# B.Sc. Biotechnology Syllabus

## SEMESTER-I

| Course Code | Courses | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO01 | Chemistry | 3 | 0 | 0 | 3 | 3 |

**COURSE OBJECTIVES:**

- To understand the basic concepts of atomic structure.
- To identify the different types of chemical bonds.
- To understand the thermodynamics
- To explore the different aspects of chemical catalysis
- To learn the ionic equilibrium.

**PRE-REQUISITE:** 12th Pass with basic knowledge of chemistry

**CO-REQUISITE:** Nil

**COURSE CONTENT**

**Unit – I: Atomic Structure (12 lectures)**

Electromagnetic radiation and spectrum; Planck's quantum theory, Bohr's atomic model; Quantum Numbers, Significance Of Quantum Numbers, Types of Quantum numbers - Principle, Azimuthal, Spin & magnetic Quantum Numbers. Shapes Of S, P, D And F Atomic Orbitals, Nodal Planes, Rules For Filling Electrons In Various Orbitals: Pauli's Exclusion Principle, Hund's Rule, Aubau Principle.

**Unit-II: Chemical Bonding (10 lectures)**

Ionic Bonding- General Characteristics Of Ionic Bonding, Polarizing Power And Polarizibility, Fajan's Rules, Ionic Character In Covalent Compounds. Covalent Bonding- General Characteristics Of Covalent Bond, Hybridization With Suitable Examples Of Linear ($BeF_2/C_2H_2$), Trigonal Planar ($BF_3/C_2H_4$), Tetrahedral ($CH_4/NH_3$), Hydrogen Bond.

**Unit-III: Thermodynamics (8 lectures)**

Introduction of thermodynamics, state of system, state variables, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes, Laws of thermodynamics.

**Unit-IV: Catalysis (10 lectures)**

Types Of Catalysis, Homogeneous Catalysis, Heterogeneous Catalysis, Characteristics Of Catalytic Reactions, Promoters, Catalytic Poisoning, Autocatalysis, Negative Catalysis, Activation Energy And Catalysis, Theories Of Catalysis, Intermediate Compound Formation Theory, Adsorption Theory, Hydrogenation Of Ethene In Presence Of Nickel, Acid Base Catalysis,

Mechanism Of Acid Catalysis, Enzyme Catalysis, Mechanism Of Enzyme Catalysis, Characteristics Of Enzyme Catalysis.

**Unit-V: Ionic equilibrium** **(5 lectures)**

Strong moderate and weak electrolytes, degree of ionization, factors affecting degrees of ionization, strong acids and weak acids pH scale and common ion effect. Quantitative treatment of acid base titration curves, theory of acid-base indicators

**SUGGESTED READINGS:**

**Textbooks**

T1. Inorganic Chemistry- RL Madan & GD Tuli (S. Chand Publication)
T2. Physical Chemistry- Arun Bahl, BS Bahl & GD Tuli (S. Chand Publication)

**Reference Books:**

R1. J.D.Lee : A New Concise Inorganic Chemistry, E.L.B.S.
R2. P.W. Atkins : Physical Chemistry, Oxford University Press
R3. R.T. Morrison &R.N.Boyd : Organic Chemistry, Prentice Hall
R4. James E.Huheeyetl. : Inorganic Chemistry : Principles of Structure and reactivity

**COURSE OUTCOME**

After completion of this course students will be able to

| | |
|---|---|
| CO1 | Understand atomic structure with various Bohrs, Aufbau, Pauli's principles. |
| CO2 | Identify chemical bonding and molecular forces. |
| CO3 | Describe chemical thermodynamics, law of thermodynamics |
| CO4 | Express the knowledge on catalysis. |
| CO5 | Interpret the ionic equilibria. |

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Medi-Caps University, Indore

| Course Code | Courses | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO02 | Cell Biology | 4 | 0 | 2 | 6 | 5 |

**COURSE OBJECTIVES:**

- To understand cell structure and function, cell integrity, shape, and movement.
- To understand the roles of cellular organelles.
- To acquire knowledge of extracellular matrix, cell signalling and cancer progression.

**PRE-REQUISITE:** 12th Pass with basic knowledge of Biology

**CO-REQUISITE: Nil**

**COURSE CONTENT:**

**Unit I: Introduction to Cell Biology (10 lectures)**

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, and 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: Cell Structure, Cytoskeletal Dynamics, and ER Function (10 lectures)**

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation.

**Unit III: Membrane-Bound Organelle (15 lectures)**

Golgi complex: Structure, biogenesis and functions including role in protein secretion. Lysosomes: Vacuoles and microbodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis.

**Unit IV: Nuclear and Extranuclear Organelle (10 lectures)**

Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure.

**Unit IV: Extracellular Matrix, Signalling and Cancer (15 lectures)**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extracellular matrix, macromolecules, regulation of receptor expression and function. Cell cycle - phases of cell cycle; cell division - mitosis and meiosis; Cell cycle regulation; Cell aging and death - necrosis and apoptosis;.

**LIST OF PRACTICALS:**

1. Microscopic techniques- light microscopy.
2. Visualization of animal and plant cell by methylene blue.
3. Cell counting method- animal cell: Haemocytometer
4. Mitosis in onion root tip.
5. Meiosis in Pollen mother cells of plants
6. Sub-cellular fractionation.
7. Visualization of nuclear fraction by acetocarmine stain.
8. Staining and visualization of mitochondria by Janus green stain.
9. Study the effect of temperature and organic solvents on semi permeable membrane.
10. Demonstration of dialysis and osmosis.

**SUGGESTED READINGS:**

**Textbooks**

T1. Cell biology by P.K. Gupta. Rastogi Publications
T2. Cell biology by C.B. Powar. Himalaya Publishing House
T3. Cell biology by S.C. Rastogi. New Age international publishers
T4. Cell biology by P.S. Verma and V.K. Agarwal. S. Chand publishers

**Reference books**

R1. Molecular cell biology by Harvey F. Lodish. W. H. Freeman and Company.
R2. The Cell: A Molecular Approach by Geoffrey M. Cooper, Robert E. Hausman. ASM Press, Washington DC, Sinauer Associates, Sunderland
R3. Molecular Biology of Cell by Bruce Alberts. Garland Science

**COURSE OUTCOME:**

After completion of this course students will be able to

| | |
|---|---|
| CO1 | Identify and classify organisms based on cell structures |
| CO2 | Understand the cytoskeleton's role in cell integrity, shape, and movement. |
| CO3 | Understand the structure and function of membrane bound organelles |
| CO4 | Understand the structure and function of nuclear and extranuclear organelles |
| CO5 | Acquire knowledge of cell signalling and cancer progression. |
| CO6 | Demonstrate the knowledge of laboratory practices in cell biology |

| Course Code | Course Name | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO03 | Biochemistry and Metabolism | 4 | 0 | 2 | 6 | 5 |

**COURSE OBJECTIVES:**

1. The main objective of the course will be to build the basic foundation for studying Biotechnology.
2. Students will be able to understand properties and structure of water and carbohydrates molecules.
3. The course will give basic knowledge of structure and function of lipid and nucleic acids.
4. Students will be able to understand the structure and function of amino acids and proteins.
5. Students will be able to get in-depth knowledge of enzyme and their relevance with metabolism.

**PREREQUISITE**: To study this course, student must have had the subject Biology in 12$^{th}$ class.

**CO-REQUISITE**: Nil

**COURSE CONTENT:**

**Unit I: Cellular Foundation and Carbohydrates (12 lectures)**

**Cellular foundation**: Chemical foundation of cell; Water: unique properties of water, interaction of water, ionization of water, role of water in biomolecular structure; pH and buffer: acid and base, Henderson Hasselbach equation, pH and buffer solution.

**Carbohydrates**: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

**Unit II : Lipids and Nucleic acids (12 lectures)**

**Lipids:** Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

**Nucleic acids**: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA

**Unit III Amino acids and Proteins (12 lectures)**

A historical prospective. Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

**Unit IV: Enzymes** **(12 lectures)**

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

**Unit V: Metabolism** **(12 lectures)**

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

**List of Practicals:**

1. Preparation of reagents and buffer.
2. Demonstration of pH meter.
3. Qualitative analysis of carbohydrates.
4. Qualitative analysis of proteins
5. Qualitative analysis of Lipids
6. Estimation of carbohydrates.
7. Estimation of proteins.
8. Isolation of enzyme from the given source
9. Effect of pH on enzyme activity
10. Effect of temperature on enzyme activity
11. Isoelectric precipitation of proteins.

**SUGGESTED READINGS:**

**Textbooks**

T1. J. L. Jain, Sanjay Jain and Nitin Jain. Fundamentals of Biochemistry. S Chand Publications

T2. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.

T3. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.

**Reference Books**

R1. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.

R2. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.

R3. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

**COURSE OUTCOME**

After completion of this course students will be able to

| | |
|---|---|
| CO1 | Explore the biochemical foundations of cell. |
| CO2 | Understand the structure, functions and classification of carbohydrate, lipids and nucleic acids. |
| CO3 | Understand the structure, functions and classification of aminoacids and proteins. |
| CO4 | Understand the basic concepts of enzymes. |
| CO5 | Acquire knowledge of basic metabolic processes. |
| CO6 | Demonstrate the knowledge of laboratory practices and analytical procedures in biochemistry |

| Course Code | Course Name | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3GE01 | Biosafety, Bioethics and IPR | 3 | 0 | 0 | 3 | 3 |

**COURSE OBJECTIVES:**

1. To understand the concepts and guidelines of biosafety.
2. To acquire the basic knowledge on bioethics and its importance in biotechnology.
3. To know the fundamentals of intellectual property rights.
4. To get the knowledge of patent, agreement and treaties.

**PREREQUISITE**: To study this course, student must have had the subject Biology in 12$^{th}$ class.

**CO-REQUISITE**: Nil

**COURSE CONTENTS:**

**Unit-I: Introdcution To Biosafety (07 lectures)**

Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

**Unit-II Biosafety Guidelines (10 lectures)**

Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol. Guidelines for using radioisotopes in laboratories and disposal of radioactive waste

**Unit-III Bioethics (08 lectures)**

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies. Case studies: ethical issues in clinical trial, women health ethics, medical errors and negligence

**Unit-IV Introduction To Intellectual Property (10 lectures)**

Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR –patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).

**Unit-V Grant Of Patent, Agreements And Treaties (10 lectures)**

Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing andagreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner. Agreements and Treaties: GATT, TRIPS, WIPO,Budapest Treaty on international recognition of the deposit of microorganisms etc.

**SUGGESTED READINGS**

**Textbook**

T1. Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson

T2. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

**References**

R1. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.

R2. Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.

R3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.

**COURSE OUTCOME**

After completion of this course students will be able to

| S.No | Course Outcome |
|---|---|
| CO1 | Understand the fundamentals of biosafety |
| CO2 | Summarize the guidelines of biosafety |
| CO3 | Understand the importance of bioethics |
| CO4 | Understand the concepts of intellectual property |
| CO5 | Describe the grant of patents, agreements and treaties |

| Course Code | Course Name | Hours per Week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs. | Credits |
| BT3AE01 | Communication Skills | 2 | 0 | 2 | 4 | 3 |

**Unit-I**

**Grammar and Vocabulary Development** : Applied Grammar and usage: Parts of Speech, Tenses, Subject-Verb Agreement, Active and Passive Voice, Clauses, Modals, Reported Speech, common errors. Vocabulary: Synonyms, Antonyms, Homophones, One Word Substitution, Affixation: Prefixes & Suffixes, Correctly Spelt Words, Idioms, Proverbs, and Derivation from root words.

**Unit-II**

**Developing Effective Communication Skills**: Corporate Communication, Process, Characteristics and principles, Verbal and non-verbal communication, Barriers to effective communication, Importance of effective communication, Importance of Feedback in communication. Seven Cs of Communication.

**Unit-III**

**Speaking Skills and Oral Presentation:** Preparing for and conducting presentations, Introducing yourself, Use of formal expressions, Delivery using Audio – Visual Aids with stress on body language and voice modulations, audience research, objective of presentation, Assimilation of data and post presentation strategy.

**Unit-IV**

**Developing Reading and Listening Skills:** Reading Comprehension, Process, note-making, note - taking, SQ3R reading technique. Listening Skills: Meaning, process hearing and listening, types, barriers.

**Unit-V**

**Developing Writing Skills**: Précis, Paragraph writing, digital communication etiquettes. Business Letters: Parts & Layouts of Business Letters, writing job application and Resume, Calling/ Sending Quotations/ Orders/ Complaints and E-mails.

**Text Books:**

1. P.C. Wren and Martin, High School English Grammar & Composition, , S Chand and Co Pvt Ltd.
2. S. Kumar and P. Lata , English for Effective Communication, Oxford UP, New Delhi.
3. J.S. Korlahalli and R. Pal, Essentials of Business Communication All Courses, Sultan Chand & Sons.

**References Books**

1. A.C. Gimson, An introduction to the Pronunciation of English, ELBS.
2. S. Greenbaum, The Oxford English Grammar, Oxford University Press.
3. K.Mohan and M. Raman, Effective English Communication, Tata Mc-Graw Hill.
4. A.J. Thompson and A. V. Martinet, A Practical English Grammar, Oxford UP, New Delhi.
5. U. S. Rai and S.M, Rai, Effective Communication, Himalaya Publishing House.

**List of Practicals (Wherever Applicable)**

1. Exercises on Grammar and vocabulary
2. Exercises based on reading and comprehension which also include taking notes during presentation.
3. Exercises based on listening which also include taking notes.
4. Writing technical description precis, business letters.
5. Presentations on various issues.
6. Presentations with Non verbal communication.
7. Delivering speeches and exercising voice modulation transcription.
8. Performing extempore.
9. Role plays.
10. Group discussions.

| Course Code | Course Name | Hours per Week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs. | Credits |
| BT3AE02 | **Elementary Mathematics** | 2 | 0 | 0 | 2 | 2 |

**COURSE OBJECTIVES:**

- To understand the basic knowledge of Sets, Relation and Function.
- Equip the students with the basic knowledge of logarithm and algebra.
- To implement basic knowledge of straight line and parabola in application of biology and chemistry.
- To analysis data classification and its graphical representation.
- Equip the students with the knowledge of statistics and its applications.

**PREREQUISITES**: Nil

**CO-REQUISITES**: Nil

**COURSE CONTENTS**

**Unit I: Sets, Relation and Function** **(7 lectures)**

Definition of sets, Type of sets, Formation of sets, Operation on sets, De Morgan's law, Definition of relation and function, Type of function (Constant, Polynomial, Trigonometric, rational), Determination of value of a function at a point.

**Unit II: Logarithm and Algebra** **(7 lectures)**

Definition of logarithm, laws of logarithm, Value of log by table, Quadratic Equation, Solution of linear equation (Substitution and graphical method), linear inequalities with graphical solution.

**Unit III: Straight line and Parabola** **(5 lectures)**

Introduction, Slope of a line, Angle between two lines parallel and perpendicular line, Intercept form of a line, General equation of a line, Introduction of parabola, Type of Parabola, Basic problems.

**Unit IV: Measure of Central Tendency** **(6 lectures)**

Collection of Data, Classification and Tabulation of Data: Graphical, Bar, Charts, Pie diagrams. Measure of Central Tendency (Mean, Median, Mode), Correlation and Regression.

**Unit V: Statistics and Probability** **(5 lectures)**

Sample from Population, Sample space, Events, Independent and Dependent events, Classical definition of probability, Basic problems, Probability distribution, Binomial and Poisson Distribution.

**SUGGESTED READINGS**

**Textbooks:**

**1.** NCERT Class XI Book.

**2.** R.D Sharma, Mathematics, Class XI

**Reference Books:**

**1.** Arora P.N. and Malhan P.K. 2002, Biostatistics, Himalyan Publishing

**2.** S. P. Gupta, Elementary Statistical Methods.

**COURSE OUTCOMES:**

After the completion of the course, the students shall be able to:

| | |
|---|---|
| CO1 | Understand the fundamental concepts of sets, relation, and function. |
| CO2 | Implement logarithmic values and basic algebra in application of biology and chemistry. |
| CO3 | Able to generate Straight line and Parabola in specific conditions. |
| CO4 | Understand data collection method and implement in analysis of drug specification. |
| CO5 | Understand the fundamental concepts of probability and implement in application of biology and chemistry. |

# Faculty of Science

## Department of Biotechnology

## B.Sc. Biotechnology Scheme and Syllabus

## SEMESTER-II

| Semester - II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.No** | **Course Code** | **Course Type** | **Course Name** | **L** | **T** | **P** | **C** |
| 1 | BT3CO04 | Core (CO) | Chemistry-II | 3 | 0 | 0 | 3 |
| 2 | BT3CO05 | Core (CO) | Microbiology | 4 | 0 | 2 | 5 |
| 3 | BT3CO06 | Core (CO) | Mammalian Physiology | 3 | 0 | 2 | 4 |
| 4 | BT3GE02 | General Elective (GE) | Developmental Biology | 3 | 0 | 0 | 3 |
| 5 | BT3AE03 | Ability Enhancement (AE) | Environmental Science | 2 | 0 | 0 | 2 |
| 6 | BT3SE01 | Skill Enhancement (SE) | Computer for Biologists | 3 | 0 | 2 | 4 |
| 7 | BT3NG02 | Non Grading Credit Course (NGCC) | Sports/Cultural/Technical/NSS/NCC-II | 0 | 0 | 2 | 1 |
| | | | **Total Credits** | 18 | 0 | 8 | **22** |
| | | | **Contact Hours** | **26** | | | |

| Course Code | Courses | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO04 | Chemistry - II | 3 | 0 | 0 | 3 | 3 |

**COURSE OBJECTIVES:**

- To understand the basic concepts of organic chemistry and its application in biology.
- To understand the mechanism and stereochemistry of reactions
- To explore the applications of heterocyclic compounds in biology and modern medicine.

**PRE-REQUISITE:** Nil

**CO-REQUISITE:** Nil

**COURSE CONTENT**

**Unit-I: Reactive Intermediates in Organic Reactions (7 lectures)**
Carbocation stability, formation and reactions with examples, carbanions, pKa values, methods of formation, stability, shapes and reactions. Free radicals their stability, methods of synthesis and reactions. Examples of reactive intermediates with applications to biological systems.

**Unit-II: Stereochemistry (6 lectures)**
Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diasteroisomers.
Conformational isomers: conformation of ethane and butane, interconversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity, Walden inversion, enantiotopic and diastereotopic hydrogens and prochiral centers.
Geometrical isomerism: Definition, nomenclature– E and Z

**Unit-III: Mechanism and stereochemistry of reactions (6 lectures)**
Substitution reactions, addition reactions, oxidation and reduction, Elimination reactions ester formation and hydrolysis, Aromaticity, aromatic and Nucleophilic substitution.

**Unit-IV: Heterocyclic chemistry (6 lectures)**
Structure, synthesis and reactivity of the following heterocycles and their significance in biology - furan and pyrrole; imidazole; thiazole; carbazole and indole; pyridine, quinoline and isoquinoline; purines and pyrimidines

**Unit-V: Mechanisms in Biological Chemistry (8 lectures)**
Active methylene groups, aldol and retroaldol reactions, schiff bases and enamine reactions, nitrogen, phosphorus and sulfur ylides. Umpolung reaction, Michael addition, Polymer supported organic reactions, phase transfer catalysis, Equivalence of these reactions in biological system.

**SUGGESTED READINGS:**

**Textbooks**

T1. Quantitative organic chemistry by Vogel
T2. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand.
T3. E. L. Eliel : Stereochemistry of Carbon Compounds, Tata McGraw Hill.

**Reference Books:**

R1. T. W. Graham Solomons : Organic Chemistry, John Wiley and Sons.
R2. I. L. Finar : Organic Chemistry (Vol. I & II), E. L. B. S.
R3. R. T. Morrison & R. N. Boyd : Organic Chemistry, Prentice Hall.

**COURSE OUTCOME**

After completion of this course students will be able to

| | |
|---|---|
| CO1 | Identify the reactive Intermediates in organic reactions |
| CO2 | Understand the concept of stereochemistry |
| CO3 | Describe the mechanism and stereochemistry of reactions |
| CO4 | Understand the concept of heterocyclic chemistry |
| CO5 | Describe the mechanism of reactions in the biological system |

| Course Code | Courses | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO05 | Microbiology | 4 | 0 | 2 | 6 | 5 |

**COURSE OBJECTIVES:**

- To understand the contributions of various scientist for development of Microbiology.
- To understand the diversity of microorganisms, their classification and control methods
- To understand the methods for the microorganisms study.
- To understand the concept and importance of Fungi and Algae.
- To understand the structure, properties and importance of viruses.

**PRE-REQUISITE:** Nil

**CO-REQUISITE:** Nil

**COURSE CONTENT:**

**Unit-I: Fundamentals, History and Evolution of Microbiology (8 lectures)**

History and contribution of various scientists: Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch, Edward Jenner and Flemming, Biogenesis and abiogenesis theory. Scope of Microbiology.
Classification of microorganisms: Whittaker 5 Kingdom, Corl Woese's classification.
Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of Bacteria, Algae, Fungi, Protozoa and viruses.

**Unit-II: Sterilization and staining techniques (8 lectures)**
Definition of sterilization, pasteurization, disinfection, sanitization and antisepsis. Physical and Chemical methods of sterilization; Stains and staining techniques
Introduction to various stains, Mechanism of simple, negative, gram, acid fast, capsule, flagella and endospore staining.

**Unit-III: Microbial growth and cultivation (10 lectures)**
Nutritional classification of micro-organisms, microbiological media and their types, methods of isolation and preservation.
Microbial growth: Batch, fed-batch, continuous culture, synchronous growth. Factors affecting microbial growth, Methods of growth estimation.

**Unit IV: Algae and Fungi (10 lectures)**
Algae – Distribution and classification of algae; reproduction in algae; Ecological significance of algae.
Fungi: outline classification of fungi, Morphology of some common fungi - Mucor, Rhizopus, Aspergillus, Penicillium and Fusarium. General characteristics of General characteristics of Lichens and Mycorrhiza.

**Unit V: Concepts in Virology** **(8 lectures)**

General characteristics of viruses, Classification of viruses. Life cycle of viruses, Lytic and lysogenic cycle, structure of viruses, Introduction to bacteriophage, Prions, Viroid, TMV virus. Bacteriophage detection assay.

**LIST OF PRACTICALS:**

1. Sterilization methods.
2. Preparation of media.
3. Methods of isolation of bacteria from different sources.
4. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
5. Isolation of fungi and fungal staining.
6. Biochemical characterization of bacteria
7. Determination of bacterial cell size by micrometry.
8. Enumeration of microorganisms.
9. Demonstration of infectivity assay of bacteriophage.

**SUGGESTED READINGS:**

**Textbooks**

T1. A Textbook of Microbiology by R. C. Dubey, D. K. Maheshwari. S Chand Publications.
T2. Textbook of Microbiology by R Ananthanarayan and CK Jayaram Paniker, Reba Kanungo. Universities Press (India) Pvt. Ltd.
T3. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.

**Reference books**

R1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
R2. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
R3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

**COURSE OUTCOME:**

After completion of this course students will be able to

| | |
|---|---|
| CO1 | Classify the various microorganisms on the basis of their characters. |
| CO2 | Understand the structure of bacteria and able to understand principles of various sterilization methods. |
| CO3 | Explore the microbial culture techniques and microbial preservation methods. |
| CO4 | Understand the structure, growth and significance of algae and fungi. |
| CO5 | Acquire basic knowledge of viruses, their properties and medical importance. |
| CO6 | Demonstrate the knowledge of laboratory practices in microbiology |

| Course Code | Course Name | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO06 | Mammalian Physiology | 3 | 0 | 2 | 5 | 4 |

**COURSE OBJECTIVES:**

- To understand the basic physiological processes of mammalian physiology.
- To understand the structural and physiological aspects of digestion, respiration and circulation.
- To learn about the coordination between endocrine and nervous system.
- To learn about the muscles and osmoregulation.
- To explore chronobiology and stress physiology.
- To inculcate the physiological aspect within students.

**PREREQUISITE**: Nil

**CO-REQUISITE**: Nil

**COURSE CONTENT:**

**Unit-I: Digestion and Respiration (7 lectures)**

Digestion: Outline of digestive system, Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and Nucleic acids. Respiration: Outline of respiratory system, Exchange of gases, Transport of $O_2$ and $CO_2$, Oxygen dissociation curve, Chloride shift.

**Unit-II: Circulation (7 lectures)**

Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Structure of heart, Mechanism of working of heart: Cardiac output, cardiac cycle.

**Unit-III: Muscle physiology (6 lectures)**

Structure of cardiac, smooth & skeletal muscles, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.

**Unit-IV: Nervous and Endocrine coordination (8 lectures)**

Mechanism of generation & propagation of nerve impulse, structure of neuron and synapse, synaptic conduction, saltatory conduction, Neurotransmitters. Hormones & Mechanism of action of hormones (peptides and steroids). Different endocrine glands– pituitary, thyroid, parathyroid Pancreas, and adrenals.

**Unit-V: Chronobiology and Stress Physiology (8 lectures)**

Circadian rhythm. Hormonal biorhythms and their significance: Role of adrenocortical and pineal hormones. Sleep-wakefulness cycle. Body temperature rhythm. Time keeping genes. Jet-lag and shift work.

Stress: Physical and Emotional Stressors. General Adaptation Syndrome. Role of endocrine system in managing stress. Effects and preventive measures of hypobaric and hyperbaric environment. Caisson disease.

**LIST OF PRACTICALS:**

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of RBCs
4. Determination of TLC
5. Determination of DLC
6. Determination of Haemoglobin
7. Study of disorders caused by endocrine glands with the help of photographs.
8. Solving problems based on ABO blood groups in human based on hypothetical problems.
9. Detection of action of salivary amylase on starch
10. Demonstration of: PCV, ESR, Osmotic fragility, Prothrombin time.

**SUGGESTED READINGS:**
**Textbooks**

T1. J. L. Jain, Sanjay Jain and Nitin Jain. ( Year )Fundamentals of Biochemistry. S Chand Publications
T2. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
T3. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.

**Reference Books**

R1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
R2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

**COURSE OUTCOME**

After completion of this course students will be able to

| | |
|---|---|
| CO1 | Understand the process of digestion and respiration. |
| CO2 | Understand the circulatory system. |
| CO3 | Explain the physiology of muscles |
| CO4 | Aquire knowledge of coordination between endocrine and nervous system. |
| CO5 | Understand the concepts of chronobiology and stress physiology. |
| CO6 | Demonstrate the knowledge of laboratory practices and analytical procedures in physiology. |

| Course Code | Course Name | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3GE02 | Developmental Biology | 3 | 0 | 0 | 3 | 3 |

**COURSE OBJECTIVES:**

- To possess basic understanding of gametogenesis and fertilization
- To understand early embryonic development
- To have In-depth knowledge of embryonic differentiation and organogenesis
- To understand medical implication of developmental biology

**PREREQUISITE**: Nil

**CO-REQUISITE**: Nil

**COURSE CONTENTS:**

**Unit-I: Gametogenesis and Fertilization (5 lectures)**
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 (8 lectures)**
Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism. Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

**Unit-III: Embryonic Differentiation (8 lectures)**
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 (6 lectures)**
Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germlayers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

**Unit-V: Medical implications of developmental biology (8 lectures)**
Factors affecting embryonic development, Overview of teratogenic disorders, role of vitamins and minerals in embryonic development.

**SUGGESTED READINGS**

**Textbook**
T1. Developmental Biology by Dr. Luna Phukan, Mahaveer Publications

T2. Developmental Biology by Dr. Asha Sharma, RBD Publication

**References**

R1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
R2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
R3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

**COURSE OUTCOME**

After completion of this course students will be able to

| S.No | Course Outcome |
|---|---|
| CO1 | Possess basic understanding of Developmental Biology |
| CO2 | Practical Understanding of Early Embryonic Development |
| CO3 | Understand the concepts of embryonic differentiation. |
| CO4 | Analytical Skills in Organogenesis |
| CO5 | Application of Developmental Biology to Medical Contexts |

| Course Code | Course Name | Hours per Week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs. | Credits |
| BT3AE03 | Environmental Science | 2 | 0 | 0 | 2 | 2 |

**COURSE OBJECTIVES:**

- To introduce environmental science as multidisciplinary course and its management.
- To learn about the natural resources.
- To understand the causes of pollution and their effects.
- To understand the concerns of global warming and climate change.
- To explore the management policies of various environmental concern.

**PREREQUISITE**: Nil

**CO-REQUISITE**: Nil

**Unit- I: Environment (4 lectures)**

Definition, scope, importance, need for public awareness. Multidisciplinary nature of environmental studies. Environmental Management Systems - its objectives & components. Environmental Impact Assessment. Concept of sustainability and sustainable development. Environment Protection Act.

**Unit II: Natural resources (6 lectures)**

Natural Resources: Land resources and land use change; Land degradation, soil erosion, salinization and desertification. Water: Use and over exploitation of surface and ground water,; Forest Resources; Food resources. Case studies on natural disaster: Earthquake, floods, cyclone, volcanoes; Energy resources: Renewable and nonrenewable energy sources, use of alternate energy sources.

**Unit III: Environment pollution and management (4 lectures)**

Environmental pollution: types, causes, effects and control of Air, water, soil and noise pollution.

**Unit IV: Global Warming and Climate Change (5 lectures)**

Atmospheric structure and composition. Significance of atmosphere in making the Earth, the only biosphere. Trends of global warming and climate change. Impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species. Impact on economy and spread of human diseases.

**Unit V: Management of environmental challenges (5 lectures)**

Disaster management – Introduction, types, disaster management cycle. Solid Waste management: Introduction, types of solid waste, methods to manage; Deforestation; Urbanization and Energy requirements

Greenhouse Gases, Ways to reduce Greenhouse gases emissions, Carbon Footprint, ways to reduce carbon footprint, Carbon Trading; Ozone layer depletion, Acid rain and impacts on human communities and agriculture.

**Case Studies:** Case studies of Bhopal Gas tragedy, Fukushima Daichii Nuclear disaster

**Text Books:**

T1. Surinder Deswal, Environmental Science, Dhanpat Rai & Co. publication
T2. Environmental Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2008, ISBN: 978-81-224-2159-0.
T3. R. Rajgopalan , Environmental Studies, Oxford IBH Publication.
T4. Daniel D. Chiras, Environmental Science , Jones & Bartlett Ltd

**References Books**

R1. G. M. Masters, Introduction to Environmental Science and Engineering, Pearson Education Pvt. Ltd.
R2. K. De, Environmental Chemistry, New Age International,1996.
R3. G.J. Rau and C.D. Wee ten, "Environmental Impact Analysis" Hand book, McGraw Hill.
R4. Petts Judith, Handbook of environmental impact assessment. Vol. 1, Blackwell Science

**COURSE OUTCOME**

After completion of this course students will be able to

| | |
|---|---|
| CO1 | Identify the scope and importance of studying the environment. |
| CO2 | Understand the natural resources. |
| CO3 | Identify the harmful effects of environmental pollution and apply suitable control methods. |
| CO4 | Understand the concepts and concerns of global warming and climate change. |
| CO5 | Explore the management of environmental challenges. |

| Course Code | Course Name | Hours per Week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs. | Credits |
| BT3SE01 | **Computer for Biologists** | 3 | 0 | 2 | 5 | 4 |

**COURSE OBJECTIVES:**

- To understand the basics of computer hardware and how software interacts with computer hardware
- To understand how computers represent and manipulate data
- To learn the concepts of C programming.
- To know how to read and understand solutions to computational problems, which will be formalized as a series of tasks (an algorithm).
- To learn about general approaches for solving computational problems, and you will be able to apply these approaches to new problems you encounter.

**PREREQUISITES**: Nil

**CO-REQUISITES**: Nil

**COURSE CONTENTS**

## UNIT- I Fundamental of Computer System

Evolution of Computers and Computer Generations, Computer Classification, Processing speed of a computer, Functional UNITs and Components in Computer Organization. Computers – Block diagram, Memory addressing, capability of a CPU, Word length of a computer, Basic components of a Digital Computer - Control UNIT, ALU, IO Subsystem of a Computer, Bus Structures. Input Devices, Keyboard, Mouse. Output Devices, CRT Monitor, LCD Displays, Touch Screen Displays, Print Devices, Multiprocessor and Multi core Architecture.

## UNIT- II Number System

Number systems – Decimal Number system, Binary number system, octal number system and Hexadecimal number system, 1's & 2's complement, Representation of Positive and Negative Numbers, Binary Fixed-Point Representation, Arithmetic operation on Binary numbers, Overflow & underflow. Floating Point Representation, Codes, ASCII

## UNIT- III Computer Memory

Storing data and Program in Memory, Memory Hierarchy in a Computer, Internal Organization of Semiconductor Main Memory Chips, Semiconductor Memory RAM and ROM, Auxiliary Memory Peripheral Devices, Secondary Storage Memory, Magnetic Memories and Hard Disk Optical Disks and CD Memories.

## UNIT –IV Introduction to C programming language

Basics of programming Language: Character set, Identifier, Keywords, Constants, Data Types, Variables and declaration. Operators and Expressions: Operator precedence and associativity, Expression Evaluation (Simple Examples), Input and output functions, Control Statements: Selection, Conditional operator, Iteration (for, while, do-while), Branching (switch, break, continue, go to).

## UNIT – V Array and Function

Arrays and Strings: 1D and 2D arrays, Strings and basic operations on strings, Strings functions, Programs on string manipulation. Functions: Definition, Calling Declaration, Parameter Passing (by value and by reference), Recursion.

## List of Practicals:

1. To study the components of computer.
2. To study different storage device in computer.
3. Write a program to print hello world.
4. Write a program to take input from user and print the value of input.
5. Write a C program for even or odd using for loop.
6. Write a C program to print multiplication table using while loop and for loop.
7. Write a C program to find leap year using if else.
8. Write a C Program to swap two numbers without using third variable.
9. Write a C program to delete an element in an array.
10. Write a C program to insert an element in an array.
11. Write a C program to generate fibonacci series without recursion.
12. Write a C program to generate fibonacci series using recursion.
13. Write a C program to check odd or even without using modulus operator and division operator.

**SUGGESTED READINGS**

**Textbooks:**

T1. Computer Fundamentals – B. Ram – New Age International Publishers
T2. P Kanetkar Yashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.
T3. E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition

**Reference Books:**

R1. Rashid Sheikh, “Computer Organization & Architecture”
R2. William Stallings, “Computer Organization & Architecture”, Pearson.
R3. Bartee, “Digital Computer Fundamentals” TMH Publication
R4. Morris Mano, “Computer System Architecture” PHI
R5. W. Hayes, Computer Architecture, McGraw-Hill

**COURSE OUTCOMES:**

After the completion of the course, the students shall be able to:

| | |
|---|---|
| CO1 | Understand and explain the basics of computer and its components. |
| CO2 | Explain the number systems and its application in computer science. |
| CO3 | Explain the computer memory types and devices. |
| CO4 | Understand the C programming language. |
| CO5 | Explain the arrays, structure and functions. |
| CO6 | Illustration and interpretation of C programs. |

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Medi-Caps University, Indore

# B.Sc. Biotechnology Semester – III Syllabus

| Course Code | Courses | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO08 | Molecular Biology | 4 | 0 | 2 | 6 | 5 |

**COURSE OBJECTIVES:**

- To understand the mechanisms of DNA replication, damage and homologous recombination.
- To learn about the process of transcription and RNA processing in prokaryotes and eukaryotes.
- To comprehend the genetic code and the mechanism of translation in both prokaryotes and eukaryotes
- To Learn about protein folding, targeting, and the regulation of gene expression in prokaryotes and eukaryotes.
- To inculcate the physiological aspect within students.

**PRE-REQUISITE: Basic Knowledge of cell biology and biochemistry**

**CO-REQUISITE:** Nil

**COURSE CONTENT:**

**Unit- I: DNA replication (7 lectures)**

DNA as genetic material, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

**Unit- II: DNA damage, repair and homologous recombination (7 lectures)**

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

**Unit- III: Transcription and RNA processing (8 lectures)**

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 - initiation, elongation & termination. RNA splicing and processing.

**Unit- IV: Translation (8 lectures)**

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.

**Unit- V: Protein sorting and Regulation of gene expression (9 lectures)**

Protein folding and targeting. Regulation of gene expression in prokaryotes: lactose, tryptophan and arabinose operon. Regulation of gene expression in eukaryotes: gene amplification and deletions. Chromosome puffs, DNA methylation, CpG islands, Changes in histone and chromosome remodelling proteins

**LIST OF PRACTICALS:**

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of DNA.
3. Isolation of RNA.
4. Estimation of DNA.
5. Estimation of RNA.
6. Spectrophotometric analysis of purity of isolated DNA.
7. Agarose gel electrophoresis of genomic DNA & plasmid DNA
8. Preparation of restriction enzyme digests of DNA samples
9. Demonstration of AMES test or reverse mutation for carcinogenicity.
10. DNA Fingerprinting Using Gel Electrophoresis

**SUGGESTED READINGS:**

**Textbooks**

T1. Molecular Biology by Verma P.S. & Agarwal V.K. S Chand Publications.
T2. Molecular Biology by P K Gupta, Rastogi Publications
T3. Fundamentals of Biochemistry. J. L. Jain, Sanjay Jain and Nitin Jain. S Chand Publications

**Reference books**

R1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
R2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
R3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
R4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

**COURSE OUTCOME:**

After completion of this course students will be able to

| | |
|---|---|
| $CO_{01}$ | Understand the process of DNA replication |
| $CO_{02}$ | Understand the mechanism of DNA damage, repair and homologous recombination. |
| $CO_{03}$ | Understand the process of transcription and RNA processing. |
| $CO_{04}$ | Understand the process of translation and post translational modifications. |
| $CO_{05}$ | Understand the concepts of Protein sorting and Regulation of gene expression |
| $CO_{06}$ | Demonstrate the knowledge of laboratory practices and analytical procedures in molecular biology. |

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# B.Sc. Biotechnology Semester – III Syllabus

| Course Code | Course Name | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO09 | Plant Physiology & Biotechnology | 4 | 0 | 2 | 6 | 5 |

**COURSE OBJECTIVES:**

- To understand the importance of water in life.
- To understand the metabolism of plant and the role of microorganisms and plant hormones in plant growth and development.
- To understand various type of cultures such as embryo culture, callus culture, organ culture, protoplast culture, meristem and shoot tip culture.
- To understand the methods of in-vitro haploid production.
- To understand the protoplast isolation methods and its importance.

**PREREQUISITE**: Basic knowledge of biochemistry and botany.

**CO-REQUISITE**: Nil

**COURSE CONTENT:**

**Unit- I: Plant water relations and micro & macro nutrients (8 Lectures)**

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: mechanism of uptake of nutrients, mechanism of food transport

**Unit- II: Metabolism, Growth and development (8 Lectures)**

Metabolism: photphosphorylation, calvin cycle, CAM plants, photorespiration.
Growth and development: growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene) seed dormancy and seed germination, concept of photoperiodism and vernalization. Growth promotion by symbiotic and non symbiotic nitrogen fixing bacteria.

**Unit- III: Cryo and organogenic differentiation (8 Lectures)**

Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Meristem and shoot tip culture, Axillary bud proliferation, organogenesis, embryogenesis. Micropopagation and its advantages and disadvantages.

**Unit- IV: In vitro haploid production methods (8 Lectures)**

Anther culture, Microspore culture androgenesis, significance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

**Unit - V Protoplast Isolation and fusion (8 Lectures)**

Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Somaclonal variation Nomenclautre, methods, applications basis and disadvantages.

**PRACTICALS**

1. Determination of solute potential by plasmolytic method.
2. Demonstration of plasmolysis using Tradescantia leaf peel.
3. Demonstration of opening & closing of stomata
4. Separation of photosynthetic pigments by paper chromatography.
5. Demonstration of aerobic respiration.
6. Effect of chemicals, temperature on membrane permeability, colorimetric determination.
7. Study of relative rates of transpiration of different plants.
8. Study the rate of photosynthesis under different light intensities.
9. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
10. Preparation of complex nutrient medium (Murashige & Skoog's medium)
11. To selection, Prune, sterilize and prepare an explant for culture.
12. Significance of growth hormones in culture medium.
13. To demonstrate various steps of Micropropagation.

**SUGGESTED READINGS**

Textbooks:

T1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
T2. VK Jain. 2017. Fundamentals Of Plant Physiology. S Chand Publishers.
T3. HS Chawla. Introduction to Plant Biotechnology. Taylor and Francis
T4. B D Singh. Plant Biotechnology. Medtech Publishers.

Reference Books

R1. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
R2. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4 th edition, W.H. Freeman and Company, New York, USA.
R3. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
R4. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4 th edition, Sinauer Associates Inc .MA, USA
R5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
R6. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

**COURSE OUTCOMES**

After completion of this course students will be able to

| | |
|---|---|
| $CO_{01}$ | Understand the role of water in plant metabolism. |
| $CO_{02}$ | Understand the mechanism of plant growth hormones and role of bacteria for plant growth and development. |
| $CO_{03}$ | Explore different types of plant cell cultures. |
| $CO_{04}$ | Understand methods of haploid plant production. |
| $CO_{05}$ | Understand concept of protoplast fusion and its methods. |
| $CO_{06}$ | Demonstrate basic knowledge of plant tissue culture methods. |

| Semester - IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C |
| 1 | BT3CO10 | Core | Immunology | 4 | 0 | 2 | 5 |
| 2 | BT3CO11 | Core | Bioanalytical Tools | 3 | 0 | 2 | 4 |
| 3 | BT3EL01 | Discipline Elective | Bioinformatics and Biostatics | 4 | 0 | 2 | 5 |
| 4 | BT3AE04 | Ability Enhancement | Entrepreneurship Development | 3 | 0 | 0 | 3 |
| 5 | BT3NG04 | Non-Grading Credit Course | Soft Skill - II | 3 | 0 | 0 | 3 |
| | | | **Total Credits** | 17 | 0 | 6 | **20** |
| | | | **Contact Hours** | **23** | | | |

## SEMESTER-IV

| Course Code | Courses | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO10 | Immunology | 4 | 0 | 2 | 6 | 5 |

**COURSE OBJECTIVES:**

1.To understand the mechanism of Immune system.
2. To study about the cells involved in immune response and their functions.
3. To comprehend the antigen antibody interactions and the immunodeficiency diseases.
4. To classify and understand MHC and hypersensitivity.
5. To develop critical thinking about immunological process among students.

**PRE-REQUISITE:** Biochemistry BT3CO03 and Microbiology BT3CO05

**CO-REQUISITE:** Nil

**COURSE CONTENT**

**Unit I : Basics of Immune Systems (10 lectures)**

Overview and History of the Immunology, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Organs and Cells of the Immune System – B and T cells, Null cells, Monocytes, Polymorphs. Primary and Secondary Lymphoid organs- Thymus, Spleen, Lymph nodes.

**Unit II: Immune Responses (10 lectures)**

Features of Immune Response – memory, cell specificity/diversity, recognition of self and non-self. Humoral & Cellular immune responses, lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells)

**Unit III : Antigen-Antibody Interactions (12 lectures)**

Antigen: Antigenicity, immunogenicity, Epitopes, Haptens, Adjuvant, non-peptide antigens
Antibody and Immunoglobulins: structure, classes and function, isotype, allotype, and idiotype, genetic diversity of antibody class, Antigen and antibody interactions: Precipitation and Agglutination reactions, Immunodeficiency diseases

**Unit IV: Major Histocompatibility Complex (10 lectures)**

Major Histocompatibility Complex (MHC) and Antigen presentation: General organization and inheritance of MHC, Classes of MHC, MHC Polymorphism,

**Unit V: Hypersensitivity** **(12 lectures)**

The complement system: Allergy and hypersensitivity: type I hypersensitivity, Antibody mediated type II hypersensitivity, Immune complex mediated type III hypersensitivity, Delayed hypersensitivity (type IV), Chronic inflammation.

## List of Practicals

1. Blood Group determination
2. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Separation of serum and plasma from blood
6. Double immunodiffusion test using specific antibody and antigen.
7. WIDAL Test
8. ELISA test

## Course Outcomes

After completion of this course students will be able to

| | | |
|---|---|---|
| 1. | List of types of immune cells and organs | BL01 |
| 2. | Understanding the basic concept of immune system, immunoglobulins, precipitation and Agglutination reactions. | BL02 |
| 3. | Understand the types of antigens and their interaction with antibody. | BL02 |
| 4. | Explain Immunodeficiency diseases. hypersensitivity and Major Histocompatibility Complex, | BL02 |
| 5. | Classify types of immune cells, types of immunity, types of MHC, types of hypersensitivity. | BL03 |
| 6. | Apply the concept of antigen -antibody interactions for disease diagnosis | BL04 |

## Suggested Readings

**Textbooks**

T2. M. P. Tiwari, Textbook of Immunology
T3 Immunology, V. S. N. Murthy

**Reference Books**

R1. Kuby J, Thomas J. Kindt, Barbara, A. Osborne: Immunology, 6th Edition, Freeman,2002.
R2. Paul, Fundamental of Immunology, 4th edition, Lippencott Raven, 1999.
R3. Abul K Abbas, Andrew H, Litchman, Shiv, Pillai. Basic Immunology, Elsevier
R4. Peter J. Delves, Seamus J. Martin, Denis Burton, IvanRoitt. Roitt's Essential Immunology, 13th edition Wiley

| Course Code | Courses | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3CO11 | Bioanalytical Tools | 3 | 0 | 2 | 5 | 4 |

**COURSE OBJECTIVES:**

1. To learn the concepts of bioanalytical techniques.
2. To understand the working principle of instruments including microscope, colorimeter, Spectrophotometer, PCR.
3. To understand the principles and applications of various chromatography techniques.
4. To comprehend the blotting techniques and its application.

**PRE-REQUISITE:** Biochemistry and Metabolism BT3CO03

**CO-REQUISITE:** Nil

**COURSE CONTENT**

**UNIT I: Microscopy** (10 lectures)

Microscopy: Body structure of microscope, Concept of resolving power, refractive Index, magnification, Light microscopy, Compound Microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM).

**UNIT II: Spectrometry and Centrifugation** (08 lectures)

Principle and applications of colorimeter, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

**UNIT III: Chromatography Techniques** (08 lectures)

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: Electrophoresis** (08 lectures)

Introduction to electrophoresis, native and SDS-PAGE, agarose-gel electrophoresis, 2 D electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing,

**Unit V: PCR and Blotting Techniques** (08 lectures)

Western blotting, Southern blotting, northern blotting, DNA sequencing, PCR, Real Time PCR.

**List of Practicals**

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide gel electrophoresis of proteins
3. Preparation of protoplasts from leaves.

5. Separation of amino acids by paper chromatography.
6. Separation of biomolecules by Thin Layer Chromatography.
6. Demonstration of Gel Filtration chromatography.
7. Demonstration of Ion Exchange Chromatography.

## Course Outcomes

After completion of this course students will be able to

| | | |
|---|---|---|
| 1. | List the name of instruments used in biotechnology | BL01 |
| 2. | Understand the principle of instruments viz. Microscope, Colorimeter, Spectrophotometer, Electrophoresis, Chromatography, PCR etc. | BL02 |
| 3. | Explain the concept of various blotting techniques | BL02 |
| 4. | Apply the techniques for analysis of biological samples | BL03 |

## Suggested Reading

**Textbooks**

T1. Bioanalytical Techniques, Sekhar Talluri
T2 Fundamentals Of Bioanalytical Techniques and Instrumentation, Sabari Ghosal

**Reference Books**

R1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
R2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
R3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
R4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

| Course Code | Courses | Hours Per week | | | Total | |
|---|---|---|---|---|---|---|
| | | L | T | P | Hrs | Credit |
| BT3EL01 | Bioinformatics and Biostatistics | 4 | 0 | 2 | 5 | 5 |

**Course Objectives**

1 To introduce the fundamentals of Bioinformatics.
2 To familiarize with biological data and databases.
3 To develop skills in database search and retrieval tools.
4 To enhance statistical analysis proficiency for biological data.
5 To equip students with data modelling techniques.

**PRE-REQUISITE:** Computer for Biologist BT3SE01

**CO-REQUISITE:** Nil

**COURSE CONTENT**

**Unit I: I Introduction to Bioinformatics (08 Lectures)**

Introduction to bioinformatics, Application of Bioinformatics, Role of internet and www in bioinformatics. Forms of biological information, Types of Nucleotide Sequences. Open Reading Frames.

**Unit II: Organization of Data and Sequence Alignment (12 Lectures)**

Organization of Data: Contents and formats of database entries, retrieval of data using text-based search tools – Entrez, SRS, NCBI, Sequence Similarity Searches-BLAST, FASTA. Multiple Sequence Alignment

**Unit III: Biological Databases (12 Lectures)**

Important Biological Databases: GenBank, EMBL, DDBJ. Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD Genome Databases with special reference to model organisms (Yeast, Drosophila, C. elegans, Rat, Mouse) Human, plants such as Arabidopsis thaliana, Rice, and others.

**Unit IV: Statistical Data and Central tendency (12 Lectures)**

Types of Data, Collection of data; Primary & Secondary data, Measures of Central tendency – Mean, Median, Mode, Dispersion and measure of dispersion – Range, Standard deviation, testing of hypothesis.

**Unit V: Statistical test of hypothesis (10 Lectures)**

Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA). Correlation and Regression.

## List of Practicals

1. NCBI and other Databases and their applications
2. Identification and mapping of genes
3. BLAST (Basic Local Alignment Search Tools) analysis
4. Multiple sequence alignments of nucleic acid
5. Multiple sequence alignment of proteins
6. Construction of phylogenetic tree
7. Identification and analysis of repeat sequence
8. Mean, mode, and median analysis and plotting graphs
9. Plotting of graphs with biological data
10. Correlation analysis using statistical software

## Course Outcomes

After completion of this course students will be able to

| | | |
|---|---|---|
| 1 | List of data and databases used in bioinformatics and biostatistics. | BL01 |
| 2 | Understand the basic concept of world-wide web, bioinformatics, and application of bioinformatics in various fields. | BL02 |
| 2 | Explain about Sequence Similarity Searches, multiple sequence alignment and phylogenetic tree construction. | BL02 |
| | Explain about various Measures of Central tendency, dispersion, Standard deviation and testing of hypothesis. | BL02 |
| 3 | Apply various biological datasets and use of SWISS-Prot database to predict secondary structure of proteins. | BL03 |
| 4 | Apply t-test, chi-square test, ANOVA, Correlation and Regression in biological analysis. | BL03 |

## Suggested Readings

### Textbooks

T1. Supratim Choudhuri. Bioinformatics for Beginners. Academic Press.
T2. Zhumur Ghosh and Bibekanand Mallick. Bioinformatics: Principles and Applications. Oxford University Press, India.
T3. An introduction to Bio-Statistics by N.Gurumani.2009 – MJP Publications.

### Reference Books

R1. Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., III-Edition, 2004, John Wiley & Sons, UK.
R2. Bioinformatics and Functional Genomics by Pevsner, J., 2003, John Wiley and Sons, New Jersey, USA.
R3. Schaum's Outline Statistics by Murray.R, Spiegel, Larry.J.Stephens, 4th edition, McGraw Hill Companies.

| Course Code | Course Name | Hours per Week | | | Total Credits |
|---|---|---|---|---|---|
| | | L | T | P | |
| BT3AE04 | Entrepreneurship Development | 3 | 0 | 0 | 3 |

**COURSE LEARNING OBJECTIVES**

| Sr. No. | Course Learning Objectives |
|---|---|
| 1 | Understand and Apply the Principles of Entrepreneurship. |
| 2 | Evaluate and Develop Business Structures, Product and Feasibility Plans. |
| 3 | Manage Financial Resources and Inventory Effectively. |
| 4 | Develop and Implement Marketing Strategies. |
| 5 | Navigate International Business and Export Operations. |

**Unit 1: Meaning and Scope of Entrepreneurship**

Meaning and Scope of Entrepreneurship, Importance of Entrepreneurship, Functions of an Entrepreneur, Challenges and Opportunities for Entrepreneurs, Entrepreneurial Ecosystems, Economic & Noneconomic Factors Influencing Entrepreneurship, Features of Successful Entrepreneurship, Entrepreneurship's Role in Innovation.

**Unit 2: Business Structures, Project Identification, Feasibility Analysis**

Forms of Business Structures, Factors Affecting Business Structure, Project Identification, Evaluating Viable Business Opportunities, Criteria for Product Selection, Product Testing and Validation, Business Plan and Key Components, Feasibility Studies, Types of Feasibility Studies.

**Unit 3: Financial Management and Inventory Control**

Significance of Finance in Business, Sources of Fixed Capital, Loan Repayments and Financial Planning, Sources of Working Capital, Challenges of Working Capital Management, Types of Inventories, Inventory Management Techniques, Inventory Cost Management.

**Unit 4: Marketing Principles, Product Strategy, Distribution Management**

Introduction to Marketing, Marketing Mix and 4 P's, Product Line and Product Mix, Product Life Cycle (PLC), Marketing Research, Role of Surveys in Marketing Research, Physical Distribution Management, Strategies for Effective Stock Management.

**Unit 5: International Business, Export Strategies, and Financing**

Meaning and Importance of International Business, Criteria for Product Selection, Criteria for Market Selection, Market Entry Strategies, Export Financing, Types of Export Financing, Role of Government Agencies in Export Promotion, Customs Procedures and Export Documentation.

**COURSE OUTCOME**

After the Student goes through the subject, he/she will be able to:

| Sr. No. | Course Outcomes | Blooms Level |
|---|---|---|
| 1 | Analyse entrepreneurship concepts, opportunities, and challenges. | BL04 |
| 2 | Develop a comprehensive business plan, including product selection and feasibility analysis. | BL06 |
| 3 | Apply financial management principles to manage capital and control inventory costs. | BL03 |
| 4 | Design and implement marketing strategies using the marketing mix. | BL06 |
| 5 | Evaluate and implement international business strategies. | BL05 |

**Reference Books:**

1. Holt DH. Entrepreneurship: New Venture Creation.

2. Kaplan JM Patterns of Entrepreneurship.

3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

| Course Code | Course Name | L | T | P | Total |
|---|---|---|---|---|---|
| BT3NG04 | Soft Skill-II | 3 | 0 | 0 | 3 |

**PRE-REQUISITE: Nil**

**CO-REQUISITE:** Nil

**COURSE CONTENT**

**Unit 1: Time Mastery & Personal Growth**

- **Time Prioritization**: Learn effective time management techniques to balance tasks and priorities for better productivity and personal success.
- **Curiosity & Lifelong Learning**: Cultivate a mindset of continuous learning and exploration to stay adaptable in an ever-changing world.

**Unit 2: Innovation & Personal Branding**

- **Creativity & Innovation**: Discover ways to think creatively and innovate solutions to problems in both personal and professional spaces.
- **Personal Branding**: Learn the art of building a unique, authentic personal brand that enhances your professional identity and opens doors to new opportunities.

**Unit 3: Confidence & Communication in Action**

- **Confidence Building & Stage Fear (PD-2)**: Continue developing techniques to enhance your self-confidence, particularly in public speaking and challenging situations.
- **Presentation Skills (Assignment)**: Apply your learning by delivering presentations, showcasing your ability to communicate ideas effectively in front of an audience.

**Unit 4: Collaboration & Conflict Resolution**

- **Collaboration & Conflict Resolution**: Learn teamwork strategies and conflict resolution techniques to foster a cooperative environment in both personal and professional contexts.
- **GD & PI (Mock)**: Practice and refine group discussion and personal interview skills through mock sessions to prepare for real-life situations.

**Unit 5: Continuous Improvement & Practical Assignments**

- **Creativity & Innovation (Assignment)**: Implement creative ideas and innovation techniques in practical assignments, encouraging out-of-the-box thinking.

**Textbooks:**

1. Emotional Intelligence (EQ) - Mind Tools
2. Adaptability in the Workplace – SHRM

**References:**

1. Professional Communication - Aruna Koneru
2. 70 Toughest Interview Questions and Answers