



मेडी-केप्स विश्वविद्यालय, इंदौर

Medi-Caps University, Indore

SCHEME AND SYLLABUS

B.Sc. Biotechnology: Curriculum structure (2023-2026)							
Semester - I							
S.No	Course Code	Course Type	Course Title	L	T	P	C
1	BT3CO01	Core (CO)	Chemistry - I	3	0	0	3
2	BT3CO02	Core (CO)	Cell Biology	4	0	2	5
3	BT3CO03	Core (CO)	Biochemistry & Metabolism	4	0	2	5
4	BT3GE01	General Elective (GE)	Biosafety, Bioethics and IPR	3	0	0	3
5	BT3AE01	Ability Enhancement (AE)	Communication Skills	2	0	2	3
6	BT3AE02	Ability Enhancement (AE)	Elementary Mathematics	2	0	0	2
7	BT3NG01	Non Grading Credit Course (NGCC)	Sports/Cultural/Technical/NSS/NC C	0	0	0	1
Total Credits				18	0	6	22
Contact Hours				24			
Semester - II							
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 Applications	3	0	2	4
7	BT3NG02	Non Grading Credit Course (NGCC)	Sports/Cultural/Technical/NSS/NC C	0	0	0	1
Total Credits				18	0	6	22
Contact Hours				24			
Semester - III							



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1	BT3CO07	Core (CO)	Genetics	3	0	0	3
2	BT3CO08	Core (CO)	Molecular Biology	4	0	2	5
3	BT3CO09	Core (CO)	Plant Physiology and Biotechnology	4	0	2	5
4	BT3GE03	General Elective (GE)	Biotechnology and Human Welfare	3	0	0	3
5	BT3AE04	Ability Enhancement Course (AE)	Soft Skill - I	2	0	0	2
6	BT3SE02	Skill Enhancement (SE)	Enzymology	3	0	0	3
Total Credits				19	0	4	21
Contact Hours				23			
Semester - IV							
1	BT3CO10	Core (CO)	Immunology	4	0	0	4
2	BT3CO11	Core (CO)	Bioanalytical Tools	4	0	2	5
3	BT3EL01	Discipline Elective (DE)	Microbial Physiology and Metabolism	3	0	2	4
4	BT3GE04	General Elective (GE)	Entrepreneurship Development	2	0	0	2
5	BT3AE05	Ability Enhancement (AE)	Soft Skill - II	2	0	0	2
6	BT3SE03	Skill Enhancement (SE)	Medical Biotechnology	3	0	0	3
Total Credits				18	0	4	20
Contact Hours				22			
Semester - V							
1	BT3CO12	Core (CO)	Bioprocess Technology	4	0	2	5
2	BT3CO13	Core (CO)	Recombinant DNA Technology	4	0	0	4
3	BT3EL02	Discipline Elective (DE)	Microbial Biotechnology	4	0	2	5
4	BT3EL03	Discipline Elective (DE)	Biostatistics	4	0	0	4
5	BT3AE06	Ability Enhancement (AE)	Soft Skill - III	2	0	0	2



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6	BT3SE04	Skill Enhancement (SE)	Drug Designing	4	0	0	4
Total Credits				22	0	4	24
Contact Hours				26			
Semester - VI							
1	BT3CO14	Core (CO)	Computational and Omics Biology	4	0	2	5
2	BT3EL04/5/6/7/8	Discipline Elective (DE)	Elective-I	3	0	0	3
3	BT3PC01	Project Work (PC)	Project Work	0	0	0	6
Total Credits				7	0	2	14
Contact Hours				9			
Electives (Any one course in Sem-VI)							
1	BT3EL04	DE	Evolutionary Biology	3	0	0	3
2	BT3EL05	DE	Pharmaceutical Biotechnology	3	0	0	3
3	BT3EL06	DE	Clinical Research	3	0	0	3
4	BT3EL07	DE	Scientific and Medical Writing	3	0	0	3
5	BT3EL08	DE	Environmental Biotechnology	3	0	0	3
6	BT3EL09	DE	Animal Biotechnology	3	0	0	3
Total Credits				123			



B.Sc. Biotechnology Semester – I Syllabus

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, Aufbau Principle.

Unit-II: Chemical Bonding

(10 lectures)

Ionic Bonding- General Characteristics Of Ionic Bonding, Polarizing Power And Polarizability, Fajan's Rules, Ionic Character In Covalent Compounds. Covalent Bonding- General Characteristics Of Covalent Bond, Hybridization With Suitable Examples Of Linear ($\text{BeF}_2/\text{C}_2\text{H}_2$), Trigonal Planar ($\text{BF}_3/\text{C}_2\text{H}_4$), 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,



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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. Huheey et al. : 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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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



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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 12th 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. β -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.



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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



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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 12th class.

CO-REQUISITE: Nil

COURSE CONTENTS:

Unit-I: Introduction 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 and agreement; 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.



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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 Intellectual Property Rights: Legal and Social Implications, 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



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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.



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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.



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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.



B.Sc. Biotechnology Semester – II Syllabus

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, diastereoisomers.

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.



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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



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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 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. 9th 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



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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 O₂ and CO₂, 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.



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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. Herculourt 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	Acquire 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.



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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



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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



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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



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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.



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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



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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.



B.Sc. Biotechnology Semester – III Syllabus

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
BT3CO07	Genetics	3	0	0	3	3

COURSE OBJECTIVES:

1. To understand the Mendelian Genetics
2. To understand and explore gene Interactions
3. To learn about chromosome and genomic organization.
4. To learn about the identification of Mutation Mechanisms, linkage and crossing over.
5. To explore extra-nuclear Inheritance and population Genetics.

PRE-REQUISITE: Basic knowledge of biology

CO-REQUISITE: Nil

COURSE CONTENT

Unit- I: Mendelian Genetics (5 lectures)

Historical developments in the field of genetics. Mendelian genetics - Mendel's experimental design, monohybrid and dihybrid crosses, Law of segregation & Principle of independent assortment. Test and back crosses, Chromosomal theory of inheritance.

Unit- II: Allelic & Non allelic interactions (6 lectures)

Allelic interactions - Concept of dominance, recessiveness, incomplete dominance, co-dominance, pleiotropy, multiple allele, pseudo-allele.

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

Unit- III: Chromosome and genomic organization (6 lectures)

Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINES & LINES, noncoding DNA. chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes.

Unit- IV: Mutations, Linkage & Crossing over (7 lectures)

Mutation – types & causes of mutations, Ames test, variations in chromosomes structure - deletion, duplication, inversion and translocation, chromosomal aberrations, Aneuploidy and Euploidy.

Sex determination - Mechanisms & Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, sex influenced dominance, sex limited gene expression, sex linked inheritance.

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in



a chromosome crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping.

Unit- V Extra chromosomal inheritance & Population genetics (6 lectures)

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

Population genetics: Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

SUGGESTED READINGS:

Textbooks

- T1. Fundamentals of Genetics by B. D. Singh 6th edition, Med Tech Publishers
- T2. GENETICS by P K Gupta, Rastogi Publications
- T3. Genetics by Verma P.S. & Agarwal V.K. S Chand Publications.

Reference Books:

- R1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
- R2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
- R3. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- R4. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

COURSE OUTCOME

After completion of this course students will be able to

CO ₀₁	Understand the Mendelian genetics and Allelic & Non allelic interactions.
CO ₀₂	Understand the concepts of chromosomal and extrachromosomal inheritance.
CO ₀₃	Explore Chromosomal and genomic organization.
CO ₀₄	Demonstrate mutation, linkage, crossing over and population genetics.

	Courses	Hours Per week	Total
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Course Code		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-priming 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.

Course Code	Course Name	Hours Per week	Total
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		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, diploidization, 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 Nomenclature, 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.



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Medi-Caps University, Indore

Course Code	Course Name	Hours Per week			Total	
		L	T	P	Hrs	Credit
BT3GE03	Biotechnology & Human Welfare	3	0	0	3	3

COURSE OBJECTIVES:

1. To understand the applications of biotechnology in industrial processes.
2. To learn about biotechnological advancements in agriculture.
3. To explore the role of biotechnology in environmental management.
4. To understand the application of biotechnology in forensic science
5. To learn about biotechnological innovations in health.

PREREQUISITE: Basic knowledge of biology and chemistry.

CO-REQUISITE: Nil

COURSE CONTENTS:

Unit- I Biotechnology in industry

(6 lectures)

Protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

Unit- II Biotechnology in Agriculture

(6 lectures)

N₂ fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

Unit- III Biotechnology in Environment

(6 lectures)

Chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

Unit- IV Biotechnology in Forensic science

(6 lectures)

Application of biotechnology in solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

Unit- V Biotechnology and Health

(6 lectures)

Development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

SUGGESTED READINGS

Textbook

- T1. Industrial Biotechnology by D A SAWANT, DR JITENDRA AMBULGE, DR N N BANDELA, DR RAHUL MAYEE. Nirali Prakashan.
- T2. Industrial Biotechnology by Varun Shastri. Isha Books.
- T3. TEXTBOOK OF AGRICULTURAL BIOTECHNOLOGY by NAG, AHINDRA.
- T4. Textbook of Environmental Biotechnology By P. K. Mohapatra. I. K. International Pvt Ltd

References

- R1. Industrial Biotechnology by Debabrata Das, Soumya Pandit. CRC Press
- R2. Industrial Biotechnology By Watson K. CBS Publishers. PHI.
- R3. Environmental Biotechnology Fundamentals to Modern Techniques By Sibi G. CRC Press.
- R4. Medical Biotechnology, Biopharmaceutics, Forensic Science and Bioinformatics. Edited By Hajiya Mairo Inuwa et al. CRC Press



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COURSE OUTCOME

After completion of this course students will be able to

CO ₀₁	Explain protein engineering, enzyme synthesis, and antibiotic formation.
CO ₀₂	Describe N ₂ fixation, pest resistance gene transfer, and livestock improvement
CO ₀₃	Discuss pollutant degradation, stress management, and biodegradable polymers.
CO ₀₄	Explain DNA fingerprinting for solving crimes and verifying identities.
CO ₀₅	Describe therapeutic agents, vaccines, gene therapy, diagnostics, and the human genome project.



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Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
BT3AE04	Enzymology	3	0	0	3	3

COURSE OBJECTIVES:

- To understand the kinetics of enzymes.
- To understand the enzyme regulation and various type of enzyme inhibition.
- To understand the methods of production and purification of enzymes.
- To explore the applications and importance of enzymes in various field.

PREREQUISITE: Biochemistry and Metabolism (BT3CO03)

CO-REQUISITE: NIL

COURSE CONTENTS:

UNIT - I Enzyme Kinetics

(8 lectures)

Concept of Enzyme substrate complex: active site, allosteric site, Michaelis-Menten equation and its derivation, Lineweaver burk plot for the determination of K_m and V_{max} and their physiological significance, Factors affecting enzyme activity, Collision and transition state theories, Significance of activation energy and free energy.

Isoenzymes– multiple forms. Multienzyme complexes. Ribozymes. Multifunctional enzyme,

UNIT – II Enzyme regulation and inhibition

(8 lectures)

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. control of enzyme synthesis, control of enzyme degradation

Enzyme regulation: Reversible inhibition - competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition. Irreversible inhibition. Feedback inhibition. Determination of K_i , suicide inhibitor.

UNIT – III Enzyme Engineering and Technology

(8 lectures)

Methods for large scale production of enzymes, Isolation, crystallization and purification of enzymes, affinity chromatography for separation of recombinant protein, homogeneity test of enzyme preparation, methods of enzyme analysis. Methods and application of enzymes immobilization. Concept and selected examples of site directed mutagenesis and enzyme engineering.

UNIT – IV Application of Enzymes

(6 lectures)

Application of enzymes in dairy and food industry, textile industry, leather industry, pulp and paper industry, detergent industry and pharmaceutical industry. Role of enzyme in diagnosis of the diseases. Enzyme in environmental management.

SUGGESTED READING

Textbooks:



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T1. Enzymology, T Devasena, Oxford University Press.

T2. J. L. Jain, Sanjay Jain and Nitin Jain. Fundamentals of Biochemistry. S Chand Publications

Reference books:

R1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.

R2. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999

R3. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004

R4. Practical Enzymology Hans Bisswanger Wiley-VCH 2004

R5. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press
2002

COURSE OUTCOME

After completion of this course students will be able to

CO ₀₁	Understand the enzymes Kinetics.
CO ₀₂	Understand the regulation of enzymes and various types of feedback inhibition.
CO ₀₃	Explore the enzyme production and purification techniques.
CO ₀₄	Understand the application of enzymes in various sectors of industries.

Course Code	Course Name	Hours per Week	Total
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		L	T	P	Hrs.	Credits
BT3AE04	Soft Skills I	3	0	0	3	3

COURSE OBJECTIVES:

- Improving professional communication
- Knowing traits of personality and working on it
- Developing writing skills
- Cultivating art of formal presentation and public speaking
- Improving interview and group discussion skills and hence employability

PREREQUISITES: Nil

CO-REQUISITES: Nil

Unit- I Communication: Communication flow/channels, types of communication. principles of communication, barriers to Communication, Verbal/ Non-Verbal Communication.

Unit- II Confidence Building: Self-evaluation and development, SWOT Analysis, overcoming hesitation and fear of facing public, exercises for confidence building, concepts and elements of emotional intelligence.

Unit-III Business Correspondence – Business letters, formats, parts and layouts of business letters. sales letters: calling and sending quotation, placing orders, complaints, and adjustments. Writing agenda, preparing minutes.

Unit-IV Report Writing – Types of reports, formats, presenting diagrams, graphs, charts, tables. Technical description, writing abstract, summary, synopsis.

Unit- V Formal Presentation- searching data, organising, presenting, assimilating, submitting preparing slides, Organising and designing presentations.

Case Studies: Nil

List of Practical: Not Applicable.

Project: Nil

SUGGESTED READINGS:

Textbooks:

- R C Sharma, Krishna Mohan. Business Correspondance and Report Writing. Mc Graw Hill Education.
- M Ashraf Rizvi. Effective Technical Communication. Mc Graw Hill Education.

Reference Books:

- Prof P N Kharu Dr Varinder Gandhi. Communication Skills in English. Laxmi Publications
- Murphy, Hildebrandt, Thomas. Effective Business Communication. Mc Graw Hill Education
- Paul V Anderson. Technical Communication. Cengage Learning.

Web Source:

<http://study.com/academy/lesson/communication-skills-definition-examples.html>

<https://books.google.co.in/books?>

Open Learning Source:

<https://onlinecourses.nptel.ac.in>



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COURSE OUTCOME

After completion of this course students will be able to

CO ₀₁	Students will be able to interact confidently at formal occasions.
CO ₀₂	Students will be able to understand their personality and improve it
CO ₀₃	Students will be able to work on their writing skills
CO ₀₄	Students will get to write formally with perfection
CO ₀₅	Students will be able to face interview confidently and will be able to know the qualities of participants taking part in GD

Course Code	Course Name	Hours per Week	Total
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		L	T	P	Hrs.	Credits
BT3AE04	Soft Skills I	2	0	0	2	2

Unit-I

Introduction to Communication: - Definition and importance of communication. - Communication processes and models. - Types of communication: verbal, non-verbal, written, and visual. **Listening and Feedback:** - The significance of active listening. - Barriers to effective listening. - Feedback: types, importance, and effective feedback strategies.

Unit-II

Emotional Intelligence and Adaptability: - Understanding one's Emotions: Self-awareness and self-regulation. - Interpersonal Skills: Building relationships and understanding others. – The Role of Empathy: Connecting with colleagues and superiors. - **Adaptability in the Workplace:** - Embracing change and learning agility.

Unit-III

Non-verbal Communication: - Types of non-verbal communication: body language, facial expressions, gestures. - Importance of tone and voice. - Cultural variations in non-verbal communication. **Interpersonal Communication:** - Nature and importance. - Strategies for effective interpersonal communication. - Barriers and overcoming barriers. **Group Communication and Team Dynamics:** - Role of communication in group settings. - Group norms and dynamics. - Strategies for effective group communication.

Unit-IV

Introduction to Quantitative and Logical Reasoning: - Importance and real-world applications. - Differences between quantitative and logical reasoning. Number Systems - Whole numbers, decimals, fractions. - Prime numbers, factors, and multiples. - Arithmetic operations and properties.

Unit-V

Modern Communication Technologies: - Introduction to digital communication. Social media and its impact on communication. - Electronic communication tools and their appropriate use. **Crisis Communication and Conflict Resolution:** - Role of communication during crises. - Strategies for crisis communication. - Communication in conflict resolution and negotiation.

Reference Book:

1. Soft Skills: Know Yourself And Know The World By Dr. K. Alex, S Chand Publishing
2. A Modern Approach to Logical Reasoning by RS Aggarwal