Proposed Syllabus of the Programme for Dual Degree B.Sc. (Hons) Biotechnology-M.Sc. Biotechnology under Choice Based Credit System

(w.e.f 2016-18 for 3rd to 6th semester)

(w.e.f 2017-19 for 1st to 6th semester)

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**Semester-IV**

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**Scheme for Dual Degree B.Sc. (Hons.) (Biotechnology)- M.Sc. (Biotechnology)**

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**Semester-VI**

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## Elective Course (EC) (any one per Semester in Semester 3\textsuperscript{rd} to 4\textsuperscript{th})

### 3\textsuperscript{rd} Semester: (Elective Course -I) (Student should take any one out of below listed 03 Course)

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<td>BBL-307-EC-I</td>
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### 4\textsuperscript{th} Semester: (Elective Course -II) (Student should take Any One out of below listed 02 Course)

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<td>BBL-406-EC-II</td>
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## Skill Enhancement Course (Student should take any one per Semester in Semester three to four)

### 3\textsuperscript{rd} semester

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Discipline Centric Subjects (any two per semester one from each group in Semester Vth & VIth)

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Notes: i) Students who have studied mathematics at 10+1 and 10+2 level shall opt Elementary Biology-I (Paper code: BBL-101) & Mathematics-I (BML-102) and those who have studied Biology shall opt Elementary Mathematics -I (BML-101) & Biology -I (BBL-102) in 1st semester. ii) Semester-I & II will be common for all the four programmes.
$1^{st}$ Semester
Paper Code: BXL 101 Ability Enhancement Compulsory Course-I
ENGLISH

30 Hrs (2Hrs /week)  Marks for Major Test (External): 70
Credits: 2  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I  Syntax  7Hrs
Sentence structures, Verb patterns and their usage.

UNIT-II  Phonetics  8Hrs
Basic Concepts – Vowels, Consonants, Phonemes, Syllables; Articulation of Speech Sounds – Place and Manner of Articulation; Transcription of words and simple sentences, using International Phonetic Alphabet.

UNIT-III  Comprehension  7Hrs
Listening and Reading comprehension – Note taking, Reviewing, Summarising, Interpreting, Paraphrasing and Précis Writing.

UNIT-IV  Composition  8Hrs
Descriptive, Explanatory, Analytical and Argumentative Writing - description of simple objects like instruments, appliances, places, persons, principles; description and explanation of processes and operations; analysis and arguments in the form of debate and group discussion.

BOOKS SUGGESTED:

2. Spoken English for India by R.K. Bansal and J.B. Harrison, Orient Longman.
4. Pink M.A. & Thomas S.E. English Grammar, Composition and Correspondence, S. Chand and Sons Pvt. Ltd., Delhi.
6. Hornby A.S Guide to Patterns and Usage in English, OUP, Delhi.
ENVIRONMENTAL SCIENCE

30 Hrs (2Hrs /week)  
Marks for Major Test (External): 70
Credits: 2  
Marks for Internal Exam: 30
Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

The Multidisciplinary nature of environmental studies  
8Hrs

Definition, scope and importance, Need for public awareness.  
Natural resources: Renewable and non-renewable resources  
Natural resources and associated problems.  
a) Forest resources: Use and over-exploitation, de-forestation  
b) Water resources: Use and over-utilization of surface and ground water, floods and drought.  
c) Mineral resources: Use and exploitation, environmental effects of extruding.  
d) Food resources: World food problems, changes caused by agriculture, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.  
e) Energy Resources: Growing energy needs, renewable and non-renewable energy sources use of alternative energy sources.  
f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

UNIT-II

Ecosystems  
7Hrs

Concept of an ecosystem, Structure and function of an ecosystem, Procedures, consumers and decomposers, Energy flow in the ecosystem, Ecological succession & Food chains, food webs and ecological pyramids.

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a megadiversity nation.

UNIT-III

Environmental Pollution  
7Hrs

Definition, Causes, effects and control measures of: - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution & Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
UNIT-IV

Social Issues and the Environment

8Hrs


BOOKS SUGGESTED:
Paper Code: BBL-102-  Core Course- I

BIOLOGY-I (CELL & CELLULAR PROCESSES)

(4Hrs /week) Marks for Major Test (External): 70
Credits: 4 Marks for Internal Exam: 30
Time: 3Hrs Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

Unit I.
Techniques in Biology
Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis

Unit II
Cell as a unit of Life
The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components

Unit III.
Cell Organelles
1. Mitochondria: Structure, marker enzymes, composition; mitochondrial biogenesis; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA
2. Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA
4. Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis
5. Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

Unit IV.
Cell Wall & Membrane
The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall
Cell Division.
Role of Cell division; Overview of Cell cycle; Molecular controls; Meiosis

SUGGESTED BOOKS
Conductance and Electrochemistry 15 Hrs

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions.

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance to measure degree of dissociation of weak electrolytes.

Quantitative aspects of Faraday’s laws of electrolysis, rules of oxidation/reduction of ions based on half cell potentials, application of electrolysis in metallurgy and industry. Chemical cells with examples; Standard electrode (reduction) potential.

UNIT-III

Fundamentals of Organic Chemistry 15 Hrs

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation.

Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles.

Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting $pK_a$ values.

UNIT-IV

Stereochemistry 8 Hrs

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds. Threo and erythro; D and L; cis–trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Chemistry of Biomolecules 7 Hrs


BOOKS SUGGESTED:
2. Castellan, G.W., Physical Chemistry, Narosa Publishers
5. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Paper Code: BPL-101    Generic Elective –II

PHYSICS-I MECHANICS

(4Hrs /week)         Marks for Major Test (External): 70
Credits: 4             Marks for Internal Exam: 30
Time: 3Hrs            Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT – 1

15 Hrs


Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

UNIT - 2

15 Hrs


UNIT – 3

15 Hrs


UNIT - 4

15 Hrs


BOOKS SUGGESTED:


Additional Books for Reference

1) Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
2) University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley


Paper Code: BML-101  Generic Elective –III

ELEMENTARY MATHEMATICS-I

30 Hrs (2Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.
UNIT – I

15 Hrs

Sets, Relations and Functions: Sets and their Representations, The Empty Set, Finite and Infinite Sets, Equal Sets, Subsets, Universal Set, Venn Diagrams, Operations on Sets, Complement of a Set, Practical Problems on Union and Intersection of Two Sets, Cartesian Product of Sets, Relations, Functions.

Sequences and Series: Sequences, Series, Arithmetic Progression (A.P.), Geometric Progression (G.P.), Relationship Between A.M. and G.M.

UNIT – II

15 Hrs


Trigonometric Functions: Angles, Trigonometric Functions, Trigonometric Functions of Sum and Difference of Two Angles, Trigonometric Equations.

UNIT – III

15 Hrs


Binomial Theorem: Introduction, Binomial Theorem for Positive Integral Indices, General and Middle Terms.

UNIT – IV

15 Hrs

Linear Inequalities: Inequalities, Algebraic Solutions of Linear Inequalities in One Variable and their Graphical Representation, Graphical Solution of Linear Inequalities in Two Variables, Solution of System of Linear Inequalities in Two Variables.


BOOKS SUGGESTED:


Paper Code: BBL-101

Generic Elective –III

ELEMENTARY BIOLOGY-I: FUNDAMENTALS OF BIOLOGY

30 Hrs (2Hrs /week) Marks for Major Test (External): 70
Credits: 4 Marks for Internal Exam: 30
Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT – I

**Introduction to concepts of biology**
Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of Science; Biology and everyday life.

**Evolutionary history of biological diversity**
Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution; Phylogeny and the tree of life.

UNIT – II

**Classifying the diversity of life**
Kingdoms of Life – Prokaryotes, Eukaryotes, Archaea

**Darwinian view of life and origin of species**
Darwin’s theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation

**Genetic approach to Biology**
Patterns of inheritance and question of biology; Variation on Mendel’s Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental noise; Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype

UNIT – III

**Chemistry of life**
The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds

**Water and life**
The water molecule is polar; Properties of water; Ionization of water

**Carbon and life**
Organic chemistry-the study of carbon compounds; what makes carbon special? Properties of organic compounds

UNIT - IV

**Structure and function of biomolecules**
Most macromolecules are Polymers; Carbohydrates act as fuel and building materials; Lipids are group of hydrophobic molecules; Protein have diverse structures and functions; Nucleic acids store and transmit hereditary information

**BOOKS SUGGESTED**
Paper Code: BBP-101  
Core Course Practical- I

BIOLOGY LAB-I

(4Hrs /week)  
Marks for Major Test (External): 70
Credits: 2  
Marks for Internal Exam: 30
Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

PRACTICALS
1. To learn a) use of microscope b) principles of fixation and staining.
2. Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions
3. Use of micropipettes
4. Measurement of cell size by cytometry
5. To perform gram staining of bacteria.
6. To study the cytochemical distribution of nucleic acids and mucopolysaccharides with in cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.
8. To study of plasmolysis & deplamolysis of Rhoeo leaf.
9. To study prokaryotic cells, Bacteria/fungi and eukaryotic cells.
10. To prepare squash from root tip of Aliumcea & study various stages of mitosis.

SUGGESTED BOOKS:
CHEMISTRY LAB-I

(4Hrs /week)  
Marks for Major Test (External): 70
Credits: 2  
Marks for Internal Exam: 30
Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

1. Preparation of reference solutions.
2. Redox titrations: Determination of Fe^{2+}, C_2O_4^{2-} (using KMnO_4, K_2Cr_2O_7)
3. Iodometric titrations: Determination of Cu^{2+} (using standard hypo solution).
4. To determine the surface tension of at least two liquids using stalagmometer by drop no. and drop weight methods (Use of organic solvents excluded).
5. To study the effect of surfactant on surface tension of water.
6. To determine the viscosity of at least two liquids by using Ostwald’s viscometer (use of organic solvents excluded).
7. To study the process of (i) sublimation (ii) Crystallization of camphor and phthalic acid
8. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point
   (i)  Iodoform from ethanol (or acetone)
   (ii)  p-Bromoacetanilide from acetonilide

BOOKS SUGGESTED:

6. Yadav J. B., Advanced Practical Physical Chemistry
1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) \( g \) and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine \( g \) and velocity for a freely falling body using Digital Timing Technique.
7. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille’s method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell’s needle.
10. To determine the elastic Constants of a wire by Searle’s method.
11. To determine the value of \( g \) using Bar Pendulum.
12. To determine the value of \( g \) using Kater’s Pendulum.

BOOKS SUGGESTED:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, KitabMahal
SEMESTER-II
Paper Code: BXL-201

Ability Enhancement Compulsory Course -III

HINDI

Marks for Major Test (External): 70
Marks for Internal Exam: 30
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidates are required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.
3. खण्ड (क) में पादमपुस्तक से निर्धारित आलोचनात्मक प्रश्नों में से दो प्रश्न पूछे जाएंगे। जिनमें से परीक्षार्थी को एक प्रश्न का उत्तर देना होगा। यह प्रश्न 10 अंक का होगा।

4. खण्ड(ख) में निर्धारित आलोचनात्मक प्रश्नों में से दो प्रश्न पूछे जाएंगे, जिनमें से किसी एक का उत्तर देना होगा। यह प्रश्न 10 अंक का होगा।

5. खण्ड(ग) से 12 अति लघुत्तमतम प्रश्न पूछे जाएंगे। प्रत्येक प्रश्न एक—एक अंक का होगा। पूरा प्रश्न 12 अंक का होगा।

6. खण्ड (घ) में निर्धारित अलंकारों में से दो अलंकार पूछे जाएंगे, जिनमें से एक अलंकार उदाहरणों सहित लिखना होगा। जो 8 अंक का होगा।

7. खण्ड (घ) से दस मुहावरों और लोकोकातियों में से किसी पाँच मुहावरों का अर्थ एवं वाक्य प्रयोग लिखना होगा। जो 10 अंक का होगा।
Paper Code: BML-201          Generic Elective -IV

ELEMENTARY MATHEMATICS-II

60 Hrs (4Hrs /week)            Marks for Major Test (External): 70
Credits: 4                       Marks for Internal Exam: 30
Time: 3Hrs                       Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I                          15 Hrs


UNIT-II                         15 Hrs

Differential Calculus : Differentiation of standard functions including function of a function (Chain rule). Differentiation of implicit functions, logarithmic differentiation, parametric differentiation, elements of successive differentiation.

Integral Calculus : Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, partial fractions and substitution. Formal evaluation of definite integrals.
**UNIT-III**

**Ordinary Differential Equations**: Definition and formation of ordinary differential equations, equations of first order and first degree, variable separable, homogeneous equations, linear equations (Leibnitz form) and differential equations reducible to these types, Linear differential equation of order greater than one with constant coefficients, complementary function and particular integrals.

**UNIT-IV**


**Vector Calculus**: Differentiation of vectors, scalar and vector point functions, gradient of scalar field and directional derivative, divergence and curl of vector field and their physical interpretation.

**BOOKS SUGGESTED:**


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**Paper Code: BBL-201**

**Generic Elective -IV**

**ELEMENTARY BIOLOGY-II (CELL BIOLOGY)**

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<td>Marks for Internal Exam: 30</td>
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**Note**: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

**UNIT I**

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**

Membrane Vacuole system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments.

Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure,
biogenesis and functions including role in protein secretion.

UNIT III

UNIT IV

SUGGESTED READING/BOOKS

Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein’s and their biological functions

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

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

UNIT IV

SUGGESTED READING/BOOKS
Paper Code: BPL-201

PHYSICS-II (WAVES AND OPTICS)

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

15 Hrs

Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and(2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.


UNIT-II

15 Hrs


UNIT- III

15 Hrs


UNIT-IV

15 Hrs

**Interferometer**: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.


**BOOKS SUGGESTED:**

Paper Code: BCL-201  
Generic Elective- VI

CHEMISTRY-II

60 Hrs (4Hrs /week)  
Marks for Major Test (External): 70
Credits: 4  
Marks for Internal Exam: 30
Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

Chemical Bonding and Molecular Structure  
15 Hrs

Introduction to Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, polarizing power and polarizability

Introduction to Covalent bonding: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Ionic Solids: Factors affecting the formation of ionic solids, concept of close packing, radius ratio rule and coordination number. Calculation of limiting radius ratio for tetrahedral and octahedral sites. Structures of some common ionic solids NaCl, ZnS (zinc blende and wurtzite).

UNIT-II

Acids and Bases  
8 Hrs

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

Basic Coordination Chemistry  
7 Hrs

Coordinate Bond. Werner’s coordination theory, ligands, chelates. Nomenclature of coordination compounds. Stereochemistry of different coordination numbers, isomerism. Valence-bond and crystalfield theories of bonding in complexes. Explanation of properties such as geometry, colour and magnetism.

UNIT-III

Chemical Kinetics And Catalysis  
15 Hrs


Catalysis: Homogeneous catalysis, Acid-base catalysis and enzyme catalysis. Heterogeneous catalysis.

UNIT-IV

Basics of spectroscopy  
15 Hrs

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection
rules, validity of Beer-Lambert's law. Electromagnetic radiations, Introduction to ultraviolet, visible and infrared spectroscopy, electronic transitions, $\lambda_{\text{max}}$ & $\varepsilon_{\text{max}}$, chromophore, auxochrome, bathochromic, hypsochromic shifts. Infrared radiation and types of molecular vibrations, functional group and fingerprint region.

**BOOKS SUGGESTED:**

8. Castellan G. W. Physical Chemistry, Narosa Publishers
UNIT-I

An Overview of Computer System 8Hrs
Anatomy of a digital Computer, Memory UNITS, Main and Auxiliary Storage Devices, Input Devices, Output Devices, Classification of Computers. Radix number system: Decimal, Binary, Octal, Hexadecimal numbers and their inter-conversions; Representation of information inside the computers.

UNIT-II

Operating System Basics 7Hrs

UNIT-III

Internet basics 7Hrs
Introduction to the basic concepts of Networks and Data Communications, How Internet works, Major features of internet, Emails, FTP, Using the internet.

UNIT-IV

Programming Languages 8Hrs

BOOKS SUGGESTED:
Paper Code: BCP-201  Generic Elective Practical -III

CHEMISTRY LAB-II

(4Hrs /week)  Marks for Major Test (External): 70
Credits: 2  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1

1. Complexo metric titrations: Determination of Mg$^{2+}$, Zn$^{2+}$ by EDTA.
2. Paper Chromatography: Qualitative Analysis of any one of the following Inorganic cations and anions by paper chromatography (Pb$^{2+}$, Cu$^{2+}$, Ca$^{2+}$, Ni$^{2+}$, Cl$^-$, Br$^-$, I$^-$ and PO$_4^{3-}$ and NO$_3^-$).
3. To determine the specific refractivity of at least two liquids.
4. Determine rate constant of acid catalysed hydrolysis of methyl acetate.
5. Determination of conductance of electrolytes
6. The preliminary examination of physical and chemical characteristics (physical state, colour, odour and ignition test), extra element detection (N,S,Cl, Br and I).

BOOKS SUGGESTED:

8. Yadav J. B. Advanced Practical physical Chemistry
Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

1. To determine the frequency of an electric tuning fork by Melde’s experiment and verify $\lambda^2/T$ law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster’s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson’s interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

BOOKS SUGGESTED:

2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, KitabMahal
COMPUTER SCIENCE LAB

(4Hrs /week)          Marks for Major Test (External): 70
Credits: 2            Marks for Internal Exam: 30
Time: 3Hrs            Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

C Programming language: C fundamentals, formatted input/ output, expressions, selection statements, loops and their applications; Basic types, arrays, functions, including recursive functions, program organization: local and external variables and scope; pointers & arrays

Representative programming in C

1. Write a program to find the largest of three numbers. (if-then-else)
2. Write a program to find the largest number out of ten numbers (for-statement)
3. Write a program to find the average mail height & average female heights in the class (input is in form of sex code, height).
4. Write a program to find roots of quadratic equation using functions and switch statements.
5. Write a program to multiply two matrices

BOOKS SUGGESTED:

1. Kanetkar Y. Let Us C, BPB publication
SEMESTER-III
Paper Code: BBL-301  Core Course-III

MAMMALIAN PHYSIOLOGY

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT I: Digestion and Respiration  (15 Periods)

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 heartbeat.

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 READING
PLANT ANATOMY AND PHYSIOLOGY

60 Hrs (4 Hrs / week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3 Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No. 1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No. 1.

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

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

UNIT III: Carbon and nitrogen metabolism  (20 Periods)
Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation, 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, gibberellins, cytokines, abscisic acid, ethylene)
Physiological role and mode of action, seed dormancy and seed germination, concept of photo-periodic and vernalization.

SUGGESTED READING

5. Mauseth, J.D. 1988 Plant Anatomy. The Benjamin/Cummings Publisher, USA.
INORGANIC CHEMISTRY-I (ATOMIC STRUCTURE & CHEMICAL BONDING)

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

Atomic Structure


Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT-II

Periodicity of Elements

\( s, p, d, f \) block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to \( s \) and \( p \)-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT-III

Chemical Bonding-I

Ionic bond: types of ions, size effects, radius ratio rule and its
Chemical Bonding

Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N₂, O₂, C₂, B₂, F₂, CO, NO, and their ions; HCl, BeF₂, CO₂. (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths.

UNIT-IV

Chemical Bonding-II

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment, percentage ionic character from dipole moment and electronegativity difference.

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions.

Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

BOOKS SUGGESTED:

ORGANIC CHEMISTRY (HYDROCARBONS)

60 Hrs (4Hrs /week)  
Marks for Major Test (External): 70

Credits: 4  
Marks for Internal Exam: 30

Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

Basis of Organic Chemistry 10Hrs


Dipole moment; Organic acids and bases; their relative strength, Curly arrow rules, formal charges; Nucleophilicity and basicity.

Aromaticity: Benzenoids and Hückel’s rule.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Chemistry of Aliphatic Hydrocarbons-I 5Hrs Carbon-Carbon sigma bonds


UNIT-II

Chemistry of Aliphatic Hydrocarbons-II 15 Hrs Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ AntiMarkownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylicbromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.


UNIT-III

Chemistry of Aliphatic Hydrocarbons-III 15 Hrs

Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of cycloalkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Aromatic Hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acetylation with their mechanism. Directing effects of the groups.
UNIT-IV

Chemistry of Halogenated Hydrocarbons  15 Hrs

Alkyl halides: Methods of preparation, nucleophilic substitution reactions - S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from diazonium salts. Nucleophilic aromatic substitution; S_NAr, Benzyne mechanism.

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li - Use in synthesis of organic compounds.

BOOKS SUGGESTED:

ELECTIVE COURSE –I
(Any one in Semester Three)

Paper Code: BBL-305- EC-I  MOOC Course through SWAYAM
Paper Code: BBL-306- EC-I  Biosafety
Paper Code: BBL-307- EC-I  Economic Botany
Paper Code: BBL-306 EC-1 – Elective Course-I

Biosafety

30 Hrs (2Hrs /week)  
Marks for Major Test (External): 70

Credits: 2  
Marks for Internal Exam: 30

Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT- I

Introduction to Bioethics. Social and ethical issues in Biotechnology, causes of unethical acts, ignorance of laws, codes, policies and Procedures, Professional ethics – professional conduct, Ethical decision making, ethical dilemmas, good laboratory practices, good manufacturing practices, laboratory accreditation

UNIT –II

Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues of biosafety. Use of genetically modified organisms (BT cotton and BT brinjal) and their release in to the environment.

UNIT- III

Intellectual property rights, patents and methods of application of patents, Trade Secrets, copyrights, Trade Marks, legal implications, farmers rights, plant breeder’s rights. International and National conventions on biotechnology and related areas. WTO guidelines.

UNIT- IV

Food Safety: Key terms, factors affecting food safety, recent concerns Food laws, standards and regulations, Food additives and contaminants, Hygiene and sanitation, HACCP.

BOOKS RECOMMENDED:

Paper Code: BBL-307 EC-1 – Elective Course-I

Economic Botany

30 Hrs (2Hrs/week)  Marks for Major Test (External): 70
Credits: 2  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I
Origin, distribution, botanical description, brief idea of cultivation and uses of the following: Food plants-

Cereals (Rice, Wheat and Maize).

Pulses- (Gram, Arhar and Pea). Vegetables- (Potato, Tomato and Onion).

Fibers- Cotton, Jute and Flax.

Oils- Groundnut, Mustard and Coconut.

UNIT-II
Morphology of plant part used, brief idea of cultivation and uses of the following:

Spices- Coriander, Ferula, Ginger, Turmeric, Cloves.

UNIT III
Medicinal Plants- Cinchona, Rauwolfia, Atropa, Opium, Cannabis, Neem.

UNIT IV
Botanical description and processing of:

Beverages- Tea and Coffee.

Rubber- Hevea.

Sugar- Sugarcane.

General account and sources of timber; energy plantations and bio-fuels.

Suggested Readings:

SKILL ENHANCEMENT COURSE-I (SEC-I)  
(Any one per semester in semester Three to Four)

**Paper Code:** BBL-308- SEC (I)  
**MOLECULAR DIAGNOSTICS**  
60 Hrs (4Hrs /week)  
**Marks for Major Test (External):** 70  
**Credits:** 4  
**Marks for Internal Exam:** 30  
**Time:** 3Hrs  
**Total Marks:** 100

**Note:** The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

**UNIT I**  
(15 Periods)

**Enzyme Immunoassays:**

Applications of enzyme immunoassays in diagnostic microbiology.

**UNIT II**  
(15 Periods)

Molecular methods in clinical microbiology:
Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide and plasmid finger printing in clinical microbiology

Laboratory tests in chemotherapy:

**UNIT III**  
(18 Periods)


**UNIT IV**  
(12 Periods)

GLC, HPLC, Electron microscopy, flowcytometry and cell sorting.

Transgenic animals.

**SUGGESTED READING:**
1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic
Paper code: BBL-309- SEC- (I)  BASICS OF FORENSIC SCIENCE

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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 handwriting and analysis of ink various samples.

Unit III  (15 Periods)
Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of fingerprint as science for personal identification.

Unit IV  (15 Periods)

SUGGESTED READING

Paper code: BBL-310- SEC- (I)  ECOLOGY AND ENVIRONMENT MANAGEMENT

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I  (12 Periods)

UNIT II  (20 Periods)

UNIT-III  (18 Periods)

UNIT-IV  (10 Periods)

SUGGESTED READING
2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
7. Mohapatra Textbook of environmental biotechnology IK publication.
8. Rana SVS, Environmental pollution – health and toxicology, Narosa Publication
PRACTICALS

A. Plant physiology
1. Study of enzyme ATPase
2. Demonstration of ascent of sap
3. Sugar and amino acids analysis of phloem sap, with paper chromatography.
5. Determination of rate of respiration in germinating seeds under aerobic and anaerobic conditions.
6. To demonstrate that oxygen is evolved during photosynthesis
7. To demonstrate that CO2 and light are necessary for photosynthesis
8. Effect of red and far red light on seed germination and study of photomorphogenesis.
9. Study of enzyme glutamate oxaloacetate transaminase.
10. Study of nitrate reductase in plants.
11. Study of effect of PEG induced water stress on seed germination.
12. Effect of phytohormones on plant growth
13. Separation of chloroplast pigments by chromatography

B. Animal physiology
1. Estimation of Hemoglobin content in the given blood sample.
2. Qualitative identification and quantitative estimation of proteins in the given sample.
3. Qualitative identification and quantitative estimation of carbohydrates in the given samples.
5. Quantitative estimation of ammonia and urea in the given sample.
7. Effect of temperature on the heartbeat of fresh water mussel.

Reference Books:
2. Comparative animal physiology - Professor C.L. and Brown, F.A W.B. Sounders, Philadelphia.
6. An introduction to general and comparative animal physiology - Floray, E. W.B.Sounders Co.,
(A) Titrimetric Analysis

(i) Calibration and use of apparatus

(ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture. (ii) Estimation of carbonate and bicarbonate present together in a mixture. (iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe(II) and oxalic acid using standardized KMnO₄ solution.

(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii) Estimation of Fe(II) with K₂Cr₂O₇ using internal (diphenylamine, anthranilic acid) and external indicator.

BOOKS SUGGESTED:

SEMESTER-IV
Paper Code: BBL-401
Core Course-VII

BASIC MICROBIOLOGY

(4Hrs /week) Marks for Major Test (External): 70
Credits: 4 Marks for Internal Exam: 30
Time: 3Hrs Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

Unit-I
History, scope and significance of Microbiology, Cell structure of prokaryotic and eukaryotic cell. Comparison of the structure and function of each component of eubacterial cell and archaebacteria. Biosynthesis of bacterial cell wall. General characters of Fungi (Yeast, Dermatophytes, and opportunistic pathogens), Algae (Cynobacteria, Chlorella), Protozoa (Entamoeba, Plasmodium). Principles of bacterial taxonomy, classification of bacteria and general characteristics of each group including Rickettsia, Pplo and Chlamydiae.

Unit-II

Unit-III

Unit-IV
Modes of gene transfer in bacteria- Conjugation, transformation and transduction, Recombination in bacteria-Homologous recombination, transpositional recombination and site-specific recombination.

Environmental Microbiology- Nitrogen cycle, Regulation of nif and nod genes, Carbon Cycle, Sulphur cycle and Phosphorous cycle.

Unit-V
Industrial Microbiology- Brief outline and type of reactions in fermentation, production of alcohol, citric acid and vineger, production of amino acids(Glu, Asp, Lys, Phe and His), Production of vitamins( Riboflavin, Vitamin B12 and carotenoids), Production of pencilllin and streptomycin.

Books/Authors
MICROBIAL PHYSIOLOGY

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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.

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. Hydrogen oxidizing 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 READING
INORGANIC CHEMISTRY-II (PERIODIC PROPERTIES OF ELEMENTS)

60 Hrs (4Hrs /week) Marks for Major Test (External): 70
Credits: 4 Marks for Internal Exam: 30
Time: 3Hrs Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I
Chemistry of s and p Block Elements 15 Hrs
Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements.

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

UNIT-II
Chemistry of p Block Elements 15 Hrs
Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogenes and basic properties of halogens.

UNIT-III
Transition Elements 15Hrs
General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes.

Stability of various oxidation states and e.m.f. (Latimer &Bsworth diagrams). Difference between the first, second and third transition series.

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

UNIT-IV
Lanthanides and Actinides 7 Hrs
Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Noble Gases 8Hrs
Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF₂, XeF₄ and XeF₆. Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF₂). Molecular shapes of noble gas compounds (VSEPR theory).
BOOKS SUGGESTED:

ORGANIC CHEMISTRY-II (Functional Group Chemistry)

60 Hrs (4Hrs /week) Marks for Major Test (External): 70
Credits: 4 Marks for Internal Exam: 30
Time: 3Hrs Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

Alcohols, Phenols, Ethers and Epoxides 15 Hrs

Alcohols: preparation, properties and relative reactivity of 1, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH₄

UNIT-II

Carbonyl Compounds 15 Hrs

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH₄, NaBH₄, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enoltautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

UNIT-III

Carboxylic Acids and their Derivatives 15 Hrs

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group- Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

Sulphur containing compounds:

Preparation and reactions of thiols, thioethers and sulphonic acids.
UNIT-IV

Nitrogen Containing Functional Groups 15 Hrs

Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

Diazonium Salts: Preparation and their synthetic applications.

BOOKS SUGGESTED:

ELECTIVE COURSES-II

(Any one out of 02 Course Code BBL405-EC-(II), BBL406-EC-II)

Paper Code: BBL-405- EC-II

BIOTECHNOLOGY AND HUMAN WELFARE

60 Hrs (4Hrs /week)  
Marks for Major Test (External): 70

Credits: 4  
Marks for Internal Exam: 30

Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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

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

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

UNIT IV  
(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 READING
Unit 1. Introduction
   Lamarckism, Darwinism, Neo-Darwinism.

Unit 2. Life’s beginning
   An overview (chemogeny, biogeny, the RNA World).

Unit 3. Evidences of evolution
   Paleontological evidences.
   Molecular evidences, Phylogeny of horse

Unit 4. Process of evolutionary change
   Organic variations
   Population genetics
   Natural selection

Unit 5. Products of evolutionary change
   Species concept
   Isolating mechanisms and modes of speciation.

Unit 6. Extinction and mass extinction

Unit 7. Origin and evolution of man

Unit 8. Phylogenetic trees
   Multiple sequence alignment, Construction of Phylogenetic tree, Interpretation of trees.

SUGGESTED BOOKS
   Wiley-Blackwell
SKILL ENHANCEMENT COURSES-II
(Any one per semester)

Paper Code: BBL-407-SEC-II INDUSTRIAL & ENVIRONMENTAL BIOTECHNOLOGY

60 Hrs (4Hrs /week) Marks for Major Test (External): 70
Credits: 4 Marks for Internal Exam: 30
Time: 3Hrs Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

Unit - 1
Principles of Microbial growth – introduction, the ways of growing microorganisms, ways to increase yield of microbes, Batch, fed-batch and continuous cultures (definition and kinetics).

Unit - 2
Bioreactor / Fermenter – types, working & operation of Bioreactors, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations. Upstream processing (Strain selection, Sterilization), Downstream processing – extraction, separation, concentration, recovery & purification, operations (Insulin, Vitamins, Metabolites).

Unit - 3
Biotechnology in specific medical & industrial applications - Retting of jute, microbial process for immunization (Production of monoclonal antibodies), Deterioration of paper, textiles, painted surfaces and their prevention, Biofilms, microbial biopolymers, biosurfactants, Microbial culture selection with high yield potential.

Unit - 4

Unit - 5

Unit - 6
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), Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

Suggested Readings
7. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
9. Introduction to Environmental Biotechnology, Milton Wainwright
10. Principles of Environmental Engineering, Gilbert Masters
11. Waste water Engineering – Metcalf & Eddy
Paper Code: BBL-408-SEC-II  AGRO & INDUSTRIAL BIOTECHNOLOGY

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

A. PLANT BIOTECHNOLOGY

UNIT I Plant Tissue Culture.


UNIT II


UNIT III


UNIT IV


UNIT V

Single cell protein. SCP from waste, agricultural crops and algae. Economic implication of SCP. Biofertilizers Mycorrhizae.

B. ANIMAL BIOTECHNOLOGY

Unit I

C. MARINE BIOTECHNOLOGY

Books/Authors:
1. Biotechnology and genomics Gupta, P.K.
2. Plant Biotechnology. Doods
3. A text Book of Biotechnology Kumar, H.D.
5. Biotechnology. Singh, B.D.
6. Gene Biotechnology Jogdand, S.N.
UNIT- I

UNIT- II
Food Preservation: Bioprocessing of meat, fisheries, vegetables, dairy products, enzymes and chemicals used in food processing, biochemical engineering for flavor and food production, cryopreservation, irradiated foods. Fermented Food Products. Dairy products. non-beverage plant products, beverages and related products of baking. Quality Control, case studies on Biotechnology in the evolution of food quality. Food Spoilage & Food Borne Diseases

UNIT- III
Utilization of microorganisms in food Industry, Single cell protein, Nutraceuticals, Natural and artificial sweeteners and their role in controlling diseases and deficiencies.

UNIT – IV
Industrial cultures-- Bacteria, Algae, Fungi, Actinomycetes; Primary and secondary screening of microorganisms for industrial products. Isolation and preservation of microorganisms for industrial products. Production of microbial products-organic acids (citric acid), amino acids (aspartic acid), alcohols and beverages (ethanol), enzymes (proteases) antibiotics (penicillin), vaccines (BCG), vitamins (B12) and dairy products (cheese).

UNIT-V
Nitrogen fixation and mass production of biofertilizers - diazotrophic microorganisms, Biochemical aspects of diazotrophy. Genetics of free living and symbiotic diazotrophs. Blue Green Algae and Azolla, Mycorrhizae. Vermiculture, Mass cultivation of commercially valuable macro and micro algae for agar agar, alginates, single cell protein and other products.

BOOKS RECOMMENDED
2. Frazier, Food Microbiology,
ORGANIC CHEMISTRY LAB-II

60 Hrs (4Hrs /week)  
Marks for Major Test (External): 70

Credits: 2  
Marks for Internal Exam: 30

Time: 4 Hrs  
Total Marks: 100


2. Functional group test for nitro, amine and amide groups.

3. Qualitative analysis of unknown organic compounds containing following functional groups: alcohol, carboxylic acid, phenol and carbonyl groups.

BOOKS SUGGESTED:


Paper code: BBP-411  Core Course Practical V

BASIC MICROBIOLOGY LAB

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 2  Marks for Internal Exam: 30
Time: 4 Hrs  Total Marks: 100

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

SUGGESTED READING
SEMESTER-V
Paper Code: BBL-501  Core course -XI

GENETICS

60 Hrs (4Hrs/week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

Unit - 1
Mendelism & Chromosome Theory – Mendel’s principles, applications of Mendel’s principles, chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked & Autosomal).

Unit - 2
Linkage & Crossing over - Chromosome theory of Linkage, kinds of linkage, linkage groups, Genetic mapping, Relationship between Linkage & Crossing over, mechanism of Meiotic Crossing over, Types and mechanism of Crossing over, significance of Crossing over.

Unit - 3
Non-Mendelian inheritance – Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast), maternal inheritance.

Unit - 4
Chromosomal variation in Number & Structure – Euploidy, Non-disjunction & Aneuploidy, Aneuploidy in Human, Induced Polyploidy, applications of Polyploidy.

Unit - 5

Suggested Readings
1. Genetics: Strickberger MW
2. Genetics Analysis by Griffiths and Suzuki
3. Genetics: Instant notes series
4. Genetics: Hartl and Jones
5. Genetics: Gupta PK
6. Genetics: Gardner
7. Microbial Genetics: David Friefelder
8. Gene IX: Lewin Benjamin
DEVELOPMENTAL BIOLOGY

60 Hrs (4Hrs /week)  
Marks for Major Test (External): 70
Credits: 4  
Marks for Internal Exam: 30
Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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)

UNIT III: Embryonic Differentiation  
(20 Periods)
Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

UNIT IV: Organogenesis  
(10 Periods)
Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germlayers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

SUGGESTED READING

Paper Code: BCL-501/BBL-503  Core Course XIII

INORGANIC CHEMISTRY-III (COORDINATION CHEMISTRY)

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

Coordination Chemistry-I  15 Hrs

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

UNIT-II

Coordination Chemistry-II  15 Hrs

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes- Thermodynamic & Kinetic stability.

UNIT-III

Reaction Kinetics and Mechanism  15 Hrs

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans-effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

UNIT-IV

Bioinorganic Chemistry  15 Hrs

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

BOOKS SUGGESTED:
PHARMACEUTICAL CHEMISTRY

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

15 Hrs

Physiochemical aspects of Drug action- Stereochemical aspects of drug action (Optical, geometric and bioisotomerism of drug molecules with biological action), conformational isomerism, solubility and partition coefficient, chemical bonding. Drug receptor, Drug receptor interactions, receptor- effector theories, types of receptor and their action including transduction mechanism and G proteins. Principles of drug design (Theoretical aspects).

UNIT-II

15 Hrs

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, and antacid (ranitidine). Antibacterial and antifungal agents (Sulphonamides, Sulphanethoxazol, Sulphacetamide, Trimethoprim).

Medicinal values of curcumin (haldi), azadirachtin (neem).

UNIT-III

15 Hrs

Synthesis of the representative drugs of the following classes: Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryltrinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine), antiviral agents (Acyclovir).

UNIT-IV

15 Hrs

Fermentation: Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

BOOKS SUGGESTED:

Paper Code: BBL-505-DSE-I  ANIMAL DIVERSITY I
60 Hrs (4Hrs/week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT I  (15 Periods)

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.

UNIT III  (15 Periods)
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 READING
Paper Code: BBL-506-DSE-I  MEDICAL MICROBIOLOGY

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT I  (15 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, pathogenesis, 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*, *Rickettsiae*, *Chlamydiae*.

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*, *Microsporin* and *Epidermophyton*) Subcutaneous infection (*Sporothrix*, *Cryptococcus*), systemic infection (*Histoplasma*, *Coccidioides*) and opportunistic fungal infections (*Candidiasis*, *Aspergillosis*), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

SUGGESTED READINGS
UNIT I

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. (10 Periods)

UNIT II

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. (20 Periods)

UNIT III

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. (20 Periods)

UNIT IV

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission.

Genome Annotation: Pattern and repeat finding, Gene identification tools. (10 Periods)

SUGGESTED READING

DISCIPLINE SPECIFIC ELECTIVE-II

Paper Code: BBL-508-DSC- (II)  PLANT DIVERSITY I

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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

UNIT III
Lichens :  (10 Periods)

UNIT IV
Bryophytes:  (10 Periods)
General characters, classification & economic impotence. Life histories of following: Marchantia. Funaria.

SUGGESTED READING
9. Vander-Poorter 2009 Introduction to Bryophytes. COP.
Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT I


UNIT II


UNIT III

Treatment of municipal waste and Industrial effluents. Bio-fertilizers

UNIT IV

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

SUGGESTED READING

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
5. Agricultural Biotechnology, S.S. Purohit
7. Introduction to Environmental Biotechnology, Milton Wainwright
8. Principles of Environmental Engineering, Gilbert Masters
9. Wastewater Engineering – Metcalf & Eddy
BIOSTATISTICS

Paper Code: BBL-510-DSC- (II)  

60 Hrs (4Hrs /week)  
Credits: 4  
Time: 3Hrs  

Marks for Major Test (External): 70  
Marks for Internal Exam: 30  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT I  
(12 Periods)

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.

UNIT II  
(18 Periods)

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

UNIT III  
(18 Periods)

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

UNIT IV  
(12 Periods)

Correlation and Regression. Emphasis on examples from Biological Sciences.

SUGGESTED READING

2. Glaser AN (2001) High Yield™ Biostatistics. Lippincott Williams and Wilkins, USA
1. Demonstration of chromosomal (structural and numerical) aberrations
2. Study of polytene chromosomes (lamp brush chromosomes and giant chromosomes).
4. Effect of colchicine on chromosomes
5. Demonstration of Mendelian laws using color marbles or beads
6. Evaluation of segregation and random assortment using Chi square test or test of fitness.
7. Construction of genetic maps based on Problems in two and three factor crosses
8. Estimation of acid phosphatase levels in Tad pole tails
9. Types of anthers
10. Types of stigmas
11. Anther development in plants
12. Stages of megsaprogenesis
13. Endosperm types
14. One and two dimensional separation of protein.
15. Scanning and image analysis of 2-D gels.
17. Computer assisted demonstration of microarray technology: DNA and protein

SUGGESTED BOOKS:

INORGANIC CHEMISTRY LAB

60 Hrs (4Hrs /week) Marks for Major Test (External): 70
Credits: 4 Marks for Internal Exam: 30
Time: 3Hrs Total Marks: 100

Gravimetric Analysis:

2. Estimation of copper as CuSCN
3. Estimation of iron as Fe₂O₃ by precipitating iron as Fe(OH)₃.
4. Estimation of Al (III) by precipitating with oxine and weighing as Al(oxine)₃ (aluminium oxinate).

Inorganic Preparations:

1. Tetraamminecopper (II) sulphate, [Cu(NH₃)₄]SO₄·H₂O
2. Cis and trans K[Cr(C₂O₄)₂·(H₂O)₂] Potassium dioxalatodiaquachromate (III)
3. Tetraamminecarbonatocobalt (III) ion
4. Potassium tris(oxalate)ferrate(III)

BOOKS SUGGESTED:

4. Synthesis and characterization of inorganic compounds by W. L. Jolly, Prentice Hall.
SEMESTER-VI
Paper Code: BBL-601   Core Course   XV

BIO-ANALYTICAL TOOLS

60 Hrs (4Hrs /week)   Marks for Major Test (External): 70
Credits: 4   Marks for Internal Exam: 30
Time: 3Hrs   Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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

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

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

UNIT IV   (20 Periods)
Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

SUGGESTED READING
RECOMBINANT DNA TECHNOLOGY

60 Hrs (4Hrs /week)  
Marks for Major Test (External): 70
Credits: 4  
Marks for Internal Exam: 30
Time: 3Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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

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

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

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

SUGGESTED READING
MOLECULAR BIOLOGY

60 Hrs (4Hrs /week)          Marks for Major Test (External): 70
Credits: 4                      Marks for Internal Exam: 30
Time: 3Hrs                           Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II: DNA Damage, repair and homologous recombination (10 Periods)


UNIT III: Transcription and RNA processing (17 Periods)

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

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

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

SUGGESTED READING

POLYMER CHEMISTRY

60 Hrs (4 Hrs /week)  
Marks for Major Test (External): 70

Credits: 4  
Marks for Internal Exam: 30

Time: 3 Hrs  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

Functionality and its importance  
15 Hrs

Criteria for synthetic polymer formation, Polymerisation reactions - Addition and condensation - Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

UNIT-III

Kinetics of Polymerization  
15 Hrs

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity  
Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers-Structure Property relationships.

UNIT-III

Determination of molecular weight of polymers \((M_n, M_w, \text{etc})\) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.

Polydispersity index.

Glass transition temperature (Tg) and determination of Tg. Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

Polymer Solution - Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

UNIT-IV

Properties of Polymers  
15 Hrs

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers, poly(vinyl...
acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylenesulphidepolypyrrole, polythiophene)].

BOOKS SUGGESTED:

DISCIPLINE CENTRIC SUBJECTS-III

ANIMAL DIVERSITY II

Paper Code: BBL-605-DSE-III  
60 Hrs (4Hrs /week)  
Credits: 4  
Time: 3Hrs  

Marks for Major Test (External): 70  
Marks for Internal Exam: 30  
Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT I: Proto-chordates, Pisces and Ambhibia  
(15 Periods)

Proto-chordates: Outline of classification, General features and important characters of Herdmannia, Branchiostoma

Origin of Chordates

Pisces: Migration in Pisces, Outline of classification

Ambhibia: Classification, Origin, Parental care, Paedogenesis

UNIT II: Reptilia, Aves and Mammalia  
(15 Periods)

Reptilia: Classification, Origin

Aves: Classification, Origin, flight- adaptations, migration

Mammalia: Classification, Origin, dentition

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 READING

PAPER CODE: BBL-606-DSE-III

ANIMAL BIOTECHNOLOGY

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT I

(10 Periods)

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT II

(10 Periods)


UNIT III

(20 Periods)


UNIT IV

(20 Periods)


SUGGESTED READING

Paper Code: BBL-607-DSE- III  IMMUNOLOGY

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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)

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

UNIT III  (13 Periods)

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

UNIT IV  (12 Periods)

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

SUGGESTED READING

DISCIPLINE SPECIFIC ELECTIVE-IV

Paper code: BBL-608-DSE-IV  PLANT DIVERSITY II

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70

Credits: 4  Marks for Internal Exam: 30

Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

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.

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 READING

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 Significance and use of haploids, Ploidy level and chromosome doubling, diploidization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

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
Nomenclature, 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 READING
Paper code: BBL-610-DSE-IV  ENZYMOTOLOGY

60 Hrs (4Hrs/week)  Marks for Major Test (External): 70
Credits: 4  Marks for Internal Exam: 30
Time: 3Hrs  Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT – I
(20 Periods)
Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis.

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

Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation.

Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.

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

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples: chymotrypsin, lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase.

Enzyme regulation: Product inhibition, feed back control, covalent modification.

UNIT – III
(13 Periods)

UNIT – IV
(13 Periods)
Enzyme Technology: Methods for large scale production of enzymes.


Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering—selected examples, Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution.

SUGGESTED READING

Paper code: BBP-611          Core Course Practical VIII

BIOLOGY LAB

60 Hrs (4 Hrs / week)          Marks for Major Test (External): 70
Credits: 2                      Marks for Internal Exam: 30
Time: 4 Hrs                     Total Marks: 100

PRACTICALS:

1. Separation of nucleic acid bases by paper chromatography.
3. Study of the following techniques through electron / photo micrographs: Fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching, shadow casting.
4. Study of structure of cell organelles through electron micrographs.

Permanent slide preparation:

a. Cytochemical staining of DNA-Feulgen.
b. Cytochemical staining of DNA and RNA- Methyl Green Pyronin (MGP).
c. Cytochemical staining of Polysaccharides-Periodic Acid Schiff's (PAS).
d. Cytochemical staining of Total proteins- Bromophenol blue.
e. Cytochemical staining of Histones -Fast Green.

SUGGESTED BOOKS

Paper Code: BCP-601/BBP-612  Core Course Practical IX
INORGANIC CHEMISTRY LAB-IV

60 Hrs (4Hrs /week)  Marks for Major Test (External): 70
Credits: 2  Marks for Internal Exam: 30
Time: 4 Hrs  Total Marks: 100

PRACTICALS:

1. Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: CO\(_3^{2-}\), NO\(_2^-\), S\(^2-\), SO\(_3^{2-}\), S\(_2\)O\(_3^{2-}\), CH\(_3\)COO\(^-\), F\(^-\), Cl\(^-\), Br\(^-\), I\(^-\), NO\(_3^-\), BO\(_3^{3-}\), C\(_2\)O\(_4^{2-}\), PO\(_4^{3-}\), NH\(_4^+\), K\(^+\), Pb\(^{2+}\), Cu\(^{2+}\), Zn\(^{2+}\), Mn\(^{2+}\), Co\(^{2+}\), Ni\(^{2+}\), Ba\(^{2+}\), Sr\(^{2+}\), Ca\(^{2+}\), Mg\(^{2+}\). Mixtures should preferably contain one interfering anion, or combination of anions e.g. CO\(_3^{2-}\) and SO\(_3^{2-}\), NO\(_2^-\) and NO\(_3^-\), Cl\(^-\) and Br\(^-\), Cl\(^-\) and I\(^-\), Br\(^-\) and I\(^-\), NO\(_3^-\) and Br\(^-\), NO\(_3^-\) and I\(^-\). Spot tests should be done whenever possible.

Chromatography of metal ions

2. Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:
   i. Ni (II) and Co (II)
   ii. Fe (III) and Al (III)
   (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

BOOKS SUGGESTED:

3. Synthesis and characterization of inorganic compounds by W. L. Jolly, Prentice Hall