**B.Sc.(HONS.) BIOTECHNOLOGY PART I (1st SEMESTER)**

**C1-BIOCHEMISTRY & METABOLISM-CODE: BHB1**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* The major objective of this subject is the complete understanding at the molecular level of all of the chemical processes associated with living cells.
* The molecular architecture of cells and organelles, including membrane structure and dynamics will be discussed.
* It will also focus on the principles of bioenergetics and enzyme catalysis.
* The chemical nature of biological macromolecules, their three dimensional construction and the principles of molecular recognition is also included.
* It helps student’s understanding in the principles and basic mechanisms of metabolic control and molecular signaling.

 **INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (10 Periods)**

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. 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, lipoproteins. 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.

**SECTION-B**

**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.

**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.

**SUGGESTED READINGS**

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- CODE: BHB2**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* This subject aims to give Students an overview of basic cell biology and its applications in and around the work place.
* In particular, this subject focuses on identifying key components that constitute living cells.
* The function and structure of each cell components (organelles and tissues) will also be discussed in this subject.
* The cellular and sub cellular specializations, and characteristics of higher tissue assemblies, will be studied to understand how cells contribute to the overall functioning of the organisms.
* As cell biology is primarily an experimental science, the working of cells will frequently be discussed in an experimental context to familiarize students with many of the common tools used by cell biologists.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**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.

**SECTION-B**

**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.

Chloroplasts:Structure and function, genomes. 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.

**SUGGESTED READINGS**

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.

**AECC1- ENGLISH-I-CODE-BHB3**

**OBJECTIVES:**

* The objective of this subject is to increase Students’s English communication skills by improving fluency through regular practice and speaking instructions.
* It will help students in developing a core understanding of basic grammar structure like nouns, verbs and adjectives through class reading and speaking tasks.
* It will also improve the ability of Students to communicate effectively in English.
* This subject also focuses to expand vocabulary through assignments and class work.

**SYLLABUS AS PER**

**UNDER GRADUATE (BOARD OF STUDIES) IN ENGLISH**

**OF PUNJABI UNIVERSITY PATIALA**

**FOR B.Sc. PROFESSIONAL COURSES**

**GE1- BIOSTATISTICS-CODE: BHB4**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will be able to understand the common statistical techniques and terminology used in studies.
* This subject provides knowledge regarding common probability distributions that are used in statistical techniques.
* Students will be able to participate in on line discussions about any subject or topic using skills developed in this course.
* Students will understand the principle numeric and graphical techniques to display and summarize medical and health related data.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

2. The use of scientific calculators is allowed.

**SECTION-A**

**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.

**SECTION-B**

**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.

**SUGGESTED READINGS**

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA

2. Glaser AN (2001) High YieldTM 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.

**GE1- DEVELOPMENTAL BIOLOGY-CODE: BHB4**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* This subject provides knowledge regarding broad phylogenetic and evolutionary relationship.
* Students will be able to understand four rounds of cell division.
* This subject explains the clinical implications of development and mechanisms that intervene in developmental alterations.
* Students will be able to identify the homologies, similarities and differences between structures and processes in the developmental models studied.
* Students will also be able to identify embryonic structures and principle cellular mechanisms of development.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**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.

**SECTION-B**

**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 germ layers
Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

**SUGGESTED READINGS**

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.

**GE1- CHEMISTRY -1-CODE: BHB4**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will understand the different principles of inorganic chemistry.
* Students will get knowledge of optical activity.
* Students will be able to perform analysis of ions from Group I & II.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**UNIT I (12 Periods)**

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements and ions. Position of element in the periodic table. Atomic and ionic radii, ionization energy, electronic affinity and electronegativity. Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Van der Walls interactions, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

**UNIT II (18 Periods)**

Intermolecular forces, structure of liquids Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquid crystal, solid and liquid,Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waals equation of states. Molecular velocities: Root mean square, average and most probable velocities. Liquifacation of gases (based on Joule-Thomson effect).

**SECTION-B**

**UNIT III (18 Periods)** Nomenclature and isomerism in alkanes, methods of formation, physical properties and Chemical reactions. Nomenclature of alkenes-methods of formation, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes. Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes.

**UNIT IV (12 Periods)**

Optical activity, polarization, orientation of dipoles in an electric field, dipole moment. Induced dipole moment, measurement of dipole moment temperature method and refractivity method. Dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetism.

**SUGGESTED READINGS**

1. Basic Inorganic Chemistry. F.A. Cotten. G. Wilkinson and P.L.. Gaus. Wiley.

1. Concise Inorganic Chemistry. 1.D. Lee. ELBS.
2. Concepts of Models of Inorganic Chemistry. B. Doaglas. D. McDaniel and 1. Alexander, John Wiley.
3. Inorganic Chemistry. D.E. Shriver, P. W. Aikins and C.H. Langford. <Oxford.
4. Inorganic Chemistry. W. W. Porterfield Addison. Wesley.
5. Inorganic Chemistry. A.G. Sharpe, ELBS.
6. Inorganic Chemistry. G.L. Miessler and O.A. Tarr, Prentice Hall.
7. Organic Chemistry. Morrison and Boyd, Prentice Hall.
8. Organic Chemistry. L.G. Wade lr.Prentice Hall.
9. Fundamentals of Organic Chemistry. Solomons, John Wiley.
10. Organic Chemistry. Vol. I, II & III. S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
11. Organic Chemistry. F.A. Aarey, McGraw Hill India.
12. Introduction to Organic Chemistry. Stretwieser, Heathcock and Kosover, Machmilan.
13. Physical Chemistry. G.M. Barrow, International Student Edition. McGraw Hill.
14. Basic Programming with Application. V.K. Jain, 1'ata McGraw Hill.
15. Computers and Common. Sense. B. Ryal and Shely, Prentice Hall.
16. University General Chemistry. C.N.B. Rao. Macmillan.
17. Physical Chemistry. R.A. Alberty, Wiley Eastern Ltd.
18. The Elements of Physical Chemistry, P.w. Aikins, Oxford.
19. Physical Chemistry Through Problems. S.K. Dogra and S. Dogra. Wiley Eastern Ltd

**AECC -2-- PUNJABI-I-CODE: BHB5**

**SYLLABUS & COURSES OF READING FOR PUNJABI QUALIFYING /ELEMENTARY PUNJABI WILL BE AS PER UG (BOARD OF STUDIES) IN PUNJABI FOR DEGREE LEVEL PROFESSIONAL COURSES, PUNJABI UNIVERSITY, PATIALA**

**PRACTICALS**

**LC-1 (PRACTICAL PERTAINING TO THEORY C1-BHB1)**

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. Estimation of blood glucose by glucose oxidase method.
4. 4. Principles of Colorimetry: (i) Verification of Beer's law, estimation of
 protein. (ii) To study relation between absorbance and % transmission.
5. Preparation of buffers.
6. Separation of Amino acids by paper chromatography.
7. Qualitative tests for Carbohydrates, lipids and proteins.

**LC-2 (PRACTICAL PERTAINING TO THEORY C2-BHB2)**

1. Study the effect of temperature and organic solvents on semi permeable membrane.

2. Demonstration of dialysis.

3. Study of plasmolysis and deplasmolysis.

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.

**LC-3 PRACTICALS PERTAINING TO (GE-1-BHB4)-BIOSTATISTICS**

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

**LC-3 (PRACTICALS PERTAINING TO THEORY GE-1-BHB4) DEVELOPMENT BIOLOGY**

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.

**LC-3 (PRACTICAL PERTAINING TO THEORY GE-1-BHB4) CHEMISTRY-I**

1. Cation analysis.
2. Separation and identification of ions from Groups I, II group.
3. Anion analysis (2 cation and 2 anion with no interference).
4. Practical’s related to concept of isomerism

**B. Sc. (HONS.) BIOTECHNOLOGY PART I (2NDSEMESTER)**

**C3- MAMMALIAN PHYSIOLOGY-CODE: BHB6**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will understand why cells need to communicate and to give examples of some of the processes involved in animals.
* Students will be informed about definition and distinguish the roles of membrane bound, secreted and diffusible signaling molecules and relate this to their functions.
* The subject will describe students the major components of the extracellular matrix and how cells adhere to it.
* The subject will describe students other forms of cell-cell contact such as cadherin junctions and gap junctions and to appreciate the functions which these serve.
* Students will understand the principles of immune recognition.
* The subject will describe students the process of fertilization and reproduction.
* Students will understand the principals of the mechanisms of action of drugs on tissues and some ways in which their effects might be tested in vitro and in vivo.
* The subject will define the terms agonist and antagonist, competitive and non-competitive and partial agonist and antagonist.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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 O2 and CO2, 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.

**SECTION-B**

**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.

**SUGGESTED READINGS**

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-CODE: BHB7**

 **Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OJECTIVES:**

* Students will have an understanding of basic plant chemistry and physiology.
* Students will have an overview of photosynthesis, cellular respiration, and fermentation.
* Students will understand the basic parts of a plant cell and the distinction between different tissue types in plants.
* Students will be familiar with the anatomical features of leaves, stems, and roots as well as flowers and fruits.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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

**SECTION-B**

**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

**SUGGESTED READINGS**

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, 4thedition, 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.

**AECC3- ENGLISH-II-CODE: BHB8**

**OBJECTIVES:**

* The objective of this subject is to increase students’s English communication skills by improving fluency through regular practice and speaking instructions.
* It will help students in developing a core understanding of basic grammar structure like nouns, verbs and adjectives through class reading and speaking tasks.
* It will also improve the ability of students to communicate effectively in English.
* This subject also focuses to expand vocabulary through assignments and class work.

**SYLLABUS AS PER**

**UNDER GRADUATE (BOARD OF STUDIES) IN ENGLISH OF**

**PUNJABI UNIVERSITY PATIALA**

**FOR B.Sc. PROFESSIONAL COURSES**

**GE2- BIOTECHNOLOGY AND HUMAN WELFARE-CODE: BHB9**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will learn new approaches from relevant areas of bio science and technology.
* Students will understand applications of biotechnology in four major fields such as industry, health care (medical), crop production and agriculture and forensic science.
* Students will learn the use of products and raw materials from biological means and processes them by using technology from different spheres like chemical engineering, bio-process engineering, information technology.
* Students will understand how to increase crop yield, reduce vulnerability of crops to environmental stresses, increased nutritional qualities, improve taste, texture or appearance of food, reduce dependence on fertilizers, pesticides and other agrochemicals and production of novel substances in crop plants.
* Students will learn designing of organisms to produce antibiotics, and the engineering of genetic cures through genomic manipulation.
* Students will learn various industrial processes such as designing of an organism to produce a useful chemical and use of enzymes as industrial catalysts to either produce valuable chemicals or destroy hazardous/polluting chemicals.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

U**NIT 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.

**SECTION-B**

**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 (12 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.

**UNIT V (13 Periods)**

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in *E.coli*, human genome project.

**SUGGESTED READINGS**

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.

**GE2- MICROBIAL PHYSIOLOGY-CODE: BHB9**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* This subject highlights diversity in microorganism based on their physical and chemical requirements for growth.
* It will help student to understand how a cell function in the environment, how it can reproduce from very simple substrates available in the environment.
* It will introduce the inter-relatedness of microbiology, biochemistry and genetics in the context of a functioning bacterial cell.
* It will help students to understand the cell structure, growth factors, metabolism and genetic composition of microorganism.
* It will help students to understand single–celled organisms as a paradigm.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (12 Periods)**

Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.

**UNIT II (13 Periods)**

Microbial Growth. Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxie growth curve. Measurement of microbial growth. Measurement of cell numbers, cell mass and metabolic activity

**SECTION-B**

**UNIT III (15 Periods)**

Effect of the environment on microbial growth

Temperature- temperature ranges for microbial growth, classification based on temperature
ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water
activity, oxygen concentration, radiation and pressure. Chemolithotrophic metabolism,
Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogenoxidizing bacteria
and methanogens.

**UNIT IV (20 Periods)**

Phototrophic metabolism. Historical account of photosynthesis, diversity of phototrophic
bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and
absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light
reactions, cyclic and non-cyclic photophosphorylation. Carbon dioxide fixation, Calvin cycle and
reductive TCA cycle.

**SUGGESTED READINGS**

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag

2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms.10th
 edition. Pearson/ Benjamin Cummings.

3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.

4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.

5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th
 edition, McMillan Press.

6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein’s
 Microbiology. 7th edition. McGraw Hill Higher Education.

**GE2- CHEMISTRY 2-CODE: BHB9**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

 **OBJECTIVES:**

* The students will develop curiosity and interest in chemistry.
* The student will acquire an ability to think rationally and critically.
* The student will learn ionic solids, solutions and chemical kinetics.
* The students will learn about Colligative properties.
* The subject will provide details about benzene and its derivatives.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (12 Periods)**

**Ionic Solids-** Concept of close packing, Ionic structures, semiconductors, lattice energy, solubility of ionic solids, polarizing power and polarisability of ions, Fajan’s rule. Metallic bond-free electron, valence bond and bond theories.

**Solutions, Dilute Solutions and Colligative Properties**- Ideal and non-ideal solutions, methods of expressing concentration of solutions, activity and activity coefficients. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, elevation of boiling point and depression of freezing point.

**UNIT II (15 Periods) Chemical Kinetics and catalysis-** Rate of a reaction, factors influencing the rate of a reaction- concentration, temperature, pressure, solvent, light, catalyst. Characteristics of simple chemical reactions-zero order, first order, second order, pseudo order, half life and mean life. Theories of chemical kinetics, effect of temperature on rate of reaction. Arrhenius equation, concept of activation energy. Catalysis and general characteristics of catalytic reactions. Homogeneous catalysis, acid base catalysis and enzyme catalysis including their mechanisms, Michaelis Menten equation for enzyme catalysis and its mechanism**.**

**SECTION-B**

**UNIT III (12 Periods)**

**Isomerism-** Concept of isomerism. Types of isomerism: Optical isomerisim-elements of symmetry, molecular chirality, enantiomers, optical activity, properties of enantiomers, diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. D & L and R & S systems of nomenclature.Geometric isomerism, E & Z system of nomenclature. Conformational isomerism. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Definition of colloids, classification of colloids.

**UNIT IV (15 Periods)**

**Benzene and its derivatives-**Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene: molecular formula vand Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, Huckel rule. Aromatic electrophilic substitution, role of σ and π complexes. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives.Methods of formation and chemical reaction of alkylbenzenes.

 **SUGGESTED READINGS**

1. Basic Inorganic Chemistry. F.A. Cotten. G. Wilkinson and P.L.. Gaus. Wiley.
2. Concise Inorganic Chemistry. 1.D. Lee. ELBS.
3. Concepts of Models of Inorganic Chemistry. B. Doaglas. D. McDaniel and 1. Alexander, John Wiley.
4. Inorganic Chemistry. D.E. Shriver, P. W. Aikins and C.H. Langford. <Oxford.
5. Inorganic Chemistry. W. W. Porterfield Addison. Wesley.
6. Inorganic Chemistry. A.G. Sharpe, ELBS.
7. Inorganic Chemistry. G.L. Miessler and O.A. Tarr, Prentice Hall.
8. Organic Chemistry. Morrison and Boyd, Prentice Hall.
9. Organic Chemistry. L.G. Wade lr.Prentice Hall.
10. Fundamentals of Organic Chemistry. Solomons, John Wiley.
11. Organic Chemistry. Vol. I, II & III. S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
12. Organic Chemistry. F.A. Aarey, McGraw Hill India.
13. Introduction to Organic Chemistry. Stretwieser, Heathcock and Kosover, Machmilan.
14. Basic Programming with Application. V.K. Jain, 1'ata McGraw Hill.
15. Computers and Common. Sense. B. Ryal and Shely, Prentice Hall.
16. University General Chemistry. C.N.B. Rao. Macmillan.
17. Physical Chemistry. R.A. Alberty, Wiley Eastern Ltd.
18. The Elements of Physical Chemistry, P.w. Aikins, Oxford.
19. Physical Chemistry Through Problems. S.K. Dogra and S. Dogra. Wiley Eastern Ltd.

**AECC-4- PUNJABI-II-CODE: BHB-10**

**SYLLABUS & COURSES OF READING FOR PUNJABI QUALIFYING /ELEMENTARY PUNJABI WILL BE AS PER UG (BOARD OF STUDIES) IN PUNJABI FOR DEGREE LEVEL PROFESSIONAL COURSES, PUNJABI UNIVERSITY, PATIALA**

**GE3- DRUG ABUSE: PROBLEM, MANAGEMENT AND PREVENTION-CODE:BHB11**

**COMMON FOR ALL UNDERGRADUATE DEGREE COURSES PART-I(SEMESTER-II)QUALIFYING SUBJECT-DRUG ABUSE:PROBLEM,MANAGEMENT AND PREVENTION**

**PRACTICALS**

**LC-4 (PRACTICAL PERTAINING TO THEORY C3-BHB6)**

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

**LC-5 (PRACTICAL PERTAINING TO THEORY C4-BHB7)**

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.

**LC-6 (PRACTICAL PERTAINING TO THEORY GE2-BHB9) BIOTECHNOLOGY & HUMAN WELFARE**

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)

**LC-6 (PRACTICAL PERTAINING TO THEORY GE2-BHB9) MICROBIAL PHYSIOLOGY**

1. To study and plot the growth curve of *E coli* using turbidometric method and to calculate
 specific growth rate and generation time.

2. To study and plot the growth curve of *Aspergillus niger* by radial growth measurements.

3. To study the effect of pH on the growth of *E. coli*

4. To study the effect of temperature of *Aspergillus niger* by dry weight method.

*5.* Demonstration of the thermal death time and decimal reduction time of *E. coli.*

**LC-6 (PRACTICAL PERTAINING TO THEORY GE2-BHB9) CHEMISTRY II**

1. Determination of melting points:Naphthalene, 80-820, Benzoic acid, 121.5-1220**,**Urea, 132.5-1330, Succinic acid, 184.5-1850, Cinnamic acid, 132.5-1330, Salicylic acid, 157.5-1580, Acetanilide, 113.5-1140, m-Dinitrobenzene, 900, ρ-Dichlorobenzene, 520, Asprin, 1350.
2. Determination of boiling points**:** Ethanol 780, Cyclohexane, 81.40. Tolune, 110.60, Benzene, 800.
3. Crystallization:Concept of induction of crystallization, Phthalic acid from hot water (using fluted filter paper and seamless funnel), Acetanilide from boiling water, Naphthalene from ethanol, Benzoic acid from water.
4. Practical pertaining to Viscosity & Surface Tension of pure liquids.
5. To determine the viscosity and surface tension of C2H5OH and glycerin solution in water.
6. Molecular weight determined by Rast method.

**B.SC. (HONS.) BIOTECHNOLOGY PART II (3RD SEMESTER)**

**C5- GENETICS-CODE: BHB12**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

 **OBJECTIVES:**

* The main objective of this subject is to understand the significance of mitosis and meiosis.
* Students will learn Mendelian Genetics which tells how to solve genetic problems that involves monohybrid and dihybrid crosses.
* Students will understand the molecular genetics which describes the structure of DNA, DNA replication, transcription and translation processes.
* It will help students to understands the causes and effects of mutation on molecular level.
* This subject also describes the role of Genetic code, gene, mRNA, ribosomes etc.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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. 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.

**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.

**SECTION-B**

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

**SUGGESTED READINGS**

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-CODE: BHB13**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* This subject highlights the structure, metabolism, genetics and ecology of prokaryotic microorganism, eukaryotic microorganism and viruses.
* Students will understand the principles of physical and chemical methods in the control of microorganism.
* Students will understand the prevention and control of infectious diseases.
* This subjects gives the understanding of various laboratory techniques such as isolation, staining, identification for various microorganism.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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 viz. 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.

**SECTION-B**

**UNIT III (20 Periods)**

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

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.

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria.
Major food born infections and intoxications.

**SUGGESTED READINGS**

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-3-CODE: BHB14**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will learn the laboratory skills.
* Students will acquire the knowledge of alcohols, aldehydes and ketones.
* Students will understand the basic concepts of thermodynamics and Chemical equilibrium

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

. **SECTION-A**

**UNIT I (15 periods)**

**Alcohols** Nomenclature, Methods of formation by reduction of aldehydes, ketone, carboxylic acids and esters. Hydrogen bonding, Acidic nature, Reactions of alcohols. PhenolsNomenclature, structure and bonding. Preparation of Phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonanace stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic subsititution, acylation and carboxylation

**UNITII (15 periods)**

**Aldehydes and Ketones** Nomenclature and structure of the carbonyl group, Synthesis of aldehydes and ketones from acid chlorides, 1,3- dithianes, nitrites and carboxylic acids. Physical properties and chemical reactions.

**Carboxylic Acids** Nomenclature, structure and bonding. physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of amides, Reactions of carboxylic acids.

**SECTION-B**

**UNIT III (12 periods)**

**Thermodynamics-I** Definition of thermodynamics terms: system, surroundings. Types of systems, intensive and extensive properties. State and path functions and their differentials, Thermodynamic processes, Concept of heat and work, elementary idea of thermochemistry. First Law of Thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law. Joule Thomson coefficient and inversion temperature, Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

**Thermodynamics-II-** Second law of thermodynamics: need for the law, different statements of the law. Concept of entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, entropy as a criterion of spontaneity and equilibrium. Entropy change in ideal gases mixing of gases.

**UNIT IV (15 periods)**

 **Thermodynamics-III** Third law of thermodynamics, Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs and Helmholtz functions; Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities. Variation of G and A with P, V and T.

**Chemical Equilibrium** Equilibrium constant and free energy, Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation and Clausius-Claperyron equation.

**SUGGESTED READINGS**

1. Basic Inorganic Chemistry. F.A. Cotten. G. Wilkinson and P.L.. Gaus. Wiley.
2. Concise Inorganic Chemistry. 1.D. Lee. ELBS.
3. Concepts of Models of Inorganic Chemistry. B. Doaglas. D. McDaniel and 1. Alexander, John Wiley.
4. Inorganic Chemistry. D.E. Shriver, P. W. Aikins and C.H. Langford. <Oxford.
5. Inorganic Chemistry. W. W. Porterfield Addison. Wesley.
6. Inorganic Chemistry. A.G. Sharpe, ELBS.
7. Inorganic Chemistry. G.L. Miessler and O.A. Tarr, Prentice Hall.
8. Organic Chemistry. Morrison and Boyd, Prentice Hall.
9. Organic Chemistry. L.G. Wade lr.Prentice Hall.
10. Fundamentals of Organic Chemistry. Solomons, John Wiley.
11. Organic Chemistry. Vol. I, II & III. S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
12. Organic Chemistry. F.A. Aarey, McGraw Hill India.
13. Introduction to Organic Chemistry. Stretwieser, Heathcock and Kosover, Machmilan.
14. Physical Chemistry. G.M. Barrow, International Student Edition. McGraw Hill.
15. Basic Programming with Application. V.K. Jain, 1'ata McGraw Hill.
16. Computers and Common. Sense. B. Ryal and Shely, Prentice Hall.
17. University General Chemistry. C.N.B. Rao. Macmillan.
18. Physical Chemistry. R.A. Alberty, Wiley Eastern Ltd.
19. The Elements of Physical Chemistry, P.w. Aikins, Oxford.
20. Physical Chemistry Through Problems. S.K. Dogra and S. Dogra. Wiley Eastern Ltd.

**C7- SPECTROSCOPIC TECHNIQUES-I-CODE: BHB14**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* This subject will explain why atomic spectra consist of lines whereas molecular spectra at room temperature are broad and continuous.
* This subject will explain what it means to use spectroscopic methods for qualitative and quantitative analysis.
* This subject will describe the difference between a fluorescence excitation and emission spectrum.
* This subject will compare two molecules and determine which one will undergo more collisional deactivation
* This subject will determine the vibrations for atomic molecules and identify whether they are infrared active.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

 Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**UNIT I (10 Periods)**

**Absorption and emission Spectroscopy**-The basis of absorption and emission of radiation by molecular species, the wave properties of the light, the quantum theory of light, quantum theory of matter, molecular energies and the Born Oppenheimer approximation, the types of molecular motion and spectroscopy associated with each

**UNIT II (15 Periods)**

**Rotational spectroscopy** – classical description of molecular rotation, quantum mechanics of molecular motion, rotational spectra, determination of the bond length from rotational constants, vibrational stretching and vibrational satellites, no-rigid rotor, centrifugal distortion, degeneracies and intensities, Stark effect, selection rules, rotational spectra of polyatomic molecules

**SECTION-B**

**UNIT III (15 Periods)**

**Vibrational spectroscopy** – classical description of molecular vibrations, the classical harmonic oscillator, quantum mechanics of molecular vibration, vibrational selection rules, anharmonic vibrations and Morse oscillator, bond dissociation energies and Birge-Sponer plots, calculation of force constants from vibrational spectrum, isotopic shift, rotational structure in vibrational spectra of diatomic molecules, vibrational selection rules, vibration of polyatomic molecules, normal modes, characteristic group vibrational energies, hydrogen bonds in IR spectra.

**UNIT IV (10 Periods)**

**Raman Spectroscopy** – description of Raman scattering, Rayleigh scattering, Stokes and anti-Stokes scattering , polarizabilityof the molecules, Placzek theory, selction rules for rotational Raman spectra of diatomic molecules, rotational Raman spectra, vibrational Raman spectra, Raman spectra of polyatomic molecules.

**SUGGESTED READINGS**

1. Introduction to Spectroscopy: Donald L. Pavia, Gary M. Lampman, George S. Kriz Cengage Learning; 4th Edition.
2. Spectrometric Identification of Organic Compounds: Robert M. Silverstein, Francis X. Webster, David Kiemle Wiley; 7th Edition
3. Infrared spectra of Complex molecules: J. Bellamy, John Wiley & Sons, Inc., 3rd Edition.
4. Spectroscopic Method in Organic Chemistry: Dudley Williams, Ian Fleming McGrawHill Education; 6th Edition.
5. Applications of spectroscopic techniques in Organic Chemistry: P.S. Kalsi, New Age International; 6th Edition.
6. Elementary Organic Spectroscopy; Principles And Chemical Applications: Y. R. Sharma, S. Chand & Co Pvt Ltd.
7. Fundamentals of Molecular Spectroscopy: C. M. Banwell and E. McCash, Tata McGraw Hill, 4th Edition.
8. Modern Raman Spectroscopy: A Practical Approach; Ewen Smith, Geoffrey Dent., Wiley; 1st Edition

**SECI- ENZYMOLOGY-CODE: BHB15**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will learn various theoretical and practical aspects of enzymology.
* This subject will stimulates students’s interest in learning the structure, function and kinetics of enzyme and their role as catalyst and regulator of cell metabolism.
* This subject will serve as foundation for more advanced enzymology courses.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (20 Periods)**

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

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. 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, Iysozyme, RNase.

Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

**SECTION-B**

**UNIT III (13 Periods)**

Allosteric enzymes with special reference to aspartate. 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. Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering- selected examples.

Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes.

**SUGGESTED READINGS**

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

**GE4- ENVIRONMENTAL BIOTECHNOLOGY-CODE: BHB16**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

 **OBJECTIVES:**

* Students will know the basic physiology of a microorganism and how their structure dictates their function in the environment.
* Students will understand the bases for microbial metabolism of environmental contaminants
* Students will know various techniques to modify and augment microorganisms in the laboratory and environment.
* Students will understand the principles of bioremediation, phytoremediation, bioleaching and waste water treatment.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (18 Periods)**

Conventional fuels and their environmental impact - Firewood, Plant, Animal, Water,

Coal and Gas. Modern fuels and their environmental impact - Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

**UNIT II (20 Periods)**

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phytoremediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products.

**SECTION-B**

**UNIT III (12 Periods)**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers

Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM).

**UNIT IV (10 Periods)**

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

**SUGGESTED READINGS**

1. Environmental Science, S.C. Santra

2. Environmental Biotechnology, Pradipta Kumar Mohapatra

3. Environmental Biotechnology - Concepts and Applications, Hans-Joachim Jordening and
 Jesef Winter

4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill

5. Agricultural Biotechnology, S.S. Purohit

6. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John
 F.T. Spencer

7. Introduction to Environmental Biotechnology, Milton Wainwright

8. Principles of Environmental Engineering, Gilbert Masters

9. Wastewater Engineering - Metcalf & Eddy

**GE4- ECOLOGY AND ENVIRONMENT MANAGEMENT-CODE: BHB16**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will learn advancement in the science and practice of ecology and environmental management for the public benefit
* Students will learn how to conserve and enhance biodiversity and maintenance of ecological processes and life support systems essential to a fully functional biosphere.
* Students will also learn environmentally sustainable management and development.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**UNIT-I (12 Periods)**

Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere Scope of Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Biological control of chemical environment.

**UNIT II (20 Periods)**

Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production &
decomposition in a system. Ecological efficiencies, Trophic structure & energy pyramids,
Ecological energetic, principles pertaining to limiting factors, Bio-geochemical cycles (N,C,P
cycles).

**SECTION-B**

**UNIT-III (18 Periods)**

Pollution & environmental Health related to Soil, Water, Air, Food, Pesticides, Metals, Solvents,
Radiations ,Carcinogen, Poisons. Detection of Environmental pollutant. Indicators & detection
systems. Bio-transformation, Plastic, Aromatics, Hazardous wastes Environmental cleanup :
Case studies

**UNIT-IV (10 Periods)**

Environmental biotechnologies, Biotechnologies in protection and preservation of environment. Bioremediation, Waste disposal.

**SUGGESTED READINGS**

1. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge University Press.
2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
3. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House
4. Joseph, B., Environmental studies, Tata Mc Graw Hill.
5. Michael Allabay, Basics of environmental science, Routledge Press.
6. Miller, G.T. 2002. Sustaining the earth, an integrated approach. (5thedition) Books/Cole,
 Thompson Learning, Inc.
7. Mohapatra Textbook of environmental biotechnology IK publication.
8. Rana SVS, Environmenta lpollution - health and toxicology, Narosa Publication
9. Sinha, S. 2010. Handbook on Wildlife Law Enforsement in India. TRAFFIC, India.
10. Thakur,IS,EnvironmentalBiotechnology,IKPublication.

**PRACTICALS**

**LC-7 (PRACTICAL PERTAINING TO THEORY C5-BHB12)**

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.

5. Karyotyping with the help of photographs

6. Pedigree charts of some common characters like blood group, color blindness and
 PTC tasting.

**LC-8 (PRACTICAL PERTAINING TO THEORY C6- BHB13)**

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.

**LC-9 (PRACTICAL PERTAINING TO THEORY C7- BHB14) CHEMISTRY III**

1. Determination of acetic acid in commercial vinegar using NaOH, Alkalinity of water sample.
2. Determination of alkaline content of antacid.
3. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
4. Estimation of hardness of water by EDT A.
5. Estimation of ferrous and ferric by dichromate method.
6. Estimation of copper using sodium thiosulphate.
7. Thin Layer Chromatography

Determination of Rf values of different components.

(a) Separation of green leaf pigments (spinach leaves may be used)

(b) Preparation and separation of 2, 4-dinitrophenylhydrazones of acetone, benzophenone and cyclohexanone using toluene and light petroleum mixture (40:60).

(c) Separation of a mixture of dyes.

**LC-9 (PRACTICAL PERTAINING TO THEORY C7- BHB14) SPECTROSCOPIC TECHNIQUE-I**

1. To study the absorption spectrum of hemoglobin and NADH.
2. Determination of Tm of nucleic acid.
3. The validity of beers law for colorimetric estimation of creatinine.
4. The ultraviolet absorption of proteins and amino acids.
5. Estimation of proteins by Lowry"s and Bradford method.

**LC- 10 (PRACTICAL PERTAINING TO THEORY SECI-BHB15)**

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

**LC-11 (PRACTICAL PERTAINING TO THEORY GE4- BHB16) ENVIRONMENT BIOTECHNOLOGY**

1. Calculation of Total Dissolved Solids (TDS) of water sample.

2. Calculation of BOD of water sample.

3. Calculation of COD of water sample.

4. Bacterial Examination of Water by MPN Method.

**LC-11 (PRACTICAL PERTAINING TO THEORY GE4- BHB 16) ECOLOGY & ENVIRONMENT MANAGEMENT**

1. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or
 terrestrial ecosystem or human modified ecosystem.

2. Determination of population density in a terrestrial community or hypothetical
 community by quad rate method and calculation of the Simpson’s and Shannon- Weiner
 diversity index for the same community.

3. Principle of GPS (Global Positioning System).

4. Study of the types of soil, their texture by sieve method and rapid tests for -pH,

chlorides, nitrates, carbonates and organic carbon

5. Study any five endangered/ threatened species- one from each class.

**B. Sc. (HONS.) BIOTECHNOLOGY PART II (4TH SEMESTER)**

**C8- MOLECULAR BIOLOGY-CODE: BHB17**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

1. This subject will demonstrate knowledge and understanding of the molecular machinery of living cells.
2. This subject will demonstrate knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition.
3. This subject will demonstrate knowledge and understanding of the principles and basic mechanisms of metabolic control and molecular signaling.
4. Students will learn the use of basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments.
5. Students will learn how to implement experimental protocols, and adapt them to plan and carry out simple investigations.
6. Students will be able to analyse, interpret, and participate in reporting to their peers on the results of their laboratory experiments;
7. Students will participate in report orally on team work investigations of problem-based assignments;
8. Students will build on their knowledge and understanding in tackling more advanced and specialised courses, and more widely to pursue independent, self-directed and critical learning.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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.

**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.

**SECTION-B**

**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,Posttranslational modifications of proteins.

**SUGGESTED READINGS**

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-CODE: BHB18**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* The students will be able to identify the cellular and molecular basis of immune responsiveness.
* The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
* The students will be able to describe immunological response and how it is triggered and regulated.
* The students will be able to demonstrate a capacity for problem-solving about immune responsiveness.
* The students will be able to transfer knowledge of immunology into clinical decision-making through case studies presented in class.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (20 Periods)**

Immune Response - An overview, components of mammalian immune system, molecular
structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T-
lymphocytes & 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)**

Antibody diversity & brief overview, allotypes, idiotypes, immunologic memory. Complement system.

**SECTION-B**

**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, precipitation, agglutination.

**SUGGESTED READINGS**

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 Publicatio

**C10-CHEMISTRY-4-CODE: BHB19**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* The students will develop curiosity and interest in chemistry.
* The student will acquire knowledge of acid and bases, carboxylic acids and its derivatives.
* The student will learn concepts of phase equilibrium, fats & oils and electrochemistry.
* The students will learn applications of conductance measurement.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**UNIT I (10 periods)**

**Acids and Bases -** Arrhenius, Bronsted-Lowry, the Lux-Flood solvent system and Lewis concepts of acids and bases. Use of redox potential.

**Non-aqueous Solvents-** Physical properties of a solvent, types of solvents and their general characteristics

**UNIT II (10 periods)**

**Carboxylic Acid Derivatives** -Structure and nomenclature of acid chlorides, esters. amides and acid anhydrides. Relative stability and reactivity of acyl derivatives.

**Ethers -** Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions-cleavage and autooxidation, Ziesel' s Method.

**Fats, Oils and Detergents-** Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

**SECTION-B**

**UNIT III (10 periods)**

**Phase Equilibrium-** Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule; phase equilibria of one component system-water and S systems. Phase equilibria of two component systems-solid-liquid equilibria, Nernst distribution law

**Electrochemistry-I-**Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance with dilution. Migration of ions and Kohlrausch law. Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes.

 **UNIT IV (10 periods)**

 **Applications of conductance measurements-**determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salts, conductometric titrations.

**Electrochemistry-II-**Definition of pH and pK., determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiomentric methods. Buffers--mechanism of buffer action, Henderson-Hazel equation.

**SUGGESTED READINGS**

1. Basic Inorganic Chemistry. F.A. Cotten. G. Wilkinson and P.L.. Gaus. Wiley.
2. Concise Inorganic Chemistry. 1.D. Lee. ELBS.
3. Concepts of Models of Inorganic Chemistry. B. Doaglas. D. McDaniel and 1. Alexander, John Wiley.
4. Inorganic Chemistry. D.E. Shriver, P. W. Aikins and C.H. Langford. <Oxford.
5. Inorganic Chemistry. W. W. Porterfield Addison. Wesley.
6. Inorganic Chemistry. A.G. Sharpe, ELBS.
7. Inorganic Chemistry. G.L. Miessler and O.A. Tarr, Prentice Hall.
8. Organic Chemistry. Morrison and Boyd, Prentice Hall.
9. Organic Chemistry. L.G. Wade lr.Prentice Hall.
10. Fundamentals of Organic Chemistry. Solomons, John Wiley.
11. Organic Chemistry. Vol. I, II & III. S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
12. Organic Chemistry. F.A. Aarey, McGraw Hill India.
13. Introduction to Organic Chemistry. Stretwieser, Heathcock and Kosover, Machmilan.
14. Physical Chemistry. G.M. Barrow, International Student Edition. McGraw Hill.
15. Basic Programming with Application. V.K. Jain, 1'ata McGraw Hill.

**C10- SPECTROSCOPIC TECHNIQUES-II-CODE: BHB19**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will understand how light interacts with matter and how it can be used to quantitatively understand chemical samples.
* Students will understand spectroscopy the way other common tools of measurement like the watch or the ruler are understood.
* Students will learn that spectroscopy is a set of tools that can put be together in different ways to understand systems and solve chemical problems.
* Students will understand basic concepts of instrumentation, data acquisition and data processing.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (12 Periods)**

**Electronic Spectroscopy** – electronic transition, energy of electronic transition, selection rules, the Franck-Condon principle, term symbols for describing atomic and molecular states, Russel Saunders spin-orbit coupling, selection rules of electronic transition, absorption intensity, probability of light absorption, an electronic spectrum, classification of electronic transition, d-d and CT transitions.

**UNIT II (15 Periods)**

**Emission Spectroscopy** – fluorescence and phosphorescence, deactivation processes – internal conversion, de-excitation process, non-radiative and radiative transitions, characteristic of fluorescence emission, Stokes shift, fluorophores, quantum yield of a fluorescent process, phosphorescence, intersystem crossing, Jablonski diagram, Kasha's rule of the quantum yield of Luminescence.

**SECTION-B**

**UNIT III (12 Periods)**

**Photoelectron spectroscopy** – the photoelectric effect, UV photoelectron spectroscopy UPES, X-ray photoelectron spectroscopy XPES, electron binding energy, ESCA, Auger electron spectroscopy. 15. EPR Spectroscopy – paramagnetic species, electron spin, magnetic properties of the electron and selected particles, magnetogyric ratio, electron spin–orbit couplings, energy levels

**UNIT IV (15 Periods)**

 **Spectra in magnetic field-NMR** – the Stern-Gerlach’s experiment, nuclear spin angular momentum, the magnetic moment of a nucleus, the nuclei in a magnetic field, the Larmor frequency, the chemical shift, electronic shielding of nuclei, the chemical scale, the spin-spin coupling, the spin-spin coupling constant, spin-spin splitting, molecular structure from NMR spectra..

**SUGGESTED READINGS**

1. Introduction to Spectroscopy: Donald L. Pavia, Gary M. Lampman, George S. Kriz Cengage Learning; 4th Edition.
2. Spectrometric Identification of Organic Compounds: Robert M. Silverstein, Francis X. Webster, David Kiemle Wiley; 7th Edition
3. Infrared spectra of Complex molecules: J. Bellamy, John Wiley & Sons, Inc., 3rd Edition.
4. Spectroscopic Method in Organic Chemistry: Dudley Williams, Ian Fleming McGrawHill Education; 6th Edition.
5. Applications of spectroscopic techniques in Organic Chemistry: P.S. Kalsi, New Age International; 6th Edition.
6. Elementary Organic Spectroscopy; Principles and Chemical Applications: Y. R. Sharma, S. Chand & Co Pvt Ltd.
7. Fundamentals of Molecular Spectroscopy: C. M. Banwell and E. McCash, Tata McGraw Hill, 4th Edition.
8. Modern Raman Spectroscopy: A Practical Approach; Ewen Smith, Geoffrey Dent., Wiley; 1st Edition.

**SEC-2 INDUSTRIAL FERMENTATIONS-CODE: BHB 20**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Industrial fermentation is an interdisciplinary science that applies principles associated with biology and engineering.
* Students will learn microbiology and biochemistry from biological aspect.
* Students will understand the commercial exploitation of microorganisms on a large scale.
* This subject provides the knowledge of basic principle of fermentation process, which help students to design, develop and operate industrial level fermentation process.
* This fundamental knowledge is essential for Students to make their career in industry based on bioprocess.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (12 Periods)**

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.

**UNIT II (15 Periods)**

Microbial products of pharmacological interest, steriod fermentations and transformations. Over
production of microbial metabolite, Secondary metabolism - its significance and products.
Enzyme and cell immobilization techniques in industrial processing, enzymes in organic
synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food
technology/organic synthesis.

**SECTION-B**

**UNIT III (13 Periods)**

Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products.
Experimental model for design of fermentation systems, Anaerobic fermentations.

**UNIT IV (20 Periods)**

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of
pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics,
mathematical derivations of batch and continuous culture operations; single stage CSTR; mass

transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka) determination, factors depending on scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.

**SUGGESTED READINGS**

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.

5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

**GE-5 - IPR, ENTREPRENEURSHIP BIOETIHCS & BIOSAFETY-CODE: BHB 21**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES**:

* This subject will introduce basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights.
* Students will understand balanced integration of scientific and social knowledge in sustainable development.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**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.

**SECTION-B**

**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).

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**SUGGESTED READINGS**

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

**GE-5-ENTREPRENEURSHIP DEVELOPMENT-CODE: BHB 21**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* The course aims to allow students to formulate an awareness of strategic areas, to critically appraise the related theory and practice of entrepreneurial strategy.
* At the same time the course will provide students with the opportunity to apply theory to practice, thereby enabling them to learn by doing.
* Students will develop necessary knowledge and skills among the participants in EDPSs.
* This subject imparts basis managerial knowledge and understanding.
* Students will develop and strengthen entrepreneurial quality and motivation.
* Students will be able to analyze the environmental issues related to the proposed project.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

 **SECTION-A**

 **UNIT I INTRODUCTION (10 Periods)**

Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

**UNIT II ESTABLISHING AN ENTERPRISE (12 Periods)**

Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

**SECTION-B**

**UNIT III 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 IV 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 V 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.

**SUGGESTED READINGS**

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.

**AECC-5- ENVIRONMENTAL & ROAD SAFETY AWARENESS-CODE: BHB 22**

**COMMON FOR ALL UNDERGRADUATE DEGREE COURSES PART-II(SEMESTER-IV)QUALIFYING SUBJECT- ENVIRONMENTAL & ROAD SAFETY AWARENESS**

**PRACTICALS**

**LC-12 (PRACTICAL PERTAINING TO THEORY C8-BHB 17)**

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

**LC-13 (PRACTICAL PERTAINING TO THEORY C9- BHB18)**

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.

**LC-14 (PRACTICAL PERTAINING TO THEORY C10-BHB19) -CHEMISTRY-4**

**1.** Detection of elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.

 22. To determine the solubility of benzoic acid at different temperatures and

3. to determine ΔH of the dissolution process.

 4. To determine the enthalpy of neutralisation of a weak acid/weak base versus strong base/strong acid and

5. To determine the enthalpy of ionisation of the weak acid/weak base.

**LC-14 (PRACTICAL PERTAINING TO THEORY C-10-BHB19) SPECTROSCOPIC TECHNIQUES- II**

1. Interpret NMR spectra of five compounds.
2. Identify chemical compound using emission spectroscopy.
3. To study the absorption spectrum of any 5 compounds.

**LC-15 (PRACTICAL PERTAINING TO THEORY SEC-2 BHB 20)**

1. Comparative analysis of design of a batch and continuous fermenter.

2. Calculation of Mathematical derivation of growth kinetics.

3. Solvent extraction & analysis of a metabolite from a bacterial culture.

4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)

**LC-16 (PRACTICAL PERTAINING TO THEORY GE5 BHB 21)-IPR, ENTREPRENEURSHIP BIOETHICS & BIO-SAFETY**

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.

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

**LC-16 (PRACTICAL PERTAINING TO THEORY GE5 BHB 21) -ENTREPRENEURSHIP DEVELOPMENT**

1. Test to assess the Entrepreneurial spirit of learner through questionnaire (Entrepreneurial Self Assessment Tool)

 2. Demonstrate and practice five core life skills

(a) Managing self and others

(b) Positive Attitude,

 (c) Creativity

 (d) Team building

(e) Motivation

3. A SWOT analysis of entrepreneurial opportunity in your locality with reference to the vocational course.

4. Prepare ppt. of successful entrepreneurs

**B.Sc. (HONS.) BIOTECHNOLOGY PART III (5TH SEMESTER)**

**C11- BIOPROCESS TECHNOLOGY-CODE: BHB23**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* The aim of this subject is to instruct students with an in-depth understanding of the key process design concepts relating to the production of biomolecules of industrial importance, produced using isolated microbial and mammalian cells.
* This will also provide students with an up-to-date knowledge of upstream and downstream processing technology.
* Throughout this module, the emphasis will be on relating how market requirements influence the development and cost-effective optimization of biotechnology processes, stressing the multidisciplinary nature of this sector.
* Students will be equipped with a knowledge and understanding of mainstream bioprocess design heuristics so that they may engage productively within multidisciplinary process development teams.

 **INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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.

**SECTION-B**

**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.

**SUGGESTED READINGS**

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-CODE: BHB24**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* This subject covers both the principles and the applications of molecular biology methods with an emphasis on the application of recombinant DNA technology to animals, plants and microbial organisms.
* It describes the use of genetically engineered products to solve environmental problems and cure human diseases.
* It also covers the practical application of recombinant DNA technology in industry, food production, human and veterinary medicine, agriculture and bioengineering.
* It will also discuss the use of recombinant DNA technology to identify, map and sequence genes and to determine their function.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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).

**SECTION-B**

**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.

**SUGGESTED READINGS**

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing,
2. 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.

**DSE-1- ANIMAL BIOTECHNOLOGY-CODE: BHB25**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* This subject covers the topics for the identification and characterization of animal breeds.
* Students will study the methods of developing DNA based diagnostics and genetically engineered vaccines for animals.
* This subject also includes animal genomics studies and its varied applications.
* Students will learn embryo-transfer technology, cloning, and transgenic animals.
* This subject also covers DNA forensics, molecular diagnostics, wildlife conservation, stem cell research and bio-processing technologies**.**

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (10 Periods)**

Gene transfer methods in Animals - Microinjection, Embryonic Stem cell, gene transfer,

Retrovirus & Gene transfer.

**UNIT II (10 Periods)**

Introduction to transgenesis. Transgenic Animals - Mice, Cow, Pig, Sheep, Goat, Bird, Insect.
Animal diseases need help of Biotechnology - Foot-and mouth disease, Coccidiosis,

Trypanosomiasis, Theileriosis.

**SECTION-B**

**UNIT III (20 Periods)**

Animal propagation - Artificial insemination, Animal Clones. Conservation Biology - Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

**UNIT IV (20 Periods)**

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy,

molecular engineering, human genetic engineering, problems & ethics.

**SUGGESTED READINGS**

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press,
 California,USA.

2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific
 publishers.

3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications
 of recombinant DNA. IV Edition. ASM press, Washington, USA.

4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An
 introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.

5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA-
 genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

**DSE-1 ANIMAL DIVERSITY I-CODE: BHB25**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES**

* Students will be able to identify the Phylum or subphylum.
* Students will be able to define and discuss the means of locomotion used by each phylum or subphylum.
* Students will be able to define characters of each phylum and class.
* Students will be able to understand the type of symmetry and level of organization of each group.
* Students will be able to define and/or locate on a specimen all of the underlined terms in the text.
* Students will learn to explain and compare the life cycles of the Hydrozoa, Scyphozoa and Anthozoa.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (15 Periods)**

a) Outline of classification of Non- Chordates upto subclasses. Coelomata, Acoelomata,
 Symmetries, Deutrostomes, Protostomes.

b) Protozoa: Locomotion, Reproduction, evolution of Sex, General features of
 *Paramoecium* and *Plasmodium*. Pathogenic protozoans

c) Porifera: General characters, outline of Classification; skeleton, Canal System

**UNIT II (15 Periods)**

a) Coelenterata: General Characters, Outline of classifications Polymorphism, Various types
 of stinging cells; Metagenesis, coral reefs and their formation.

b) Platyhelminthes- General Characters; Outline of classification; Pathogenic flatworms:
 Parasitic adaptations.

c) Aschelminthes: General features, Outline of classification, Pathogenic roundworms and
 their vectors in relation to man: Parasite adaptation.

**SECTION-B**

**UNIT III (15 Periods)**

a) Annelida: - General features, Outline of classification, Coelom: Metameric segmentation,
 General features of Earthworm, Vermicomposting.

b) Arthropoda: General Features, Outline of Classification; Larval forms of crustacean,
 Respiration in Arthropoda; Metamorphosis in insects; Social insects; Insect vectors of
 diseases; Apiculture, Sericulture.

**UNIT IV (15 Periods)**

a) Mollusca : general features, Outline of classification, Shell Diversity; Torsion in
 gastropoda,

b) Echinodermata: General features, Outline of Classification Larval forms

c) Hemichordata: Phylogeny: Affinities of *Balanoglossus*

**SUGGESTED READINGS**

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The
 Invertebrates: A New Synthesis. III Edition. Blackwell Science.

2. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and
 Nelson.

3. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia
 Publishing Home.

4. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Pres

**DSE-2 PLANT BIOTECHNOLOGY–CODE: BHB26**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES**

* The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.
* Students will develop molecular strategies to support plant breeding programs, including molecular biodiversity analysis, quantitative genetics and molecular marker-trait associations.
* Students will be able develop a model to introduce and to study the expression of genes related to plant adaptations.
* Students will learn to apply biotechnology to the development of agriculture.
* Students will learn to apply and develop strategies to produce bio-products (metabolites, enzymes, recombinant proteins)
* Students will understand biotechnological processes that have also applicative value in pharmaceutical and food industry, in agriculture and in ecology.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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.

**SECTION-B**

**UNIT - III (20 Periods)**

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification 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.

**SUGGESTED READINGS**

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. 3rdedition. 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.

**DSE-2 PLANT DIVERSITY I-CODE: BHB26**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES**

* Students will learn taxa of lower and higher plant giving:  characteristics, structures, forms, life cycle and economic importance.
* Students will be able to identify characteristics that distinguish the various plants adaptations

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

2. The use of scientific calculators is allowed.

**SECTION-A**

**UNIT I**

Algae:  **(20 Periods)**

General character, classification and economic importance. Life histories of algae belonging to various classes:

Chlorophyceae - *Volvox, Oedogonium* Xantho phyceae -*Vaucheria*

Phaeophyceae *- Ectocarpus*Rhodophyceae-*Polysiphonia*

**UNIT II**

Fungi: **(20 Periods)**

General characters, classification & economic importance. Life histories of Fungi:

Mastigomycontina- *Phytophthora* Zygomycotina-*Mucor*

Ascomycotina- *Saccharomyces*Basidomycotina-*Agaricus*Deutromycotina-*Colletotrichum*

**SECTION-B**

**UNIT III**

Lichens: **(10 Periods)**

Classification, general structure, reproduction and economic importance. Plant diseases:

4 of 36

Casual organism, symptoms and control of following plant diseases. Rust & Smut of Wheat.

White rust of Crucifers.
Late blight of Potato.
Red rot of Sugarcane.
Citrus Canker.

**UNIT IV**

Bryophytes: **(10 Periods)**

General characters, classification & economic impotance. Life histories of following:

*Marchantia.*

*Funaria.*

**SUGGESTED READINGS**

1. Agrios, G.N. 1997 Plant Pathology, 4thedition, Academic Press, U.K.

2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996 Introductory Mycology, 4 thedition,
 John Wiley and Sons (Asia) Singapore.

3. Bold, H.C. & Wayne, M.J. 1996 (2ndEd.) Introduction to Algae.

4. Kumar, H.D. 1999. Introductory Phycology. Aff. East-West Press Pvt Ltd., Delhi.

5. Lee, R.E. 2008. Phycology, Fourth Edition, Cambridge University Press, USA.

6. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany.
 IK International Publishers.

7. Shaw, A.J. and Goffinet, B. 2000 Bryophyte Biology. Cambridge University Press.

8. Van den Hoek, C.; Mann, D.J. & Jahns, H.M. 1995. Algae: An introduction to Phycology.
 Cambridge Univ. Press.

9. Vander-Poorteri 2009 Introduction to Bryophytes. COP.

10. Webster, J. and Weber, R. 2007 Introduction to Fungi. 3 rd edition, Cambridge University Press,
 Cambridge.

11. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers,
 Dordrecht, The Netherlands

**GE-6-CHEMISTRY-5-CODE: BHB27**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will acquire an ability to observe accurately and objectively.
* Students will acquire an ability to solve problem.
* Students will acquire an ability to think scientifically, independently and to make rational discussion.
* Students will be able to understand what it means to use spectroscopic methods for qualitative and quantitative analysis.
* This subject will be able to describe the difference between a fluorescence excitation and emission spectrum.
* This subject will determine the vibrations for atomic molecules and identify whether they are infrared active.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I (15 Periods)**

**Spectroscopy** Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol

Electromagnetic radiation, regions of spectrum, basic features of different spectrometers, statement of Born-Oppenheimer approximation, degrees of freedom.

**UNIT II (18 Periods)**

**Electromagnetic spectrum: Absorption Spectra** Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert's law, Molar absorptivity, presentation and analysis ofUV Spectra, types of electronic transitions, effect of conjugation.Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts.

**SECTION-B**

**UNIT III (15 Periods)**

**Infrared (IR)** Infrared (IR) absorption spectroscopy-molecular vibrations, Hooke's law, Selection rules, intensity and position of IR bands, measurement of lR spectrum, fingerprint region, characteristic absorption of various functional groups and Interpretation of IR spectra of simple organic compounds.

**Raman Spectrum** Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

**UNIT IV (18 Periods)**

**Elementary Quantum Mechanics**

 Black-body radiations, Planck's radiation law, photoelectric effect, heat capacity of solids. Sinusoidal wave equation Hamiltonian operator, Schrodingcr wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

**SUGGESTED READINGS**

1. Basic Inorganic Chemistry, F.A. Cotton, G Willdson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Leee, ELBS.
3. Concept of models of Inorganic Chemistry, B. Douglas, D. McDaniel, and J. Alexander, Jolin Wiley.
4. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W. W. Porterfield Addison-Welsey.
6. Inorganic Chemistry, A. G Sharpe, ELBS
7. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice Hall.
8. Inorganic Chemistry, Morrison and Boyd, Prentice-Hall.
9. Inorganic Chemistry, L.G Wade Jr. Prentice-Hall.
10. Fundamentals of Organic Chemistry, Solomons, John Wiley.
11. Organic Chemistry, Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
12. Organic Chemistry, F.A Carey, McGraw-Hill, Inc.
13. Introduction to Organic Chemistry, Streitwieser, Healthcock and Kosover and Kosover, Macmillan.
14. Physical Chemistry, G.M. Barrow, International Student edition, McGraw Hill.
15. University General Chemistry, C.N.R. Rao. Macmillan.
16. Physical Chemistry, R.A Alberty, Wiley Eastern Ltd.

**GE-6- BASICS OF FORENSIC SCIENCE-CODE: BHB27**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will understand the use of creativity in problem solving.
* Students will use primary scientific literature affectively in their own research.
* Students will be demonstrated practical experience of public speaking and presentation of their ideas and research.
* Students will be demonstrated competency in written forms of scientific communication.
* Students will learn principles and scientific knowledge in order to find facts about a criminal case.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**UNIT I (15 Periods)**

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

**UNIT II (15 Periods)**

Classification of fire arms and explosives, introduction to internal, external and terminal
ballistics. Chemical evidence for explosives. General and individual characteristics of
handwriting, examination and comparison of handwritings and analysis of ink various samples.

**SECTION-B**

**UNIT III (15Periods)** Role of the toxicologist, significance of toxicological findings, Fundamental principles of
fingerprinting, classification of fingerprints, development of finger print as science for personal
identification,

**UNIT IV (15 Periods)**

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

**SUGGESTED READINGS**

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press,
 Washington.

2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First
 Century, Select Publishers, New Delhi (2001).

3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University
 of Delhi, Delhi (2002).

4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and
 Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).

5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G.
 Eckert (ED.), CRC Press, Boca Raton (1997).

6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).

7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher’s Techniques of Crime Scene
 Investigation, CRC Press, Boca Raton (2013).

**PRACTICALS**

**LC-17 (PRACTICAL PERTAINING TO THEORY C11-BHB23)**

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.

**LC-18 (PRACTICAL PERTAINING TO THEORY C12-BHB24)**

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

**LC-19 (PRACTICAL PERTAINING TO THEORY DSE-1-BHB25) –ANIMAL BIOTECHNOLOGY**

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media
 sterilization, Laboratory sterilization

2. Sources of contamination and decontamination measures.

3. Preparation of Hanks Balanced salt solution

4. Preparation of Minimal Essential Growth medium

5. Isolation of lymphocytes for culturing

6. DNA isolation from animal tissue

7. Quantification of isolated DNA.

 8. Resolving DNA on Agarose Gel.

**LC-19 (PRACTICAL PERTAINING TO THEORY DSE-1-BHB25) –ANIMAL DIVERSITY-I**

1. Identification and Classification of Any these of the following -

Porifera*: Scypha, , Leucosolenia, Euspongia, Hylonema, Euplectella Cnidaria:
Medrepora, Millepora, Physalia, Porpita, Valella, Aurelia, Metridium* Platyhelminthes: *Taenia, Fasciola*, Aschelminthes*: Ascaris, Ancylostoma, Enterobius* Annelida: *Pheretima, Hirudinaria, Chaetopterus, Nereis, Aphrodite* Arthropoda: *Julus,
Scolopendra, Peripatus, Carcinus, Limulus, Lepisma, Dragonfly, Musca, Acheta*Mollusca: *Pila, Unio, Mytilus, Loligo, Sepia, Octopus, Solen*Echinodermata: *Asterias, Ophiothrix, Echinus, Holothuria, Astrophyton*Hemichordata: *Balanoglossus*

*2.*  Identification of slides with two points of identification.

*Amoeba, Paramoecium, Ceratium, Plasmodium, Opalina*, L.S. Sponge, Spicules of sponges, L.S. *Hydra, Obelia, Bougainvillia*, Larvae of *Fasciola,* Seta of Earthworm, Radula

 3. Ecological Note - On any of the specimens in Exercise No 1

Models of dissection of Earthworm, Cockroach

Earthworm: Digestive, Nervous System,

Cockroach: Digestive Reproductive, Nervous System

**LC-20 (PRACTICAL PERTAINING TO THEORY DSE-2-BHB26) PLANT BIOTECHNOLOGY**

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.

**LC-20 (PRACTICAL PERTAINING TO THEORY DSE-2-BHB26) PLANT DIVERSITY I**

1. Comparative study of thallus and reproductive organs of various algae mentioned in
 theory

2. Comparative study of vegetative and reproductive parts of various fungi mentioned in
 theory.

3. Study and section cutting and lectophenol mount of plant disease materials studied in
 theory.

4. Study of various types of lichens.

5. Study of external features & anatomy of vegetative and reproductive parts of Marchantia
 and Funaria

6. Collection of algae, fungi, plant diseases materials and bryophytes available locally.

**LC-21 (PRACTICAL PERTAINING TO THEORY GE-6-BHB27**) **CHEMISTRY-5**

**1. Synthesis and Analysis**

(a) Preparation of sodium trioxalatoferrate(III), Na3 *[Fe(C2O4*)3] and determination of its composition by permagnometry.

**2. Synthesis or Organic Compounds**

 (a) Iodoform from ethanol and acetone

 (b) Aromatic electrophlic substitution of benzene

1. p-nitroacetanilide
2. 2,4,6-tribromophenol
Diazotization/Coupling

3.Preparation of m-nitroaniline from m-dinitrobenzene

4. Interpretation of different spectra

**LC-21(PRACTICAL PERTAINING TO THEORY GE-6-BHB27) BASICS OF FORENSIC SCIENCE**

1. Documentation of crime scene by photography, sketching and field notes.

2. a. Simulation of a crime scene for training.

b. To lift footprints from crime scene.

3. Case studies to depict different types of injuries and death.

4. Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.

5. Investigate method for developing fingerprints by Iodine crystals.

6. PCR amplification on target DNA and DNA profiling,

7. E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Recovering
 deleted evidences, Password Cracking.

**B. SC (HONS.) BIOTECHNOLOGY 3rd Year (6TH SEMESTER)**

**C13- BIO-ANALYTICAL TOOLS-CODE: BHB 28**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* The primary objectives of this course are to develop the skills to understand the theory and practice of bio-analytical techniques.
* This subject will provide scientific understanding of analytical techniques and detail interpretation of results.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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, infra-
red), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and
particles.

**SECTION-B**

**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.

**SUGGESTED READINGS**

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-CODE: BHB29**

 **Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* The ultimate goal of this subject is to develop student’s understanding towards the identification and characterization of proteins expressed in a genome.
* It includes study of the entire set of proteins in order to understand its structure and function.
* This subject will cover recent developments in genetics, epigenetics, small RNAs, proteomics, gene expression, mutagenesis and mapping genes.
* It aims to teach students advanced technologies, research methods with major emphasis on the applications of DNA sequencing and protein analysis techniques**.**

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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.

**SECTION-B**

**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.

**SUGGESTED READINGS**

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.

**DSE-3- MEDICAL MICROBIOLOGY-CODE: BHB-30**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will be able to identify common infectious agents and the diseases that they cause.
* Students will be able to evaluate methods used to identify infectious agents in the clinical microbiology lab.
* Students will be able to recall microbial physiology including metabolism, regulation and replication.
* Students will be able to explain general and specific mechanisms by which an infectious agent causes disease.
* Students will be able to recognize and diagnose common infectious diseases from the clinical presentation and microbiological lab findings.
* Students will be able to describe the epidemiology of infectious agents including how infectious diseases are transmitted.
* Students will be able to explain interventions employed to prevent infectious diseases including infection control measure and vaccines.

 **INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

**SECTION-A**

**UNIT I (18 Periods)**

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus, S.pyogenes, B.anthracis, C.perferinges, C.tetani, C.botulinum, C.diphtheriae M.tuberculosis, M. leprae.*

**UNIT II (15 Periods)**

Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli, N. gonorrhoea, N. meningitidis, P. aeruginosa, S. typhi, S. dysenteriae, Y. pestis, B. abortus, H. influenzae, V. cholerae, M. pneumoniae, T. pallidum M. pneumoniae, Rickettsiaceae, Chlamydiae.*

**SECTION-B**

**UNIT III (12 Periods)**

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

**UNIT IV (15 Periods)**

Fungal and Protozoan infections. Dermatophytoses (*Trichophyton, Microsporun and
Epidermophyton*) Subcutaneous infection (*Sporothrix, Cryptococcus*), systemic infection
(*Histoplasma, Coccidoides)* and opportunistic fungal infections (*Candidiasis, Aspergillosis*),
Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis,
Malaria)

**SUGGESTED READINGSS**

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg’s
 Medical Microbiology. 24th edition. McGraw Hill Publication.

2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims’ Medical Microbiology.
 4th edition. Elsevier. .

3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein’s

Microbiology. 7th edition. McGraw Hill Higher Education.

**DSE-3 ANIMAL DIVERSITY II-CODE: BHB-30**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will be able to identify organisms of given phylum.
* Students will be able to learn defining characters of each Phylum and Class and identify them
* Students will be able to learn general characteristics of each phylum, e.g. type of coelom, digestive system, circulatory system, fate of blastopore, type of symmetry, number of germ layers.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**UNIT I: Proto-chordates, Pisces and Ambhibia (15Periods)** Proto-chordates: Outline of classification, General features and important characters of

*Herdmania, Branchiostoma*

Origin of Chordates

Pisces: Migration in Pisces, Outline of classification

Amphibia: Classification, Origin, Parental care, Paedogenesis

**UNIT II: Reptilia, Aves and Mammalia (15Periods)** Reptelia: Classification, Origin

Aves: Classification, Origin, flight- adaptations, migration Mammalia: Classification, Origin, dentition

**SECTION-B**

**UNIT III: Comparative anatomy of vertebrates I (15 Periods)**

Comparative anatomy of various systems of vertebrates: Integumentary, digestive respiratory
systems.

**UNIT IV: Comparative anatomy of vertebrates II (15 Periods)** Comparative Anatomy of vertebrates - Heart, Aortic arches, Kidney & urinogenital
system, Brain, Eye, Ear.

Autonomic Nervous system in Mammals

**SUGGESTED READINGS**

1. Hall B.K. and Hallgrimsson B. (2008). Strickberger’s Evolution. IV Edition. Jones and
 Bartlett Publishers Inc.

2. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition.
 McGraw-Hill Higher Education.

3. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The
 McGraw-HillCompanies.

4. Weichert, C.K. (1970). Anatomy of Chordate. McGraw Hill.

5. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.

**DSE-4 BIOINFORMATICS-CODE: BHB31**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* The basic objective is to give students an introduction to the basic practical techniques of bioinformatics.
* Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.
* The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.
* The aim of practical subject is to provide practical training in bioinformatics methods including accessing the major public sequence databases, use of the different computational tools to find sequences, analysis of protein and nucleic acid sequences by various software packages.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

**SECTION-A**

**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.

**SECTION-B**

**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.

**SUGGESTED READINGS**

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.

**DSE-4 PLANT DIVERSITY II-CODE:** **BHB31**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will learn about seeds and pollen grains which are the key adaptations for life on land
* Students will learn about general characters of pteridophytes and gymnosperms

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have fourquestions from the respective sections of the syllabus and carry 11 marks each. Section C willconsist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of thequestion paper and the entire section C.

**SECTION-A**

**UNIT I: Pteridophytes (10 Periods)**

General characters of pteridophytes, affinities with bryophytes & gymnosperms, classification, economic importance, study of life histories of fossil Pteridophytes - *Rhynia*

**UNIT II: Pteridophytes** Type studies **(20 Periods)**

Life histories of *Selaginella*- (Heterospory and seed habit), *Equisetum,* *Pteris, Lycopodium*

**SECTION-B**

**UNIT III: Gymnosperms (20 Periods)**

General characters, classification, geological time scale, theories of fossil formation, types of
fossils, fossil gymnosperms*- Williamsonia* & *Glossopteris,* telome and stele concept.

**UNIT IV: Gymnosperms: Type studies (10 Periods)**

Life histories of *Cycas & Pinus*, economic importance of gymnosperms.

**SUGGESTED READINGS**

1. Bhatnager, S.P. and Moitra, A. 1996 Gymnosperms. New Age International (P) Ltd. Publishers, New Delhi.

2. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.

3. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.

4. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers,
 Dordrecht, The Netherlands

**GE-7 FOOD BIOTECHNOLOGY-CODE: BHB32**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* This subject discusses the technological principles and industrial applications of microorganisms and enzymes in food production and processing systems to provide useful products and services.
* This subject will cover basic properties, characteristics of microorganisms and enzymes, their metabolic pathways and how these are harnessed, manipulated and applied to increase productivity in food sector.
* Major fermented food product technologies will also be discussed with specific references to alcoholic beverages, dairy products, organic acid, traditional fermented products.
* The practical component of this subject will include food fermentation and processing concepts to help student’s understanding in food technology and related processes.

**INSTRUCTIONS FOR THE PAPER-SETTER**

1. The question paper will consist of three sections A, B and C. Section A and B will have fourquestions from the respective sections of the syllabus and carry 11 marks each. Section C willconsist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of thequestion paper and the entire section C.

**SECTION-A**

**UNIT I** (**12 Periods)**

Food and Microorganisms: Composition of food, food as substrates for microbes (intrinsic and extrinsic factors), factors affecting growth of microorganisms, SCP mushroom, food yeast’s, algal proteins, applications of enzymes in food processing.

**UNIT II (12Periods)**

Principles of food preservation: Physical, chemical, and biological methods of preservations.

Contamination, preservation and spoilage of different kind of foods. Fermented foods: Bread, cocoa, coffee, tea, cheese, yoghurt, meat and alcoholic beverages.

**SECTION-B**

**UNIT III (10 Periods)**

Food adulterants and food additives: Major food adulterants, types and their methods of assay, food additives their function and uses, flavoring agents, coloring agents and vitamins as food additives.

Probiotics, biofortified foods, fortified foods, functional foods, nutraceuticals, organic foods.

Biotechnology and future foods (Golden rice, potato).

**UNIT IV (15 Periods**)

Food and water borne diseases: Shigellosis, salmonellosis, cholera. Food borne intoxications:

Stapgylococcal, Bacillus and Clostridium. Detection of microorganisms in food: Qualitative methods to isolate pathogenic microorganisms, test for bacterial toxins in foods; Quantitative methods for microbial enumeration: Direct enumeration, indirect estimations and standard and recommended methods; Rapid methods and automation: Immunoassays, nucleic acid probe for detection of pathogens.

**SUGGESTED READINGSS**

1.Frazier W.C., Westhoff, D.C. (Ed). (1988). Food microbiology (McGraw Hill).

2.Admas, M.R., Moss, M.O (2005). Food microbiology (Edition 3, Illustrated

Publisher Royal Society of Chemistry).

3.SriLakshmi B. (2003) Food science (New Age International Publishers, India).

4. Jay J.M., M.J. Loessner, D.A. Golden. (2005). Modern food microbiology (Edition 7, Illustrated Publisher Springer).

5.B. Sivasankar (2004). Food processing and preservation (PHI Private Ltd, New Delhi).

6. Michael P. Doyle (1989). Food borne bacterial pathogens (Edition illustrated, Publisher Marcel Dekker).

7. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory manual (Pearson Benjamin Cummings).

**GE-7 -CHEMISTRY-6-CODE: BHB32**

**Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %**

**OBJECTIVES:**

* Students will acquire an ability to communicate using the language of chemistry.
* Students will develop an appreciation of chemistry and its application in daily life.
* Students will develop an awareness of the social, economic, environmental and technological implication of chemistry.

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Section A and B will have four

questions from the respective sections of the syllabus and carry 11 marks each. Section C will

consist of 15 short answer type questions which will cover the entire syllabus uniformly and

will carry 30 marks in all.

**INSTRUCTIONS FOR THE CANDIDATES**

1. Candidates are required to attempt two questions each from sections A and B of the

question paper and the entire section C.

 **SECTION-A**

**UNIT I (15 Periods)**

**Bioinorganic Chemistry-**Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca+2, Nitrogen fixation.

 **Carbohydrates** Classification and nomenclature, Monosaccharides, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers, and esters. Determination of ring size of monosaccharides. Cyclic structure of D ( + )-glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose. An introduction to disaccharides ( maltose, sucrose and lactose) and polysaccharide starch and cellulose.

**UNIT II. (15 Periods)**

**Amino Acids, Pcptidcs, Proteins and Nucleic Acids**

Classification, structure and stereochemistry of amino acids. Acid base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids.

 **Structure and nomenclature of peptides and proteins**. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical levels of protein structure. Protein denaturation/renaturation.

**Nucleic acids**: Introduction, Constituents of nucleic acids Ribonucleosides and ribonucleotides. The double helical structure of DNA.

**SECTION-B**

**UNIT III (18 Periods)**

**Solid State** Definition of space lattice and unit cell.

Laws of crystallography, X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure ofNaCI, KCI and CsCI.

**Heterocyclic Compounds** Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Introduction to condensed five and six membered heterocycles.Preparation of indole, quinoline and isoquinoline .

**UNIT IV (15 Periods)**

**Photochemistry** Interaction of radiation with matter, difference between thermal and photochemical process. Laws of photochemistry: Grothus-Drapperlaw, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, non- radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions- energy transfer processes (simple examples). Photochemistry of vision and colour.

**SUGGESTED READINGSS**

1. Basic Inorganic Chemistry, F.A. Cotton, G Willdson and P.L. Gaus, Wiley.

2.Concise Inorganic Chemistry, J.D. Leee, ELBS.

3. Concept of models of Inorganic Chemistry, B. Douglas, D. McDaniel, and J. Alexander, Jolin Wiley.

4.Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C.H. Langford, Oxford.

5.Inorganic Chemistry, W. W. Porterfield Addison-Welsey.

6.Inorganic Chemistry, A. G Sharpe, ELB

7. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice Hall.

8.Inorganic Chemistry, Morrison and Boyd, Prentice-Hall.

9.Inorganic Chemistry, L.G Wade Jr. Prentice-Hall.

11.Fundamentals of Organic Chemistry, Solomons, John Wiley.

12.Organic Chemistry, Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).

13.Organic Chemistry, F.A Carey, McGraw-Hill, Inc.

14.Introduction to Organic Chemistry, Streitwieser, Healthcock and Kosover and Kosover, Macmillan.

1. Physical Chemistry, G.M. Barrow, International Student edition, McGraw Hill.

16.University General Chemistry, C.N.R. Rao. Macmillan.

17.Physical Chemistry, R.A Alberty, Wiley Eastern Ltd.

18.The Elements of Physical Chemistry, P. W. Atkins, Oxford

**PRACTICALS**

**LC-22 (PRACTICAL PERTAINING TO THEORY C13-BHB28)**

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.

**LC-23 (PRACTICAL PERTAINING TO THEORY C14-BHB29)**

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

**LC-24 (PRACTICAL PERTAINING TO THEORY DSE-3-BHB30) MEDICAL MICROBIOLOGY**

1. Identification of pathogenic bacteria (any two) based on cultural, morphological and

biochemical characteristics.

2. Growth curve of a bacterium.

3. To perform antibacterial testing by Kirby-Bauer method.

4. To prepare temporary mounts of Aspergillus and Candida by apprpriate staining.

5. Staining methods: Gram’s staining permanent slides showing Acid fast staining, Capsule
 staining and spore staining.

**LC-24(PRACTICAL PERTAINING TO THEORY DSE-3-BHB30) ANIMAL DIVERSITY II**

1. Identification & Classification upto order of the following: Proto-chordata: *Salpa, Doliolum,
 Herdmania, Branchiostoma*

Cyclostomata*: Myxine, Petromyzon*

Chondrichthyes: *Scoliodon, Zygnea, Pristis, Trygon, Raja, Chimaera*

Ostiechthyes: *Labeo, Mystus, Catla, Hippocampus, Anabas, Echeneis, Lophius, Polypeterus* Amphibia: *Rana, Hyla, Amblystoma, Necturus, Proteus*.

Reptiles: *Hemidactylus, Calotes, Draco, Phrynosoma, Naja Vipera, Bungarus* Aves*: Columba, Alcedo, Passer*

Mammalia: *Ornithorhynchus, Macropus, Didelphes, Dasypus*

2. An Ecological Note on any one of the specimens in Experiment 1

3. Identification of the following slides

Mammalian Histology: Liver, Lung, Intestine, Kidney, Ovary, Testes
Slides of *Salpa, Doliolum,* Spicules of *Herdmania*, Tadpole of Frog

4. Preparation of a permanent mount of *Salpa*, Placoid scales, spicules of
 *Herdmania,* Pharynax of *Amphioxus*, Tadpole Larva of frog

5. Identification of endoskeletons of frog and rabbit.

**LC-25 (PRACTICAL PERTAINING TO THEORY DSE-4-BHB31) BIOINFORMATICS**

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.

**LC-25 (PRACTICAL PERTAINING TO THEORY DSE-4-BHB31) PLANT DIVERSITY-II**

1. Examination of morphology and anatomy of vegetative and reproductive parts of
 *Selaginella, Equisetum & Pteris*.

2. Examination of morphology and anatomy of vegetative & reproductive parts of *- Cycas
 & Pinus*

3. Plant collection (pteridophytes & gymnosperms)

**LC-26 (PRACTICAL PERTAINING TO THEORY GE-7-BHB32) FOOD BIOTECHNOLOGY**

1. Isolation and identification of microorganisms of spoiled (fungi and bacteria).

2.Inhibitory effect of low temperature on microbial growth.

3.Production and estimation of ethanol.

4.Production of vinegar.

5.Estimation of lactose in milk.

6.Methylene blue reductase test (MBRT) for determination of quality of milk.

7.Plating the milk samples for microbial contamination.

8.Demonstration for the identification of mushrooms by spore prints.

9.Checking the effect of pasteurization of milk by alkaline phosphatase.

**LC-26 (PRACTICAL PERTAINING TO THEORY GE-7-BHB32) CHEMISTRY-6**

1.Column Chromatography
2. Separation of leaf pigments from spinach leaves.

3. Physical Experiments

(a) To determine the strength of the given acid conductometrically using standard alkali solution.

(b) To determine the solubility and solubility product of a given sparingly soluble electrolyte conductometrically.

(c) To study the saponification of ethyl acetate conductometrically.

(d) To determine the ionisation constant of a weak acid conductometrically.

(e) To determine the strength of the given acid solution pH- metrically by using standard alkali solution.

(f) To determine the molar refraction of methanol, ethanol and propanol.

(g) To study the distribution of benzoic acid between benzene and water, and ether and

 water.

(h) Knowledge of Stereochemical Study of Organic Compounds.
 R and S configuration of optical isomers.

 E and Z configuration of geometrical isomers.

 Conformational analysis of cyclohexanes and substituted cyclohexanes.