HONORS/CORE) BIOTECHNOLOGY

UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

PROPOSED BY UNIVERSITY GRANTS COMMISSION (UGC)-2015

Distribution of credits of B.Sc. Biotechnology (Honors/Core) under choice based credit system (CBCS):

S.No.	Categories of Courses	Credits per Course	Total No. of courses in the given category	Total Credits in the given category of course
1.	Core Course (C)	6 Credits	14	84 Credits
2.	Ability Enhancement Compulsory Course (AECC)	2 Credits	02	04 Credits
3.	Generic Elective Course (GE)	6 Credits	04	24 Credits
4.	Skill Enhancement Course (SEC)	2 Credits	02	04 Credits
5.	Discipline Specific Elective Course (DSE)	6 Credits	04	24 Credits
Total Number of Credits in B.Sc. (Core/ Honors) Biotechnology				**140 Credits**

Proposed syllabus and Structure

For

B.Sc. (Honors) Biotechnology

Submitted

To

University Grants Commission
New Delhi

Under

Choice Based Credit System

April 2015

CORE COURSES

(C1) BIOCHEMISTRY AND METABOLISM

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I: (10 Periods)
Introduction to Biochemistry: A historical prospective.
Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.
Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.

UNIT II (10 Periods)
Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.
Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

UNIT III (20 Periods)
Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD+, NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions.

UNIT IV (20 Periods)
Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

PRACTICALS
1. To study activity of any enzyme under optimum conditions.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.
4. Estimation of blood glucose by glucose oxidase method.
5. Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein. (ii) To study relation between absorbance and % transmission.
6. Preparation of buffers.
7. Separation of Amino acids by paper chromatography.
8. Qualitative tests for Carbohydrates, lipids and proteins

SUGGESTED READING
1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

(C2) CELL BIOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (10 Periods)
Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.
Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT II (15 Periods)
Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments.
Endoplasmic reticulum: Structure, function including role in protein segregation.
Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III (20 Periods)
Lysosomes: Vacuoles and micro bodies: Structure and functions
Ribosomes: Structures and function including role in protein synthesis.
Mitochondria: Structure and function, Genomes, biogenesis.
Chloroplasts: Structure and function, genomes, biogenesis
Nucleus: Structure and function, chromosomes and their structure.

UNIT IV (15 Periods)

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

PRACTICALS

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

(C3) MAMMALIAN PHYSIOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **$10 \times 1 = 10$**

Group II – Definition or concept based questions (4 questions of 5 marks each). **$4 \times 5 = 20$**

Group III – Brief answer questions (2 questions of 10 marks each). **$2 \times 10 = 20$**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I: Digestion and Respiration (15 Periods)
Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice.
Respiration: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift.

UNIT II: Circulation (15 Periods)
Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood.
Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

UNIT III: Muscle physiology and osmoregulation (15 Periods)
Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.
Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

UNIT IV: Nervous and endocrine coordination (15 Periods)

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters

Mechanism of action of hormones (insulin and steroids)

Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

PRACTICALS

1. Finding the coagulation time of blood.
2. Determination of blood groups.
3. Counting of mammalian RBCs.
4. Determination of TLC and DLC.
5. Demonstration of action of an enzyme.
6. Determination of Haemoglobin.

SUGGESTED READING

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

(C4) PLANT ANATOMY AND PHYSIOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I: Anatomy (10 Periods)
The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf).

UNIT II: Plant water relations and micro & macro nutrients (12 Periods)
Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing.
Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport.

UNIT III: Carbon and nitrogen metabolism (20 Periods)
Photosynthesis- Photosynthesis pigments, concept of two photo systems, photphosphorylation, calvin cycle, CAM plants, photorespiration, compensation point.
Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

UNIT IV: Growth and development (18 Periods)
Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene).

Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization.

PRACTICALS

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of plasmolysis by *Tradescantia* leaf peel.
3. Demonstration of opening & closing of stomata
4. Demonstration of guttation on leaf tips of grass and garden nasturtium.
5. Separation of photosynthetic pigments by paper chromatography.
6. Demonstration of aerobic respiration.
7. Preparation of root nodules from a leguminous plant.

SUGGESTED READING

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA.

(C5) GENETICS

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (12 Periods)

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance.

Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms.

Mendelian genetics : Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT II (18 Periods)

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA.

Genetic organization of prokaryotic and viral genome.

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology,

concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

UNIT III (15 Periods)

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abonormalities– Aneuploidy and Euploidy.

Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

UNIT IV (15 Periods)

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping.

Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting.

Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

PRACTICALS

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body -*Rhoeo* translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

SUGGESTED READING

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

(C6) GENERAL MICROBIOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (10 Periods)
Fundamentals, History and Evolution of Microbiology.
Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria.
Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

UNIT II (10 Periods)
Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

UNIT III (20 Periods)
Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.
Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways
Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT IV (20 Periods)

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents

Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.

PRACTICALS

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

SUGGESTED READING

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7thedition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

(C7) CHEMISTRY-1

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **$10 \times 1 = 10$**

Group II – Definition or concept based questions (4 questions of 5 marks each). **$4 \times 5 = 20$**

Group III – Brief answer questions (2 questions of 10 marks each). **$2 \times 10 = 20$**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (10 Periods) Concept of atoms and molecules; Dalton's atomic theory; Mole concept; Chemical formulae; Balanced chemical equations; Calculations (based on mole concept) involving common oxidation-reduction, neutralisation, and displacement reactions; Concentration in terms of mole fraction, molarity, molality and normality.

UNIT II (20 Periods) Absolute scale of temperature, ideal gas equation; Deviation from ideality, van der Waals equation; Kinetic theory of gases, average, root mean square and most probable velocities and their relation with temperature; Law of partial pressures; Vapour pressure; Diffusion of gases.

Bohr model, spectrum of hydrogen atom, quantum numbers; Wave-particle duality, de Broglie hypothesis; Uncertainty principle; Qualitative quantum mechanical picture of hydrogen atom, shapes of s, p and d orbitals; Electronic configurations of elements (up to atomic number 36); Aufbau principle; Pauli's exclusion principle and Hund's rule; Orbital overlap and covalent bond; Hybridisation involving s, p and d orbitals .

UNIT III (15 Periods) First law of thermodynamics; Internal energy, work and heat, pressure-volume work; Enthalpy, Hess's law; Heat of reaction, fusion and vapourization; Second law of thermodynamics; Entropy; Free energy; Criterion of spontaneity.

UNIT IV(15 Periods) Law of mass action; Equilibrium constant, Le Chatelier's principle (effect of concentration, temperature and pressure); Significance of ΔG and ΔG° in chemical equilibrium; Solubility product, common ion effect, pH and buffer solutions; Acids and bases (Bronsted and Lewis concepts); Hydrolysis of salts. Rates of chemical reactions; Order of reactions

PRACTICALS

1. Study of preparation of a normal (N/10) solution of KCl .
2. Study of preparation of percentage (w/V) solution (0.80 % NaCl).
3. Study of preparation of a 0.1 molal solution of K_2HPO_4.
4. Study of preparation of a molar (0.1M) solution of NaOH.
5. Study of preparation of molar (1M) solution of HCl.
6. Study of determination of the strength of a given solution by titrating it against a standard solution.
7. Study of measurement of surface tension of a given liquid.
8. Study of measurement of viscosity of a given liquid.

SUGGESTED READING

1. Physical chemistry- Atkins, R. W., Oxford University Press.
2. Advance physical chemistry- Gurdeep Raj.
3. Pradeep's chemistry (Vol. I, II & III), Pradeep's Publication.
4. Text book of physical chemistry (Vol. 6)- K. L. Kapoor.
5. Fundamentals of physical chemistry- Ananya Ganguly.
6. Advanced physical chemistry- D. N. Bajpai.
7. Text book of physical chemistry- H. K. Moudgil.
8. Physical chemistry- N. B. Singh.

(C8) MOLECULAR BIOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I: DNA structure and replication (15 Periods)
DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II: DNA damage, repair and homologous recombination (10 Periods)
DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

UNIT III: Transcription and RNA processing (17 Periods)
RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT IV: Regulation of gene expression and translation (18 Periods)

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation.,Posttranslational modifications of proteins.

PRACTICALS

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity

SUGGESTED READING

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

(C9) IMMUNOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (20 Periods)
Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, Tlymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

UNIT II (15 Periods)
Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

UNIT III (13 Periods)
Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

UNIT IV (12 Periods)
Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA.

PRACTICALS
1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

SUGGESTED READING
1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

(C10) CHEMISTRY-2

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (10 Periods) Friedal craft alkylation, Friedal craft acylation, Decarboxylation ,Iodoform ,Williamson reactionHalogenation, Nitration, Sulphonation, Riemar-tiemann formation, Riemer-tiemann carboxylation, Nitroso test of phenol, Fries rearrangement, Claisen rearrangement, Diasotisation reaction, Coupling reaction(N-N Coupling and C-N Coupling), Ollmann reaction, Hoffmann bromide reaction.

Preparation of carbonyl compound by pinacol pinacolone rearrangement, Dry distillation of calcium salt of acid, by MnO , Etard reation , gemhalide, Wakar process, Chemical reation of carbony compounds in acidic and in basic medium, Beckmann rearrangement of oxime, Aldol reaction, Canizaro reation, Cross canizaro reation, Perkeins Condensation, Witting reaction, Benzoin condensation, Esterification.

UNIT II (20 Periods) Wurtz reaction, Covay house synthesis, Kolbe electrolysis, Chemical reaction of alkene/alkyne by (X2 HX HOX H_2O NOCl), OM-DM (Oxymercuration demercuration) HBO (hydroboration oxidation), Hydrolysis of vinyl ether, Dehydrohalogenation reaction, Hydrolysis of carbide

Organo metallic compound,Preparation of Grignard reagent, Reaction with cyanide, Digrignard Reduction (Stephen reduction,lindlar catalyst, rosenmund catalyst ,birch reduction , red P+ HI), Oxidation (oxidation By HIO_4, by MnO_2, By cold dilute alkaline $KMnO_4$, by peracid , by hot dilute alkaline KMnO4), Hydrolysis of ether, Hydrolysis of epoxide in acidic and basic medium.

UNIT III (20 Periods) Nucleophilic addition reaction, Electrophilic substitution reaction of aromatic compounds (ESR), Sulphonation reaction, SN2Ar reaction, Free radical substitution reaction, Allylic or benzylic substitution, Free radical substitution reaction, Elecrophilic addition reaction, Unimolecular nucleophilic substitution (SN1), Biomolecular nucleophilic substitution (SN2), Elimination reaction [E1, E2].

Inductive effect and its application, Resonance, Mesomeric effect, Carbanion, Carbcation, Rearrangement of carbcation, Ring contraction and ring expansion.

UNIT IV (10 Periods) Brief introduction of periodic table, Atomic radii, Ionization energy, Electron affinity, Electron negativity.

Ionic bond, covalent bond, Hybridization, VBT (Valence bond theory), Bond length, MOT (Molecular orbital theory) and its application, Dipole moment, Hydrogen bonding, Fajans rule.

PRACTICALS

1. Detection of salt (Group –II) by different salt analysis test methods.
2. Detection of amino-acid by using Ninhydrin reagent.
3. Estimation of Protein by Lowery's method.
4. Estimation of sugar.

SUGGESTED READING

1. A text book of organic chemistry and problem analysis- K. L. Ghatak.
2. Text book of organic chemistry (Vol. 3)- Ahluwalia.
3. Fundamentals of organic chemistry (Vol. 2)- Ananya Ganguly.
4. Organic chemistry: problems and solutions- Raj K. Bansal.
5. Inorganic chemistry- Gargy Wulfsberg.
6. Modern inorganic chemistry- W. L. Jolly.
7. New pattern text book of inorganic chemistry for competitions (JEE Main & Advanced)- O. P. Tandon.
8. Fundamentals of inorganic chemistry- Ananya Ganguly.
9. Chemistry- O. P. Agrawal.
10. General chemistry- D. D. Ebbing.
11. Organic chemistry- R. T. Morrison & R. N. Boyd.
12. Concise inorganic chemistry- J. D. Lee.

13. Advanced organic chemistry: reaction, mechanism & structure- Michael B. Smith.
14. Organic chemistry- T. W. G. Solomons & C. B. Fryhle.
15. Organic chemistry- K. Peter & C. Vollhardt.

(C11) BIOPROCESS TECHNOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **$10 \times 1 = 10$**

Group II – Definition or concept based questions (4 questions of 5 marks each). **$4 \times 5 = 20$**

Group III – Brief answer questions (2 questions of 10 marks each). **$2 \times 10 = 20$**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (10 Periods)
Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II (20 Periods)
Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization.

UNIT III (15 Periods)
Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV (15 Periods)
Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

PRACTICALS
1. Bacterial growth curve.
2. Calculation of thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

SUGGESTED READING
1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

(C12) RECOMBINANT DNA TECHNOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (15 Periods)
Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.

UNIT II (20 Periods)
Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

UNIT III (10 Periods)
Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

UNIT IV (15 Periods)
Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and A. rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

PRACTICALS
1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from *E.coli*
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells
7. Transformation of competent cells.
8. Demonstration of PCR

SUGGESTED READING
1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

(C13) BIO-ANALYTICAL TOOLS

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (10 Periods)
Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy.

UNIT II (15 Periods)
Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared),
centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT III (15 Periods)
Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV (20 Periods)

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

PRACTICAL

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

(C14) GENOMICS & PROTEOMICS

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 50 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (10 questions of 1 mark each). **10 × 1 = 10**

Group II – Definition or concept based questions (4 questions of 5 marks each). **4 × 5 = 20**

Group III – Brief answer questions (2 questions of 10 marks each). **2 × 10 = 20**

2. For group I at least 2 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 4 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (15 Periods)
Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT II (10 Periods)
Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT III (20 Periods)
Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation

analysis, gel filteration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

UNIT IV (15 Periods)
Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution.
Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. *De novo* sequencing using mass spectrometric data.

PRACTICALS
1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2D PAGE database
5. Softwares for Protein localization.
6. Hydropathy plots
7. Native PAGE
8. SDS-PAGE

SUGGESTED READING
1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.

DISCIPLINE SPECIFIC ELECTIVE COURSES

(DSE1) DISSERTATION

The students will have to undergo 1-2 months project work at any industry or research institute or hospital or university or training institute. Dissertation topic will be decided by the student and concerned institute to which he/she is attached.

PATTERN OF PROJECT EXAMINATION

This course consists of 100 marks and marks distribution is as follows:

1.	Dissertation	40
2.	Presentation	40
3.	Viva	20

(DSE2) BIOSTATISTICS

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **20 × 1 = 20**

Group II – Definition or concept based questions (5 questions of 5 marks each). **5 × 5 = 25**

Group III – Brief answer questions (2 questions of 15 marks each). **2 × 15 = 30**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (12 Periods)
Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.

UNIT II (18 Periods)
Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT III (18 Periods)
Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA).

UNIT IV (12 Periods)
Correlation and Regression. Emphasis on examples from Biological Sciences.

PRACTICALS

1. Based on graphical Representation
2. Based on measures of Central Tendency & Dispersion
3. Based on Distributions Binomial Poisson Normal
4. Based on t, f, z and Chi-square

SUGGESTED READING

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High Yield™ Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

(DSE3) BIOINFORMATICS

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **20 × 1 = 20**

Group II – Definition or concept based questions (5 questions of 5 marks each). **5 × 5 = 25**

Group III – Brief answer questions (2 questions of 15 marks each). **2 × 15 = 30**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (10 Periods)
History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

UNIT II (20 Periods)
Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

UNIT III (20 Periods)
Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT IV (10 Periods)
Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission.
Genome Annotation: Pattern and repeat finding, Gene identification tools.

PRACTICALS

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.

SUGGESTED READING

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

(DSE4) PLANT BIOTECHNOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **20 × 1 = 20**

Group II – Definition or concept based questions (5 questions of 5 marks each). **5 × 5 = 25**

Group III – Brief answer questions (2 questions of 15 marks each). **2 × 15 = 30**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (15 Periods)
Introduction, Cryo and organogenic differentiation, Types of culture: Seed , Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT- II (20 Periods)
In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesis Sgnificance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

UNIT – III (15 Periods)
Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations.
Somaclonal variation
Nomenclautre, methods, applications basis and disadvantages.

UNIT – IV (10 Periods)
Plant Growth Promoting bacteria.
Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation,
Biocontrol of pathogens, Growth promotion by free-living bacteria.

PRACTICALS
1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. To selection, Prune, sterilize and prepare an explant for culture.
4. Significance of growth hormones in culture medium.
5. To demonstrate various steps of Micropropagation.

SUGGESTED READING
1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rd edition. Benjamin Co.
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

SKILL ENHANCEMENT COURSES

(SEC1) ENZYMOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **$20 \times 1 = 20$**

Group II – Definition or concept based questions (5 questions of 5 marks each). **$5 \times 5 = 25$**

Group III – Brief answer questions (2 questions of 15 marks each). **$2 \times 15 = 30$**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (20 Periods)

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis.

Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin).

Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis- Menten equation and its derivation, Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.

UNIT II (15 Periods)

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor.

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site

groups, specific examples-: chymotrypsin, lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase.
Enzyme regulation: Product inhibition, feed back control, covalent modification.

UNIT III (13 Periods)
Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative cooperativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

UNIT IV (12 Periods)
Enzyme Technology: Methods for large scale production of enzymes.
Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Enzyme electrodes.
Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering– selected examples, Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution.
Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding *invitro* & i*n vivo*.

PRACTICALS
1. Purification of an enzyme from any natural resource
2. Quantitative estimation of proteins by Bradford/Lowry's method.
3. Perform assay for the purified enzyme.
4. Calculation of kinetic parameters such as Km, Vmax, Kcat.

SUGGESTED READING
1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley andSons, 1995.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning,2005.
5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999.
6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004.
7. Practical Enzymology Hans Bisswanger Wiley–VCH 2004.
8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002.

(SEC2) MOLECULAR DIAGNOSTICS

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **20 × 1 = 20**

Group II – Definition or concept based questions (5 questions of 5 marks each). **5 × 5 = 25**

Group III – Brief answer questions (2 questions of 15 marks each). **2 × 15 = 30**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (15 Periods)
Enzyme Immunoassays:
Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology.

UNIT II (15 Periods)
Molecular methods in clinical microbiology:
Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology
Laboratory tests in chemotherapy:
Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests:Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

UNIT III (18 Periods)
Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes.

Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

UNIT IV (12 Periods)
GLC, HPLC, Electron microscopy, flowcytometry and cell sorting.
Transgenic animals.

PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Perform/demonstrate RFLP and its analysis
2. Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture
3. A kit-basd detection of a microbial infection (Widal test)
4. Study of Electron micrographs (any four).
5. Perform any one immuno diagnostic test (Typhoid, Malaria, Dengue).

SUGGESTED READING

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walke.r
2. Bioinstrumentation, Webster.
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic.
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
9. Microscopic Techniques in Biotechnology, Michael Hoppert.

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GENERIC ELECTIVE COURSES

(GE1) DEVELOPMENTAL BIOLOGY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **20 × 1 = 20**

Group II – Definition or concept based questions (5 questions of 5 marks each). **5 × 5 = 25**

Group III – Brief answer questions (2 questions of 15 marks each). **2 × 15 = 30**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I: Gametogenesis and Fertilization (10 Periods)
Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.

UNIT II: Early embryonic development (20 Periods)
Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

UNIT III: Embryonic Differentiation (20 Periods)
Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription

and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

UNIT IV: Organogenesis (10 Periods)

Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germlayers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

PRACTICALS

1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of *Anopheles*.
4. Study of the developmental stages of *Drosophila* from stock culture/ photographs.
5. Study of different types of placenta.

SUGGESTED READING

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

(GE2) BIOETIHCS & BIOSAFETY

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **20 × 1 = 20**

Group II – Definition or concept based questions (5 questions of 5 marks each). **5 × 5 = 25**

Group III – Brief answer questions (2 questions of 15 marks each). **2 × 15 = 30**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (15 Periods)
Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

UNIT II (20 Periods)
Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

UNIT III (10 Periods)
Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.

UNIT IV (15 Periods)
Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good

Manufacturing Practices (GMP).

PRACTICALS

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste

SUGGESTED READING

1. Entrepreneurship: New Venture Creation : David H. Holt
2. Patterns of Entrepreneurship : Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international Publishers.

(GE3) BIOTECHNOLOGY AND HUMAN WELFARE

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **20 × 1 = 20**

Group II – Definition or concept based questions (5 questions of 5 marks each). **5 × 5 = 25**

Group III – Brief answer questions (2 questions of 15 marks each). **2 × 15 = 30**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I (10 Periods)
Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II (10 Periods)
Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III (15 Periods)
Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT IV (25 Periods)
Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.
Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in *E.coli*, human genome project.

PRACTICALS

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Perform of ethanolic fermentaion using Baker's yeast
2. Study of a plant part infected with a microbe
3. To perform quantitative estimation of residual chlorine in water samples
4. Isolation and analysis of DNA from minimal available biological samples
5. Case studies on Bioethics (any two).

SUGGESTED READING

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international Publishers.

(GE4) ENTREPRENEURSHIP DEVELOPMENT

INSTRUCTIONS TO QUESTION SETTER AND EXAMINEE:

1. The question paper will be of 75 marks and divided into three groups:

Group I – Multiple choice questions / fill in the blanks / true or false / matching type (20 questions of 1 mark each). **20 × 1 = 20**

Group II – Definition or concept based questions (5 questions of 5 marks each). **5 × 5 = 25**

Group III – Brief answer questions (2 questions of 15 marks each). **2 × 15 = 30**

2. For group I, 5 questions must be given from each unit.

3. For group II, 2 questions must be given from each unit (total 8 questions). Students have to answer any 5 questions out of 8 questions.

4. For group III, 1 question must be given from each unit (total 4 questions). Students have to answer any 2 questions out of 4 questions.

5. All questions must cover the entire syllabus with equal distribution of marks as far as practicable.

UNIT I INTRODUCTION AND ESTABLISHING AN ENTERPRISE (22 Periods)
Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.
Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

UNIT II FINANCING THE ENTERPRISE (15 Periods)
Importance of finance / loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw materials and its management.

UNIT III MARKETING MANAGEMENT (13 Periods)
Meaning and Importance, Marketing-mix, product management – Product line, Product mix, stages of product like cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management.

UNIT IV ENTREPRENEURSHIP AND INTERNATIONAL BUSINESS (10 Periods)
Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports.

Project Report on a selected product should be prepared and submitted.

SUGGESTED READING

1. Holt DH. Entrepreneurship: New Venture Creation.
2. Kaplan JM Patterns of Entrepreneurship.
3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

21/08/2021