Netaji Subhas University
Jamshedpur

NEP

SYLLABUS AND REGULATIONS IN

B.Sc. (Honours) BIOTECHNOLOGY

Academic Year 2025 onwards

Course Structure Credits and Work Hours on a Semester Basis In Accordance With the National Education Policy (NEP) For Academic Year 2025-2026 onwards.

SEMESTER I

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 101	Major Disciplinary courses	Cell Structure & Biology	**3(T)+1(P)=4**	**5**
ACBT 101	Minor Disciplinary courses	Information Technology and Application	**3(T)+1(P)=4**	**5**
MLDBT 101	Multi-Disciplinary courses	Biostatistics	**3(T)**	**3**
SEC 101	Skill Enhancement Course	Biotechnological Laboratory Technique -I	**3(P)**	**6**
AEC 101	Ability Enhancement courses	English Composition	**2(T)**	**2**
VAC 1O1	NEP Value added common courses I	Understanding India	**2(T)**	**2**
IKS01	Indian Knowledge System	Basic to Indian Knowledge	**2(T)**	**2**
			20 Credit	**25 Hours**

SEMESTER II

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 202	Major Disciplinary courses	Microbiology	**3(T)+1(P)=4**	**5**
ACBT 202	Minor Disciplinary courses	Programming in C	**3(T)+1(P)=4**	**5**
MLDBT 202	Multi-Disciplinary courses	Immunology	**3(T)**	**3**
SEC 202	Skill Enhancement Course	Biotechnological Laboratory Technique -II	**3(P)**	**6**
AEC202	Ability Enhancement courses	English/Hindi Composition	**2(T)**	**2**
VAC 02	NEP Value added common courses I	Environmental Studies	**2(T)**	**2**
IKS 02	Awareness Modules	Awareness of Civic Education	**2(T)**	**2**
Total Credits/	Total Hours of Work		**20 Credit**	**25 Hours**

SEMESTER III

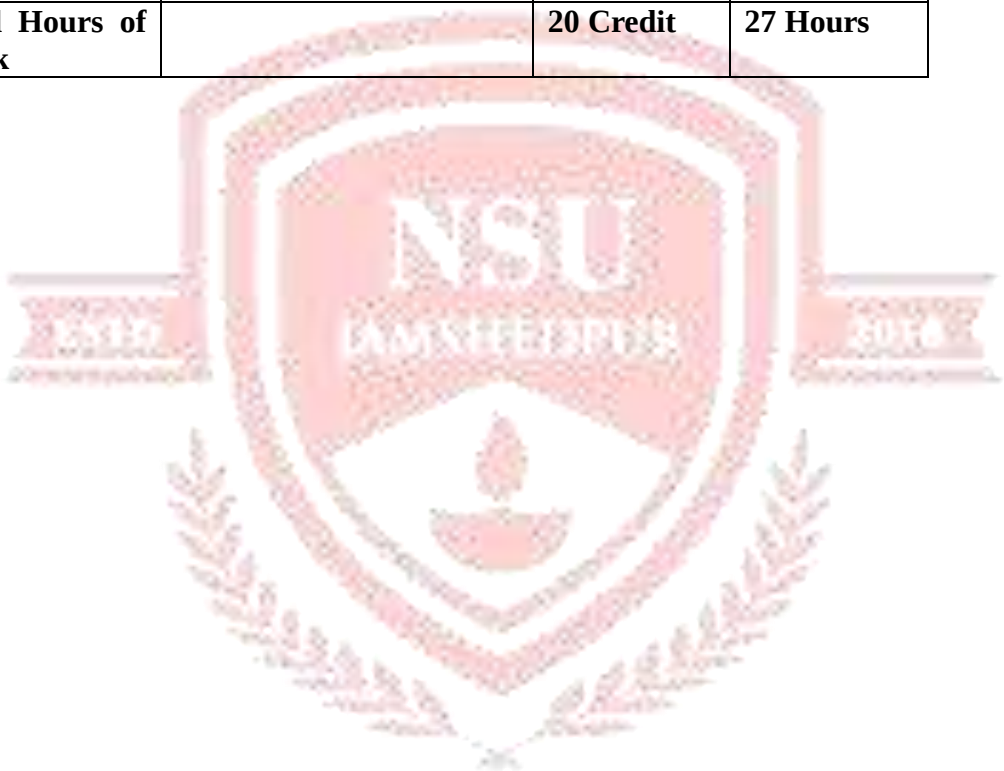
Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 303	**Major Disciplinary courses**	Molecular Biology	**3(T)+1(P)=4**	**5**
MJDBT 304	**Major Disciplinary courses**	Biochemistry	**3(T)+1(P)=4**	**5**
ELBT 301	**Minor Disciplinary courses**	Data structure using C	**3(T)+1(P)=4**	**5**
MLDBT 303	**Multi-Disciplinary Courses**	Animal Physiology	**3(T)**	**3**
SEC 303	**Skill Enhancement courses**	Biotechnological Laboratory Technique -III	**3(P)**	**6**
AEC 303	**Ability Enhancement Courses**	English/ Hindi	**2(T)**	**2**
Total Credits/	**Total Hours of Work**		**20 Credit**	**26 Hours**

SEMESTER IV

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 405	Major Disciplinary courses	Bioinstrumentation	**3(T)+1(P)=4**	**5**
MJDBT 406	Major Disciplinary courses	Genetic Engineering	**3(T)+1(P)=4**	**5**
MJDBT 407	Major Disciplinary courses	Plant Physiology	**3(T)+1(P)=4**	**5**
ELBT 402	Minor Disciplinary courses	Object oriented programming using Java	**3(T)+1(P)=4**	**5**
AEC 04	Ability Enhancement Courses	English/Hindi	**2(T)**	**2**
VAC		Health &Wellness	**2(T)**	**2**
Total Credits/	Total Hours of Work		**20 Credit**	**24 Hours**

SEMESTER V

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs.
MJDBT 508	Major Disciplinary courses	Genetics	**3(T)+1(P)=4**	**5**
MJDBT 509	Major Disciplinary courses	Applied Environmental Biotechnology	**3(T)+1(P)=4**	**5**
MJDBT 510	Major Disciplinary courses	Metabolism	**4(T)**	**4**
ELBT 503	Minor Disciplinary courses	Database Management System	**3(T)+1(P)=4**	**5**
MJDBT 511		Summer Internship	**4(T)**	**8**
Total Credits/	**Total Hours of Work**		**20 Credit**	**27 Hours**



SEMESTER VI

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 612	**Major Disciplinary courses**	Plant Biotechnology	**3(T)+1(P)=4**	**5**
MJDBT 613	**Major Disciplinary courses**	Environmental Science & Bioresources	**3(T)+1(P)=4**	**5**
MJDBT 614	**Major Disciplinary courses**	Intellectual Property Rights (IPR)	**4(T)**	**4**
MJDBT 615	**Major Disciplinary courses**	Bioethics and Biosafety measures of lab	**4(T)**	**4**
ELBT 604	**Minor Disciplinary courses**	Python Programming	**3(T)+1(P)=4**	**5**
Total Credits/	**Total Hours of Work**		**20 Credit**	**23 Hours**

SEMESTER VII (HONS.)

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 716	**Major Disciplinary courses**	Animal Biotechnology	**3(T)+1(P)=4**	**5**
MJDBT 717	**Major Disciplinary courses**	Enzyme Technology	**3(T)+1(P)=4**	**5**
MJDBT 718	**Major Disciplinary courses**	Therapeutic Medical Biotechnology	**4(T)**	**4**
ELBT 705	**Minor Disciplinary courses**	AI (Artificial intelligence)	**3(T)+1(P)=4**	**5**
AMJ 701		Industrial Biotechnology	**3(T)+1(P)=4**	**5**
Total Credits/	**Total Hours of Work**		**20 Credit**	**24 Hours**

SEMESTER VII (HONS.WITH RESEARCH)

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 716	**Major Disciplinary courses**	Research Methodology	**4(T)**	**4**
MJDBT 717	**Major Disciplinary courses**	Enzyme Technology	**3(T)+1(P)=4**	**5**
MJDBT 718	**Major Disciplinary courses**	Therapeutic Medical Biotechnology	**3(T)+1(P)=4**	**5**
ELBT 705	**Minor Disciplinary courses**	AI (Artificial intelligence)	**3(T)+1(P)=4**	**5**
RC		Research Proposal- Planning and techniques.	**4(T)**	**4**
Total Credits/	**Total Hours of Work**		**20 Credit**	**23 Hours**

SEMESTER VIII (HONS.)

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 819	**Major Disciplinary courses**	Biological Data Analysis	**3(T)+1(P)=4**	**5**
MJDBT 820	**Major Disciplinary courses**	Agricultural Biotechnology	**3(T)+1(P)=4**	**5**
ELBT 806	**Minor Disciplinary courses**	Data Mining	**3(T)+1(P)=4**	**5**
AMJ 802		Diagnostic Medical Biotechnology	**3(T)+1(P)=4**	**5**
AMJ 803		Bioprocess Technology	**3(T)+1(P)=4**	**5**
Total Credits	**Total Hours of Work**		**20 Credit**	**25 Hours**

Semester 8 (Hons.With Research)

Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJDBT 819	**Major Disciplinary courses**	Biological Data Analysis	**3(T)+1(P)=4**	**5**
MJDBT 820	**Major Disciplinary courses**	Agricultural Biotechnology	**3(T)+1(P)=4**	**5**
ELBT 806	**Minor Disciplinary courses**	Data Mining	**3(T)+1(P)=4**	**5**
RP 01	**Research Project**	Research Internship and dissertation/Thesis	**8 (P)**	**2**
Total Credits/	**Total Hours of Work**		**20 Credit**	**15 Hours**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SEMESTER I

CELL BIOLOGY

Course code: MJDBT 101 **Total Marks: 100 (IA 25+EA75)** **Credits: 4**

Unit-I

Cell Structure & Theory, Structure of prokaryotic cell, Eubacteria and Archaebacteria. Size, shape and arrangement of bacterial cells. Gram's positive and Gram's negative cells. Structure of Eukaryotic cell, plant cells, animal cells. Difference between prokaryotic and Eukaryotic cells.

Unit-II

Structure and function of bacterial cell — flagella, pill, Cell wall, cytoplasmic membrane, nuclear region, mesosomes, ribosomes, vacuoles. Structure and function of eukaryotic cell — Cell wall, cell membrane, mitochondria, chloroplast, endoplasmic reticulum, Golgi bodies, nucleus, cytoskeleton, microbodies, Centriole, Lysosome.

Unit-III

Cell cycle and cell division- mitosis, meiosis. Anomalies in cell division and associated diseases. Cell synchrony, Cell-cell interactions.

Unit-IV

Transport Process: Cell Membrane: Models of membrane structure, Membrane proteins and their properties, Membrane carbohydrates and their roles. Transport across membranes —active and passive diffusion, mechanisms.

Unit-V

Introduction to Necrosis, Senescence, Apoptosis — Programmed cell death. Mechanism of Apoptosis, Intrinsic &Extrinsic pathways of cell death, Apoptosis in relation to Cancer, Oncogenes — Types of cancer.

Course Learning Outcomes (CLO)

1. Understand cell structures and functions, including organelles in plant, animal, bacterial cells, and viruses.

2. Study cell interactions with their environment, focusing on membrane dynamics, transport mechanisms, and surface differentiation.

3. Learn the organization of the nucleus and chromosomes, understanding cellular inheritance and specialized structures.

4. Understand the cell cycle, mitosis, meiosis, and regulation mechanisms with checkpoints and proteins

5. Explore cell signaling pathways, receptor mechanisms, apoptosis, and necrosis, understanding cellular communication and death.

Programme Outcomes (POs)

1. Gain a comprehensive understanding of the structure, function, and processes of cells, including organelles, membranes, cell cycle, and signal transduction.

2. Develop hands-on experience in cell biology laboratory techniques such as microscopy, cell culture, staining, and quantification methods.

3. Analyse and interpret experimental data, identify patterns in cellular processes, and propose logical explanations based on scientific evidence.

4. Apply principles of cell biology to address real-world problems such as cancer development, genetic disorders, and immune responses.

5. Relate cellular mechanisms to human health and disease, contributing to public health awareness, diagnostics, and therapeutic research.

BOOKS:

1. Molecular Biology of the cell, 2002: Albert's et al

2. The cell: A molecular approach: J.M. Cooper

3. Cell biology: P.S. Verma and V.K. Agarval

4. Cell and Molecular Biology: P.K. Gupta

5. A practical book of Molecular Biology and Immunology; 2017: P.K. Singh et al

INFORMATION TECHNOLOGY AND APPLICATION

Course code: ACBT101 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Introduction to Computers

Introduction, Characteristics of computers, Evolution of computers, Generation of Computers, Classification of Computers, The Computer System, Applications of Computers.

Input / Output devices and Memory

Introduction, Keyboard, Pointing Devices, Speech Recognition, Digital Camera, Scanners, Optical Scanners. Classification of Output, Printers, Plotters, Computer Output Microfilm (COM), Monitors, Audio Output, Projectors. Random Access Memory (RAM), Types of RAM, Read Only Memory (ROM), Types of ROM. Classification of Secondary Storage Devices.

Software Concepts

Introduction to Software, Relationship between Software and Hardware, System Software, Application Software and its types, Utility Software, Algorithm, Flowchart, Program, and Pseudo code (P-Code).Features of a Good Programming Language.

Data Communication and Computer Network

Introduction, Data Communication, Transmission Media, Multiplexing, Switching, Computer Network, Network Topologies, Communication Protocols, Network devices.
World Wide Web, Hypertext, Uniform Resource Locator, Web Browsers, IP Address, Domain Name, Internet Services Providers, Internet Security, Internet Requirements, Web Search Engine, Net Surfing, Internet Services

MS-Office – MS-Word, MS-Excel, MS-Power Point.

Course Learning Outcomes (CLO)

1. Describe the basic components of computer systems, software types, and IT infrastructure.
2. Demonstrate the use of essential application software like MS Word, Excel, and PowerPoint.
3. Explain key concepts of networking, the internet, and cyber security
4. Apply data handling, formatting, and formula tools in spread sheet software.
5. Use search engines and online databases for academic and professional research.

Programme Outcomes (POs)

1. Understand the fundamentals of computers, software, and information systems.
2. Demonstrate awareness of how IT is applied in various sectors like education, health, banking, government, and business.
3. Develop skills to use common software tools (e.g., MS Office, Internet browsing, email, cloud services) efficiently.
4. Apply IT tools to solve simple real-life problems such as data management, online transactions, and research.
5. Collaborate effectively in group activities using online tools and digital platforms.

Text Books:

1. V. Rajaraman, Fundamentals of Computers, 3rd Edition, PHI Publications

2. Nasib S. Gill, Essentials of Computer & Network Technology, Khanna Publications.

3. Deepak Bharihoke, Fundamentals of Information Technology, Excel Books.

BIOSTATISTICS

Course code: MLDBT101 **Total Marks:** 75 **Credits:** 3

Unit I:

Biostatistics - Definition and Scope

Collection, Classification and Tabulation of data

Presentation of Data: Diagrams and graphs; bar, pie Histogram, line graph.

Frequency curves - Gives.

Unit II:

Calculation of Mean

Calculation of Mode

Calculation of Median

Calculation of Range

Unit III:

Standard deviation

Calculation of Variance

Standard error and its calculation

Test of Significance: Basic concept, Levels of significance, test of significance,

Unit IV:

Types of hypothesis- Null hypothesis and Alternate hypothesis.

Probability: Definition and scope

Probability theorem

Chi square test

References:

1. Statistics – N. G. Das (Central)

2. Basic Statistics – A. M. Goon, M. K. Gupta & B. Dasgupta (World Pr.)

Course Learning Outcomes (CLOs)

1. Define biostatistics and explain its applications in medical and life sciences.
2. Compute mean, median, mode, range, and variance for datasets and visualize data using graphs.
3. Calculate standard error and apply significance tests (e.g., t-test, Chi-square) to analyze data.
4. Formulate null and alternative hypotheses and interpret p-values for research conclusions.
5. Critically assess statistical validity in research studies and justify test selections.

Programme Outcomes (POs)

1. Demonstrate core biostatistical concepts relevant to life sciences and medicine.
2. Solve biological/medical data problems using appropriate statistical methods.
3. Design studies and analyse data with correct statistical techniques.
4. Perform statistical calculations (SD, Chi-square) and interpret results accurately.
5. Evaluate statistical claims in scientific literature for reliability and bias.

Suggested Readings:

1. **Das, N. G.** *Statistics* (Central) – A foundational textbook covering core concepts with biomedical applications.
2. **Goon, A. M., Gupta, M. K., & Dasgupta, B.** *Basic Statistics* (World Pr.) – Practical guide to computations and data analysis in life sciences.
3. **Glantz, S. A.** *Primer of Biostatistics* (McGraw-Hill) – Clear, concise explanations of key tests and their interpretations in medical research.

BIOTECHNOLOGICAL LABORATORY TECHNIQUE -I

Course code: SEC101 **Total Marks:** 75 **Credits:** 3

1. To study the plant cell structure using various plant materials.

2. To study microbial cell by Monochrome stains and Gram staining.

3. To prepare and study the different stages of mitosis and meiosis.

4. Prepare slide for study of stomata.

5. Study of permanent slides like cell division, prokaryotic and eukaryotic cells, Muscles and Nerve cells, T.S. of stomata.

6. To study the animal cell structure using cheek cells.

7. Histochemical localization of flagellin.

8. Viable cell counting using haemocytometer.

9. Measurement of cell by light microscope:-Calibration of ocular micrometer, finding out average cell size

10. Separation of cell types from blood by TLC/differential counting.

11. Methods of cell lysis: rupture osmotic/chemical/enzymatic.

ABILITY ENHANCEMENT COURSE

ENGLISH COMPOSITION

Course code: AEC101 **Total Marks:** 50 **Credits:** 2

Course Objective:

1. To provide learning environment to practice listening, speaking, reading and writing skills.
2. To assist the students to carry on the tasks and activities through guided instructions and materials.
3. To effectively integrate English language learning with employability skills and training.
4. To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Course Content:

Unit- I: Vocabulary Building

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.

Unit-II: Basic Writing Skills

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

Unit- III: Identifying Common Errors in Writing

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies

Unit- IV: Nature and Style of sensible Writing

Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion.

Unit- V: Writing Practices

Comprehension, Précis Writing, Essay Writing

Unit-V: Oral Communication (This unit involves interactive practice

Sessions in Language Lab)

Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations

Text/Reference Books:

1. Communication Skills in English (with Lab Manual), Anjana Tiwari, Khanna Book Publishing Co., 2023.

2. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.

3. Practical English Usage. Michael Swan. OUP. 1995.

4. Remedial English Grammar. F.T. Wood. Macmillan.2007

5. On Writing Well. William Zinsser. Harper Resource Book. 2001

6. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

7. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011. 8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Course Outcomes: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

PO :

PO1: Demonstrate effective communication in English across speaking, listening, reading, and writing.

PO2: Apply language skills in professional and academic contexts.

PO3: Integrate language learning with soft skills and workplace readiness.

PO4: Work effectively in teams through group tasks and presentations.

PO5: Develop confidence in public speaking and formal interactions.

UNDERSTANDING INDIA

Course code: VAC101 **Total Marks:** 50 **Credits:** 2

UNIT I: Introducing India (2 lectures)

I. The Land of India: landscape, mountains and rivers

II. The People of India: demography and languages

III. The Name of our Country: Jambudvipa, Sindhu (Indus), Inde, Hind, Hindustan, Bharat India

UNIT II: The Heritage of India: Unity in Diversity (10 lectures)

I. **Architecture and Sculpture**: Indus Valley town planning, rock cut architecture, major Styles of temples, Mughal architecture, modern and contemporary architecture, stone and metal sculpture

II. **Painting:** Ajanta murals, Mughal paintings, Madhubani paintings, paintings of Jharkhand (Kohbar, Sohrai, Jadopatia, etc.).

III. **Music and Dance:** Overview of various forms of music and dances in India; Chau dance Of Jharkhand and Odisha

IV. **Science, Technology and Medicine**: A general survey of the progress of science, technology and medicine in ancient India

UNIT III: The Knowledge System of India (4 lectures)

I. Traditional Knowledge System: Gurukuls, Pathsalas, Tols, Maktabs, Madrasas

II. Beginnings of Modern Education: Main features of British Government's educational policies

III. Growth of higher and technical education in India

UNIT IV: The Indian Economy (4 lectures)

I. Features of the Indian economy from past to present (agriculture, industry and trade)

UNIT V: The Making of Contemporary India (10 lectures)

I. The struggle for Independence (1885-1947)

II. Framing of the Indian Constitution; Fundamental Rights and Duties

III. India's Foreign Policy: Main Elements (Non Alignment, Panchsheel)

IV. Panchayati Raj in India with special reference to PESA in Jharkhand

Suggested Readings

NCERT, classes 6-12 books on History, Political Science, Economics, Geography etc.

A. L. Basham, *A Cultural History of India*, Oxford University Press, 1997

A.L. Basham, *A Wonder that was India*, Rupa, New Delhi, 1994

B.C. Deva, *Indian Music*, ICCR, 1976

Braj, B. Kachru, et.al., Languages in South Asia, Cambridge University Press, 2013

Hemant, *Jharkhand*, Prakashan Sansthan, New Delhi, 2008

Herman Kulke and Deitmar Rothermund, *A History of India*, Taylor and Francis, 2016

Krishna Chaitanya, *A Profile of Indian Culture*, The Indian Book Company, New Delhi, 1976

N.R. Ray, *An Approach to Indian Art*, Publication Bureau, Chandigarh, 1974

R.S. Sharma, *India's Ancient Past*, Oxford University Press, 2020

R.C. Majumdar (ed.), *History and Culture of Indian People* (Relevant Volumes and Chapters), Bhartiya Vidya Bhawan, Bombay.

S.C. Ghosh, *History of Education in Modern India, 1758-1986*, Orient Longman, Hyderabad, 1995

Romila Thapar, *The Prnguin History of Early India: From the Origins to AD 1300*, Penguin India, 20031

Tirthankar Ray, *The Economic History of India 1857-1947*, OUP, 2006

Vijay Joshi and I.M.D. Little, *India's Economic Reforms, 1991-2001*, OUP, 1996

IKS (INDIAN KNOWLEDGE SYSTEM)

BASIC TO INDIAN KNOWLEDGE

Course code: VAC101 **Total Marks:**50 **Credits:** 2

Learning Objectives:

1. To make student aware of the trajectories of historical and cultural development of India and the making of unity in diversity

2. To understand the major forms and phases of freedom struggle

3. To make student aware of the major contributors to our struggle for independence

4. To familiarize students with the process of constitutional developments and its emergence as one of the largest democratic state in the world

5. To make student aware of the major contributions of India to world civilization in the field of science and technology

UNIT-I (Ancient Era) **(12 lectures)**

I. *Bharatavarsha:* concept and its evolution: Vedic, Epic and Puranic traditions and the making of Modern India

II. State and Imperial formation: Rise of Janapadas, The Mauryas, the Kushanas, the Guptas, Pallava, Cholas and Vijayanagara Empire

III Origin and growth of major religious streams: Vedic, Jainism, Buddhism, Bhakti and Sufism, Brahmo Samaj, Arya Samaj, Religious philosophy of Sri Aurobindo

IV. Development of literary traditions: Panini, Kalidasa, Veda Vyasa, Valmiki

UNIT-II (India's Struggle for freedom) **(09 lectures)**

I. 1857 as the First War of Independence

II. Important heroes of Freedom struggle: Birsa Munda, Bhagat Singh, Chandrasekhar Azad, Subhash Chandra Bose.

III. Formation of Indian National Congress and Contribution of Mahatama Gandhi·

IV. Re-emergence of Swadeshi Movement in India; Flagship Programmes: Jan DhanYojana; Skill·India Mission; Make in India; Atma Nirbhar Bharat.

UNIT-III (India's contribution to the world) **(09 lectures)**

I. Medical science: Charaka, Sushruta;

II. Mathematics and Astronomy: Aryabhatta, Baudhyana, Brahmagupta, Ramanujam,

III. Physics: Kanad, P.C.Ray, Raman

Readings:

• Basu.D. (2012) 'Introduction to the Constitution of lndia'. New Delhi, Lexis Nexis.

• Bhikku, Parekh (I 989). Colonialism, Tradition and Reforms: An Analysis of Gandhi's Political Discourses, New Delhi, Sage Publications.

• Bipan Chandra (I 987). lndia's Struggle for Independence. Penguin, Delhi.

• Dhar, P.K**.** (2000): Growing Dimensions of Indian Economy, Kalayani Publishers. New Delhi.

• Dhingra, I.C (2020).: Indian Economy, Sultan Chand & sons. New Delhi.

• Dutt, R. and Sundharam (2018): Indian Economy, S. Chand & Co. Ltd., New Delhi.

• Gautam A (2009): Advanced Geography of India, Sharda Pustak Bhawan, Allahabad.

• Godschalk, D.R. (et.al.) (1999): Natural Hazard Mitigation Recasting Disaster Policy and Planning, Island Press, Washington, D.C.

• Gore, M. S. (2002) Unity in Diversity: The Indian Experience in Nation-Building. Rawat Publication, Jaipur.

• Government of India, Economic Survey (Annual), Economic Division, Ministry of Finance.

New Delhi.

• K. Roy, C. Saunders and J. Kincaid (2006) (eds.) 'A Global Dialogue on Federalism', Volume) Montreal, Queen's University Press.

• Kabir, Humayun (1946). Our Heritage, National Information and Publications Ltd. Mumbai.

Semester 2

MICROBIOLOGY

Course Code: MJD02 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit-I

Introduction of Microbiology History, Applications & Status of Microbiology in India.

Classification of Microorganisms-General Features, systems of Classification.

Unit-II

Structure and Diversity of Bacteria &; Virus, Microbes in extreme environment. Nutritional requirement of microbes. Bacteriology: Morphology and ultra-structure of bacteria and its morphological types, Archaebacteria.

Unit-III

Various methods of staining: Simple, Gram staining, Endospore staining and capsule staining.

Unit-IV

Microbial growth — mathematical expression of growth, growth curve, factors affecting growth. Quantification of microbial growth. Control of microorganisms- physical & chemical, Evaluation of chemical disinfectants- tube dilution test, agar diffusion test and phenol- coefficient.

Unit-V

Microbial Nutrition and metabolism- Microbial Metabolism- Concept of Anabolism & catabolism processes. Nitrogen Fixation- Types and mechanisms, Microbial disease in plants & Animals (Only General concept). Fermentation Process —Fermenter & its microbes of industrial importance.

Course Outcomes (CLO):

1. Explain the contributions of pioneers in microbiology.
2. Classify microorganisms based on taxonomy, morphology, and genetics.
3. Understand the ultrastructure of bacteria, viruses, fungi, protozoa, and archaea.
4. Explain reproduction methods (binary fission, budding, viral replication).
5. Identify types of media and culture techniques.

Programme Outcomes (POs):

1. Demonstrate a comprehensive understanding of microbial structure, classification, physiology, genetics, and their role in ecosystems, health, and industry.
2. Develop competency in microbiological techniques including aseptic handling, staining, culturing, microbial enumeration, sterilization, and microbial identification.
3. Apply microbiological knowledge in diverse fields such as medicine, agriculture, industry, biotechnology, pharmaceuticals, and environmental sciences.
4. Design and conduct experiments, analyze microbial data, and solve problems related to microbial contamination, disease control, or bioprocess optimization.
5. Develop skills to explore, investigate, and innovate in the field of microbiology using current molecular, biochemical, and computational tools.

Books:

1. Textbook of Microbiology: Prescott
2. Textbook of Microbiology: Pelczar, Pelczar and Chan
3. Textbook of Microbiology: RC Dubey and DK Maheshwari
4. General Microbiology Vol. I and II : Powar and Dhagniwala
5. Experiments in Biotechnology: Nighojkar and Nighojkar

PROGRAMMING IN C

Course code: MID02 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Fundamentals of C: History of Programming language. Identifier and keywords - data types - constants - Variables - Declarations -Expressions - Statements - Arithmetic, Unary, Relational and logical, Assignment and Conditional Operators - Library functions. Simple C programs - Flow of control - if, if-else, while, do-while, for loop, Nested control structures - Switch, break and continue, go to statements - Comma operator.

Functions -Definition - prototypes –types-Passing arguments–Recursion and its types- Storage Classes - Automatic, External, Static, Global and Register Variables.

Arrays - Defining and Processing - Passing arrays to functions - Multi-dimension arrays - Arraysand Strings.

Structures and unions - User defined data types - Passing structures to functions - Self- referential structures - Unions - Bit wise operations.

Pointers - Declarations - Passing pointers to Functions - Operation on Pointers - Pointer and Arrays.

Files: File Handling in C Using File Pointers, Open a file using the function fopen ( ), Close a fileusing the function fclose ( ), Input and Output using file pointers, Character Input and Output in Files, String Input / Output Functions, Formatted Input / Output Functions, Block Input / Output Functions, Sequential Vs Random Access Files, Positioning the File Pointer.

Text Book:

1. E. BalaguruSwamy - ANSI C Programming Language, 2nd Edition, PHI, 1988.
2. Kanetkar Y., Let us C, BPB Pub., New Delhi, 1999.
3. ReemaThareja - Programming in C

Reference Book:

1. H. Schildt, C: The Complete Reference, 4th Edition, TMH Edition, 2000.
2. Byron Gotlfried – C Programming; Oxford University Press

IMMUNOLOGY

Course code: MLD02 **Total Marks:** 75 **Credits:** 3

Unit I:

Immunity: Introduction. Cells of immune system. Cells and organs of Immune system (Primary and Secondary Lymphoid organs), Haematopoiesis.

Unit II:

Types of Immunity – Innate and acquired. Basic properties of antigens. B and T cell epitopes, haptens, and adjuvants. Structure, function and types of an antibody.

Unit III:

Monoclonal antibodies and their production. Antigen-antibody interactions as tools for research and diagnosis. T-Cell and B-Cell activation. Humoral and Cell mediated immunity.

Unit IV:

Structure and functions of major histocompatibility complex. Basic properties and functions of Cytokines. Elementary idea of Complement system. Interferon: Definition and uses

Unit V:

Basic idea of Hypersentivity. Concept of Autoimmunity. Immunodeficiency: AIIDS Introduction to Vaccines and types of Vaccines.

Course Outcomes (CLO):

1. Explain the structure and function of immune organs, cells, and molecules.
2. Distinguish between innate and adaptive immunity.
3. Explain antigen processing and presentation, lymphocyte activation, and cytokine signaling.
4. Understand humoral and cell-mediated immune responses.
5. Understand antibody diversity, isotypes, and the structure-function relationship of antibodies.

Programme Outcomes (POs):

1. Gain in-depth understanding of immune system components, functions, and mechanisms, including innate and adaptive immunity.
2. Explore how the immune system defends against pathogens, and understand mechanisms of disease progression, immune evasion, and immune defence.
3. Apply immunological principles in understanding autoimmunity, hypersensitivity, immunodeficiency, organ transplantation, cancer immunology, and vaccine development.
4. Analyse experimental data, design immunological experiments, interpret diagnostic test results, and evaluate immune responses in health and disease.
5. Foster scientific inquiry into immune-related problems and explore emerging research in areas such as monoclonal antibodies, immunotherapies, and immunogenomics.

References:

1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.

2. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing.

Biotechnology Laboratory Techniques – II

Course code: SEC02 **Total Marks:** 100 (IA 25+EA75) **Credits:** 3

1. Microscopic Examination of Bacteria, Yeasts, and Fungi
2. Bacterial Motility Assay
3. Simple Staining of Bacteria
4. Gram Staining Procedure
5. Preparation of Solid, Liquid, and Semi-Solid Media
6. Techniques for Inoculation
7. Isolation and Maintenance of Pure Bacterial Cultures
8. Enrichment Culture Techniques
9. Microbial Growth Curve Analysis

ENVIRONMENTAL STUDIES

Course Code: VAC01 **Marks:** 50 **Credits:** 2

Unit I

Scope – Branches of ecology – Abiotic factors – water – soil – temperature – light. Biotic factors – Animal relationship – symbiosis – commensalisms – mutalism –Antagonism – Parasitism – Predation – competition.

Unit II

Ecosystem –Definition –structure – pond ecosystem – primary production –secondary production – food chain – food web – trophic levels – energy flow – pyramid of biomass– pyramid of energy. Biogeochemical cycle: Nitrogen and Phosphorous.

Unit III

Pollution – types – sources – effects – Air-water – land – Noise – Thermal – Pesticide – Radioactive – greenhouse effect, ozone and its importance – global warming – Acid rain– Bio accumulation – Bio magnification.

Unit IV

Water management and wastewater treatment: Water as a scarce natural resource, water management including rainwater harvesting. Wastewater characteristics, waste water treatment-physical, chemical, biological processes. Aerobic processes; and; anaerobic processes.

Course Learning Outcomes (CLOs):

1. Explain key ecological concepts (abiotic/biotic factors, ecosystems, and pollution types) and their environmental significance.
2. Analyze energy flow in ecosystems (food chains, pyramids) and biogeochemical cycles (N, P) using case studies.
3. Evaluate the causes, effects, and mitigation strategies for air, water, noise, and thermal pollution.
4. Propose solutions for water scarcity and wastewater treatment (e.g., rainwater harvesting, aerobic/anaerobic processes).

Programme Outcomes (POs):

1. Demonstrate understanding of ecological principles and human impacts on ecosystems.
2. Apply knowledge of resource management (water, waste) to sustainable practices.
3. Interpret data on pollution and ecosystem dynamics to assess environmental health.

References:

1. Anderson L and Tilman D A. (1997) Fuels from waste, Academic Press.
2. Christon, J. Harst (1997) Manual of Environmental Microbiology, ASM Press, Washington DC

AWARENESS MODULES

Course Title: Awareness of Civic Education

Course Code: IKS 02 **Full Marks:** **50 Credits: 02**

(Internal Assessment)

Internal Assessment (50marks)

1. The student evaluation consists of two tests and a set of out-of-class activities. There is no final end semester examination in this course.

2. Tests: Each test will consist of 05 multiple-choice questions consisting 01 mark each and 02 short questions (2-3 sentence responses). The first test will be conducted after Part 1 of the course. The second test will be conducted after Part 2 of the course.

1. Out of class–activities: Each of the 10 activities specified in the syllabus will receive full marks if turned in. Usual deliverable is a short report. Each activity will count the same.

2. The elements of evaluation will carry the following weights in computing the final course grade: Test 1: 10 marks; test 2: 15 marks; Out of class activities: 25 marks.

Course Learning Outcomes

The course is designed:

1. To develop the students' awareness of the challenges society faces today.

2. To improve students' knowledge and skills to navigate such challenges, including those related to gender and women empowerment, road safety, water, sanitation and hygiene, and environmental sustainability..

3. To increase awareness about problems associated with drug addiction.

4. To discuss approaches about how to manage such risks.

5. To increase awareness about other addictions and risky behaviours that can affect youth, including social media and gambling addiction.

6. To encourage students to actively learn about topics by participating in out - of –class activities tied closely to the theory covered in the class.

Course Contents Theory: 20 periods of 01 hour each, Activities: 10 periods of 02 hours each.

PART 1

UNIT I:

General Social Awareness (05 Lectures + 04 Activities+01 Assessment)

1. Introduction
2. Gender and Women Empowerment
3. Activity: Survey to understand challenges faced by working women
4. Road Safety
5. Activity: Road safety report using information from news articles
6. Water, Sanitation & Hygiene (WASH)
7. Activity: Effectiveness of government programs in addressing WASH challenges
8. Environmental Sustainability
9. Activity: Environmental Sustainability policies and their compliance
10. *Internal Assessment test – I (10 Marks*

PART2

UNIT II:

Understanding Drug Abuse and Addiction
(4 Lectures+ l Activity)

I. Concepts and overview of drug abuse
2. Physical and psychological dependence
3. Signs and symptoms of drug abuse
4. Commonly abused drugs and their effects
5. Activity: Summarize 2 recent news articles about drug-related problems in Jharkhand

Unit III:
Causes and Consequences of Drug Abuse
(4 Lectures+ 1 Activity)

I. Causes of drug abuse
2. Risks and consequences of drug abuse

3. Identifying and understanding drug abuse in youth - I

4. Identifying and understanding drug abuse in youth - 2

5. Activity: Watch the assigned video on drug abuse in youth and extract main 3 lessons

Unit IV:

Management and Prevention Strategies (3 Lectures+ 2 Activities)

I. Management of drug abuse
2. Activity: Familiarize yourself with resources for drug abuse prevention

3. Prevention of drug abuse

4. Stories of recovery

5. Activity: Design anti-drug poster or slogan aimed at prevention

Unit V: Other Addictions and Risky Behaviour

(2 Lectures+ 2 Activities+ l Assessment)

1. Social media and phone addiction.
2. Activity: Review usage statistics from own phone or that of friend or relative; count number of times friend or relative checks phone per day
3. Gambling addiction
4. Activity: Watch assigned video on gambling risk
5. Internal Assessment Test-2 (15 marks)

Reference Books:

1. l. Baluja, Ramesh. 2022. Road Traffic Legislation- India. New Delhi: Institute of Road Traffic Education.
2. Bandyopadhyay, Arnab, Jan Erik Nora, Dipan Bose, Krishnan Srinivasan, John Henry Faber Woodrooffe, Nitika Suri, and Anthony G. Bliss. 2020. Delivering Road Safely in India:
3. Leadership Priorities and Initiatives to 2030. Washington, DC: World Bank Group.
4. Ghuman. Ranjit Singh. Jatindcr Singh, and Gurindcr Kaur. 2023. Dynamics of Drug Addiction and Abuse in India. New Delhi: Routledge India.
5. Mehta, Balwant, and L C. Awasthi. 2019. Women and labour Markel Dynamics: New insights and Evidences. Singapore: Springer Nature.
6. Nath, KallolJit, and Yeerappan P. Sharma, ed. 2017. Water and Sanitation in the New Millennium. New Delhi: Springer India.
7. Rajagopalan, Raghavachari.2015. Environme111al Studies: From Crisis to Cure. 3rd ed. New Delhi: Oxford University Press.
8. Sen, Arun Kumar. 1999. Drug Abuse and Youth. New Delhi: Gyan Publishing House.
9. Sharma, Rajeev, and Yogita Bansal. 2017. Drug Abuse: Problem. Management and Prevention. New Delhi: RD Publications.
10. United Nations Office on Drugs and Crime: 2024. World Drug Report 2024. New York: United Nations.
11. World Bank, 2023. Global Water Security and Sanitation Partnership: Annual Report 2023. Washington, DC: World Bank.

SEMESTER 3

MOLECULAR BIOLOGY

Course code: MJDBT303 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit I

Nucleic acid: Sugars and bases. Watson Crick model of DNA. Difference between A, B and Z type of DNA. Denaturation of DNA strands

Unit II:

Ribonucleic acid: Sugars and bases. Structures of RNA. Different types of RNA. RNA as catalyst: Ribozyme

Unit III:

Double helical structure of DNA. Eukaryotic DNA packaging. Establishment of DNA as genetic material. Different types of enzymes involved in DNA replication

Unit IV:

Replication in prokaryotes. Transcription in prokaryotes. Genetic code: Wobble hypothesis, Translation in Prokaryotes

Unit V:

Concepts of Operon (Positive and Negative, Inducible and Repressible). Lac Operon and its mechanism. Trp Operon and its regulation.

Course Outcomes (CLO):

1. Understand the chemical nature of DNA, RNA, and proteins.
2. Describe the central dogma of molecular biology.
3. Compare mechanisms across domains of life.
4. Identify key enzymes and regulatory proteins involved.
5. Explain control mechanisms like the lac operon and trp operon.

Programme Outcomes (POs):

1. Acquire a strong conceptual foundation in the molecular mechanisms that govern the structure, function, and regulation of biological macromolecules.

2. Interpret and analyze molecular data, design experiments, and troubleshoot protocols in a research or diagnostic setting.

3. Apply molecular biology concepts in areas such as genetic engineering, disease diagnostics, biotechnology, and pharmaceuticals.

4. Demonstrate ethical conduct in genetic research and understand the societal implications of technologies like gene therapy, cloning, and GMOs.

5. Encourage scientific inquiry and innovation by formulating hypotheses and conducting molecular biology experiments with precision.

References:

1. De Robertis- Cell and Molecular Biology

2. Alberts et al.: Molecular Biology of the cell. Garland Publ., New York.

BIOCHEMISTRY

Course code: MJDBT304 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit I

Carbohydrates: Classification of carbohydrates, Occurrence and structure of mono, di and polysaccharides (homo and heteropolysaccharides), asymmetry, stereo-isomerism and optical isomerism of sugars, anomeric form and mutarotation. Biological importance of carbohydrates (starch, cellulose, chitin).

Unit II:

Classification, structure and Properties of amino acids, Essential and non-essential amino acids, peptide bond and chemical bonds involved in protein structure - Protein classification based on solubility, shape, composition and function, Structure of proteins (Primary, secondary tertiary and quaternary), Biologically important peptides (insulin).

Unit III:

Classification, nomenclatures, structure and functions of Simple, Compound and Derived lipids, Structure and functions of fatty acids (Essential Fatty Acids), Tri-acyl glycerol, phospholipids, sphingolipids, Glycolipids and Gangliosides. Biological importance of lipids (PUFA)

Unit IV:

Vitamins: Classification of vitamins. Fat soluble vitamins and their functions. Water soluble vitamins and their functions. Diseases associated with the deficiency of vitamins

Unit V:

Structure, Properties and types of nucleic acid, Composition of DNA and RNA -Watson and Crick model of DNA, Structure of purines and pyrimidines, Structure of Nucleosides and Nucleotides. Structural forms of DNA, Biological importance of Nucleic acids.

Course Learning Outcomes (CLO):

1. Classify and describe the structures of carbohydrates, amino acids, proteins, lipids, and nucleic acids. 2.
2. Identify and explain the structural levels of proteins and their biological significance.
3. Classify different lipids and understand their structures and biological functions.
4. Describe the structure, types, and properties of nucleic acids, understanding their significance in genetics.
5. Vitamins and their biological importance

Programme Outcomes (POs):

1. Apply critical thinking and problem-solving skills to investigate and solve biochemical and biomedical problems, including metabolic disorders, enzyme deficiencies, and genetic mutations.
2. Perform standard biochemical laboratory techniques with accuracy and safety, and maintain proper laboratory records and documentation.
3. Integrate concepts from biology, chemistry, physics, and computational sciences to understand complex biological systems at the molecular level.
4. Demonstrate ethical conduct in scientific research and professional practices, including honesty in data handling, respect for life, and awareness of biosafety and bioethics.
5. Communicate scientific information clearly and effectively through written reports, oral presentations, and digital platforms for both academic and non-academic audiences.

References:

1. Harper Biochemistry. McGraw- Hill Publication.

2. Lehninger, A.L., Nelson, D.L. & Cox, M.M. Principles of Biochemistry. CBSD Publishers & Distributors, Delhi.

DATA STRUCTURE USING C

Course code: ELBT301 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Primitive and Composite Data Types, Time and Space Complexity of Algorithms, Stack and Primitive Operation on Stack. Applications- Infix, Postfix, Prefix and Recursion. Queues, Primitive Operations on Queues, Circular Queue, De Queue and Priority Queue.

Linked List: Basic Operation on Linked List, Circular Linked List, Doubly Linked List, Linked Representation of Stack and Queue, Application of Linked List.

Trees: Basic Terminology, Binary Trees, Tree Representation as Array and Linked List, Basic Operation on Binary Tree, Traversal of Binary Tree – In Order, Preorder, Post Order, Application of Binary Tree, Threaded Binary Tree, B-Tree and Height Balance Tree(AVL).

Sorting & Searching: Sequential Search, Binary Search, Insertion Sort, Selection Sort, Quick Sort, Bubble Sort, Heap Sort, and Comparison of Sorting Methods.

Graph: Introduction to Graphs, Definition, Terminology, Directed, Undirected, Weighted Graph, Representation of Graphs, Graph Traversal – Depth First and Breadth First, Spanning Trees, Minimum Spanning Trees, Shortest Path Algorithm.

Text Book:

1. Expert Data Structure with 'C' By R.B Patel (Khanna Book Publishing Co.(P))
2. Data structure By Lipschutz (Tata McGraw Hill)
3. Data Structure By YashvantKanitkar (BPB)

Reference Book:

1. An Introduction to Data Structures with Applications, By Jean-Paul Tremblay, Paul G.Sarerson (Tata McGraw Hill)
2. Data Structure Using C and C++ By Yedidyahlangsam, Moshe J.Augenstein, Arora M. Tenenbaum (Prentice- Hall India)

ANIMAL PHYSIOLOGY

Course code: MLDBT303 **Total Marks:** 75 **Credits:** 3

Unit-I

Digestion: Definition and types (extra and intracellular digestion); Digestion, absorption and assimilation of Carbohydrates.

Unit-II

Respiration: Definition of Respiration and Respiratory mechanisms – External, Internal and cellular. Respiratory Pigments; Transport of oxygen, Oxygen dissociation curves. Bohr's effect

Unit-III

Circulation: Types of circulation - Open and Closed circulation; Blood and its types and function

Unit-IV

Excretion: Definition; Classification (Ammoniotelic, Uricotelic, Ureotelic), Structure and function of Nephron

Unit-V

Endocrine System: Endocrine glands - Structure, secretions and functions of Pituitary, Thyroid, Parathyroid, Adrenal glands and Pancreas.

Course Outcomes (CLO):

1. Describe the organization and physiological roles of the circulatory, respiratory, digestive, excretory, nervous, endocrine, and reproductive systems.
2. Understand how feedback systems regulate temperature, pH, ion balance, and water balance in animals.
3. Discuss gas exchange, transport of respiratory gases, cardiac cycle, blood pressure regulation, and heart function in vertebrates.
4. Explain the role of digestive enzymes, hormones, and nutrient absorption in vertebrates.
5. Discuss energy production pathways and metabolic regulation.

Programme Outcomes (POs):

1. Gain in-depth knowledge of the structural and functional aspects of various physiological systems in vertebrates and invertebrates, including digestion, respiration, circulation, excretion, nervous coordination, and reproduction.

2. Understand the interrelationship between anatomy and physiology and how different organ systems work together to maintain homeostasis and survival.

3. Develop hands-on skills in conducting physiological experiments, collecting and analysing biological data, and interpreting normal and altered physiological states.

4. Relate physiological principles to human and veterinary health, including mechanisms of diseases, clinical symptoms, and therapeutic interventions.

5. Foster a scientific approach to studying life processes, formulating hypotheses, designing experiments, and analysing results in the field of comparative and human physiology.

Books:

1. Hughes, G.M. Comparative Physiology of vertebrate respiration (1963) Cambridge.

2. Guyton and Hall (2001) text book of medical physiology.

3. Schmidt –Neilson, K (2002) Animal physiology, Adaptation and environment

4. Cell and Molecular Biology: P.K. Gupta

5. Websteir, R. Neurotransmitters , drugs and brain function.

Biotechnology Laboratory Techniques – III

Course code: SEC303 **Total Marks:** 75 **Credits:** 3

1. Conducting agarose gel electrophoresis for DNA.
2. Executing Poly Acrylamide Gel Electrophoresis for proteins.
3. Staining SDS-PAGE gels using Coomassie Brilliant Blue and silver staining methods.
4. Utilizing column chromatography for separation.
5. Implementing thin-layer chromatography.
6. Estimating nucleic acid content via colorimetric methods.
7. Isolating DNA from prokaryotes like E. coli.
8. Principles and working knowledge of instruments like Colorimeter, pH meter, Centrifuge, Spectrophotometer, Microscope etc.
9. Qualitative analysis of Carbohydrates, Proteins and Lipids.
10. Quantitative estimation of Protein by Folin-Lowry method.
11. Quantitative estimation of sugar by Nelson Smogyi's method.
12. Determination of enzyme activity by amylase.
13. Study the effect of pH on enzyme activity.

Semester 4

BIOINSTRUMENTATION

Course code: MJDBT405 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit-I:

Microscopy: Light, phase contrast, dark - field fluorescence. Electron microscopy -transmission and scanning electron microscopy.

Unit-II:

Separation techniques and instrumentation: Paper Chromatography. Thin layer Chromatography, Ion exchange chromatography, Gel filtration chromatography, HPLC and Gas chromatography.

Unit-III:

Separation techniques and instrumentation: Electrophoresis and electro focusing, SDS- PAGE, 2-D Gel Electrophoresis; Centrifugation- types and functions.

Unit-IV:

Spectroscopy: UV-Visible spectroscopy, Infrared spectroscopy, NMR spectroscopy, Flow cytometry and FISH.

Unit-V:

Radioisotopes and tracer techniques: Definition, properties of radioisotopes. Units of measurement of radioactivity. Autoradiography and its utility. Radioimmunoassay, radiometric enzyme assays. Liquid scintillation counters.

Course Outcomes (CLO):

1. Grasp intricate working principal of microscopy.
2. Spectroscopy techniques for precise biomolecule analysis. - Proficiently employ chromatography methods for effective biomolecule separation
3. Knowledge abbot separation techniques of DNA and RNA.
4. Working knowledge about radioactivity.
5. Skilfully apply advanced bio-physical techniques for accurate structure prediction Grasp intricate water properties, pH, and acid-base theories thoroughly.

Programme Outcomes (POs):

1. Gain comprehensive knowledge of the physical, chemical, and biological principles underlying various analytical techniques used in biological research and diagnostics.
2. Develop practical skills in operating key instruments such as spectrophotometers, centrifuges, chromatography systems, electrophoresis units, and microscopes.
3. Apply analytical tools to investigate biomolecules (DNA, RNA, proteins, metabolites) and solve biological problems in molecular biology, genetics, and biochemistry.
4. Interpret experimental results, including quantitative and qualitative analysis of biological samples, and understand error analysis and calibration techniques.
5. Design and implement experimental protocols using appropriate analytical methods, contributing to research in biotechnology, medicine, and environmental biology.

References:

1. Robert Brown. Introduction to instrumental analysis. McGraw Hill International Editions.

GENETIC ENGINEERING

Course code: MJDBT406 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT -I

History and basic steps involved in genetic engineering, Enzymes involved in genetic engineering (Nucleases, Restriction enzymes and their types, DNA ligases and ligation, Kinases, Phosphatases, Reverse transcriptase, Deoxynucleotidyl transferases, DNA polymerase), Restriction mapping.

UNIT -II

Basic design of cloning vectors - plasmid (pBR322 and pUC 18/19), cosmids, phage vectors (lambda and M13), phagemid. Expression of cloned genes - general features of an expression vector, expression of eukaryotic gene in prokaryotes - advantages and limitations.

UNIT -III

Gene transfer techniques - physical (Electroporation, microinjection and biolistic transformation), chemical ($CaCl_2$ mediated transformation and Lipofection), transduction. Selection of recombinants - blue and white screening and plus and minus screening.

UNIT -IV

Construction of genomic and cDNA library, PCR- steps involved, Guidelines for PCR primer designing, variants of PCR (multiplex, nested, quantitative real time, RT- PCR), applications and limitations. Blotting - southern, northern and western blotting; Nucleic acid and immuno probes.

UNIT -V

Manipulation of gene sequences by random mutations and site directed mutagenesis, Applications of Genetic engineering in industry, medicine and agriculture. Bioethics and Biosafety.

Course Outcomes (CLO):

1. Apply landmark discoveries to develop molecular techniques in rDNA technology.

2. Select suitable hosts for specific vectors in diverse applications. Utilize restriction enzymes and other tools for genetic manipulations.

3. Conduct PCR applications and gene expression experiments for research purposes.

4. Understand the ethical and safety considerations in genetic engineering applications.

5. Application in pharmaceuticals industry

Programme Outcomes (POs):

1. Apply genetic engineering tools in fields such as agriculture (GMOs), medicine (gene therapy), pharmaceuticals (recombinant proteins), and environmental biotechnology.
2. Analyse and troubleshoot gene cloning experiments, construct gene maps, and evaluate expression systems and recombinant protein production strategies.
3. Design and execute gene modification experiments, formulate scientific questions, and contribute to innovations in genomics, synthetic biology, and gene therapy.
4. Demonstrate awareness of ethical issues and biosafety guidelines in handling recombinant organisms and genetic modification technologies.
5. Work effectively in interdisciplinary teams across molecular biology, bioinformatics, and applied biotechnology sectors.

Reference Books:

1. Primrose, S.B., & Twyman, R. (2006). Principles of Gene Manipulation and Genomics (7th ed.). Wiley-Blackwell.

2. Brown, T.A. (2010). Gene Cloning and DNA Analysis: An Introduction (6th ed.). Wiley.

PLANT PHYSIOLOGY

Course code: MJDBT407 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit-I

Plant water relations, Diffusion, Osmosis, Water transport mechanisms, Transpiration and Stomatal physiology.

Unit-II

Minerals Nutrition in plants: types and function and deficiency disease.

Unit-III

Photosynthesis and General concept of photosynthesis, photosynthesis pigment, C2, Calvin cycle, C4 cycle and CAM pathway.

Unit-IV

Respiration: Photo oxidation of water, glycolysis, TCA cycle and ATP synthesis.

Unit-V

Plant growth regulators: Definition, Types (Auxins, Cytokinins, Gibberellin's, Ethylene & ABA) and Application.

Course Outcomes (CLO):

1. Explain water absorption, transpiration, and the ascent of sap.
2. Understand osmotic relations and water potential in plant systems.
3. Identify essential macro- and micronutrients.
4. Understand active and passive transport mechanisms in plants.
5. Describe light and dark reactions, photorespiration, and C3/C4/CAM pathways.

Programme Outcomes (POs):

1. Gain in-depth understanding of plant physiological processes such as water relations, mineral nutrition, photosynthesis, respiration, and growth regulation.
2. Apply physiological knowledge to real-world issues like crop productivity, drought resistance, and nutrient management in agriculture and horticulture.

3. Develop skills to design, conduct, and interpret experiments related to plant water status, enzyme activity, photosynthesis, transpiration, and other physiological functions.
4. Operate scientific equipment and techniques relevant to plant physiological studies (e.g., spectrophotometry, respirometry, osmometry).
5. Understand how plant physiological mechanisms contribute to sustainable agriculture, climate change adaptation, and ecosystem health.

Books:

1. Textbook of plant pathology Agrios, Academic Press London.
2. Plant physiology, Delvin, Yan Nostrand Reinhold comp. New York.
3. Textbook of various adaptation of plants, Jones A.D And willbins.
4. Lyndon, R.F 1990 Plant development, The cellular basis
5. Tayal M.S 1996 Plant anatomy. Rastogi publication, Meerut.

OBJECT ORIENTED PROGRAMMING USING JAVA

Course code: ELBT402 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Introduction to java: evolution, features, comparison with C and C++; Java program structure; tokens, keywords, constants, variables, data types, type casting, statements, Operators and Expression; Conditional Statements and Loop Statements.

Class: syntax, instance variable, class variables, methods, constructors, overloading of constructors and methods. Arrays, Strings and Vectors.

Inheritance: types of inheritance, use of super, method overriding, final class, abstract class, wrapper classes. Interface, Packages and visibility controls.

Errors and Exceptions: Types of errors, Exception classes, Exception handling in java, use of try, catch, finally, throw and throws. Taking user input, Command line arguments. **Multithreaded Programming:** Creating Threads, Life cycle of thread, Thread priority, Thread synchronization, Inter-thread communication, implementing the Runnable Interface;

Applet: Applet Life Cycle, Applet Tag, Adding Applet to HTML File; Passing Parameters to Applets, Getting Input From User. **AWT :** AWT Classes, Working With Frame Windows, Working With Graphics, Working With Colour, Adding And Removing Controls, Responding To Controls, Labels, Buttons, Checkbox, Checkbox Group, Choice Control, Lists, Text Field, Text Area. Menus, Dialog Box, Handling Events.

Text Book:

1. Java: A Beginner's Guide, Sixth Edition: A Beginner's Guide by Herbert Schildt, McGraw-Hill Osborne Media
2. Programming in JAVA By E. Balagurusamy (TMH)
3. JAVA 2 programming Black Book By Steven Holzner et al. (Dreamtech Press)

Reference Book:

1. The Complete reference Java Ninth Edition By Herbert Schildt (Tata McGraw Hill)
   Core Java Volume I--Fundamentals (9th Edition) by Cay S. Horstmann, Gary Cornell, Prentice Hall

VALUE ADDED COURSES

Health and wellness,

Course code: ELBT402 **Total Marks:** 50 **Credits:** 2

Course Objectives:

I. To help understand the importance of a healthy Lifestyle

2. To familiarize students about physical and mental health

3. To create awareness of various life style related diseases

4. To provide understanding of stress management

Unit I. Introduction to Health & Wellness

Define and differentiate health and wellness. Importance of health and wellness Education. Local, demographic, societal issues and factors affecting health and wellness. Diet and nutrition for health & wellness. Essential components of balance diet for healthy living with specific reference to the role of carbohydrates, proteins, fats, vitamins & minerals. Processed foods and unhealthy eating habits.

Unit II. Deficiencies & Diseases

Malnutrition, under nutrition and over nutrition. Body systems and common diseases. Sedentary lifestyle and its risk of disease. Stress, anxiety, and depression. Factors affecting mental health. Identification of suicidal tendencies. Healthy foods for prevention and progression cancer. Hypertension, Cardiovascular, and metabolic diseases (Obesity, Diabetes. Polycystic Ovarian Syndrome). Modern life style and hypo-kinetic diseases prevention and management through exercise.

Unit III. Management of Health and Wellness

Substance abuse (Drugs, Cigarette, Alcohol), de-addiction, counseling and rehabilitation. Types of Physical Fitness and its Health benefits. Postural deformities and corrective measures. Spirituality and mental health. Role of Yoga, asanas and meditation in maintaining health and wellness. Role of sleep in maintenance of physical and mental health.

Suggested Books:

1. Physical Activity and Health by Claude Bouchard, Steven N. Blair. William L. Haskell.

2. Mental Health Workbook by Emily Attached & Marzia Fernandez, 2021.

3. Mental Health Workbook for Women: Exercise to Transform Negative Thoughts and Improve Well-Being by Nashay Lorick. 2022.

4. Lifestyle Diseases: Lifestyle Disease Management. by C. Nyambichu & Jeff Lumiri. 2018.

5. Physical Activity and Mental Health by Angela Clow & Sarah Edmunds. 2013.

Semester 5

GENETICS

Course code: MJDBT 508 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit I:

Elements of heredity & variation. Mendel's laws of inheritance, Monohybrid and dihybrid cross, their significance and current status. Gene interaction: Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy Pedigree analysis

Unit II:

Environmental effects on phenotypic expression of the organisms. Multiple Alleles: Coat Colour in mice, ABO Blood group in man, Rh factor Linkage and crossing over: Cytological basis of crossing over, Molecular mechanism of crossing over. Recombination: Types and significance

Unit III:

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy. Gene mutations: Induced versus Spontaneous mutations. Molecular basis of Mutations. Mutagens and its types

Unit IV:

Chromosome theory in sex determination. Genic balance theory of sex determination, X/A ratio in Drosophila. Chromosomal mechanisms of sex determination in mammals, Grasshoppers, birds and Man. Variation in chromosomal number; haploid, diploid, polyploidy, aneuploidy.

Unit V

Genetic disorder in Human beings (Down's, Turner's, Klinefelter's). Transposons in bacteria Ac-Ds elements in maize and P elements in Drosophila. Transposons in humans

Course Outcomes (CLO):

1. Understand the principles of classical and molecular genetics, including Mendelian laws, chromosomal theory of inheritance, and genetic linkage.
2. Describe the structure, function, and replication of DNA and RNA, gene expression, regulation, and the flow of genetic information.
3. Apply knowledge of genetic mapping techniques and analyse the impact of mutations on gene function and phenotype.
4. Gain hands-on knowledge of modern genetic tools such as PCR, gel electrophoresis, gene cloning, and sequencing used in genetic analysis.
5. Understand the genetic structure of populations and the principles governing the inheritance of quantitative traits.

Programme Outcomes (POs):

1. Develop a deep understanding of classical, molecular, microbial, and human genetics to explain the principles of inheritance and gene function.
2. Apply genetic principles and molecular tools to analyse inheritance patterns, gene interactions, mutations, and genetic mapping in various organisms.
3. Demonstrate practical skills in genetic techniques such as DNA extraction, PCR, gene cloning, and electrophoresis, applicable in academic and industrial research.
4. Design and interpret experiments related to genetic analysis, gene expression, and genome organization to solve real-world biological problems.
5. Integrate genetic knowledge with disciplines such as genomics, bioinformatics, biotechnology, and evolutionary biology for advanced scientific understanding.

References:

1. Principles of Genetics – R. H. Tamarin (McGraw Hill)
2. Genetics – M. W. Strickberger (Macmillan)

APPLIED ENVIRONMENTAL BIOTECHNOLOGY

Course code: MJDBT 509 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT I:

Bioremediation & Phytoremediation: Biofeasibility, applications of bioremediation, Bioreduction, Phytoremediation. Solid waste pollution and its management: Current practice of solid waste management, composting systems, vermicomposting, sewage treatment.

UNIT II:

Bioabsorption and Bioleaching of heavy metals: Cadmium, Lead, Mercury, Metal binding targets and organisms, Bioabsorption, Metal microbial interaction, Biomethylation of elements (Methylation of mercury and arsenic), Commercial biosorbants, bioleaching, metal precipitation, advantages and disadvantages of bioleaching.

UNIT III:

Waste water Treatment: Biological treatment system (Oxidative ponds, aerobic and anaerobic ponds, facultative ponds, aerated ponds), Biological waste treatment, activated sludge treatment, microbial pollution in activated sludge, percolating filters, waste water treatment by biofilms. Treatment scheme of Dairy, Distillery, Tannery, Sugar, Fertilizers, Refinery, Chemical and Antibiotic waste.

UNIT IV:

Xenobitics in environment: Biodegradation of Hydrocarbons, Substituted hydrocarbons, Surfactant, Pesticides, Lignin, Tannin, Synthetic dyes, Biotransformation: Oxidation reactions: Cytochrome P450 monooxygenase system, Alcohol and aldehyde dehydrogenases, Peroxidases.

UNIT V:

Reduction reactions: Cytochrome P450 and flavin dependent reactions. Hydrolysis reactions: Carboxyl esterases. Conjugation reactions: Gluthione S transferases. Regulation of biotransformation.

Course Learning Outcome

1. Understand the concepts and applications of bioremediation, phytoremediation, and solid waste management.
2. Explain mechanisms and applications of bioabsorption, biomethylation, and bioleaching for metal detoxification.
3. Analyze wastewater treatment processes and industrial effluent treatment methods using biological systems.
4. Evaluate the microbial degradation and biotransformation of xenobiotics including hydrocarbons and dyes.
5. Demonstrate awareness of environmental sustainability through biological waste treatment approaches.

Programme Outcomes (POs):

1. Engineering knowledge
2. Problem analysis
3. Design/development of solutions
4. Conduct investigations of complex problems
5. Project management and finance

Reference Books

1. "Environmental Biotechnology: Principles and Applications" Authors: **Bruce E. Rittman & Perry L. McCarty**
2. "Bioremediation and Natural Attenuation: Process Fundamentals and Mathematical Models"Authors: **Pedro J. Alvarez & Walter A. Illman**

INTERMEDIARY METABOLISM

Course code: MJDBT510 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT -I

Carbohydrate Metabolism: Glycolysis, Fermentation, Citric acid cycle, Oxidative Phosphorylation & Electron transport chain, Gluconeogenesis

UNIT -II

Amino Acids Metabolism: General aspects of amino acid metabolism, Transamination, Transamidation, Deamination, Uric acid biosynthesis,

UNIT -III

Lipid Metabolism: Biosynthesis of fatty acids - long chain, unsaturated, Triacylglycerols, phospholipids, comparison of fatty acid synthesis and degradation;

UNIT -IV

Nucleic Acid Metabolism: Biosynthesis of purines and pyrimidines, NMP conversion to NTP, Nucleotide degradation, salvage pathways,

UNIT -V

Degradation of purine and pyrimidines to uric acid & urea, nucleotides as regulatory molecules, non-enzymatic transformation of nucleotides & nucleic acids.

Course Learning Outcomes (CLO): Students will be able to

1. Understand carbohydrate metabolism: glycolysis, fermentation, citric acid cycle, oxidative phosphorylation, gluconeogenesis, glycogen metabolism.
2. Analyze amino acid metabolism: transamination, deamination, urea cycle, catabolism, and biosynthesis.
3. Evaluate lipid metabolism: fatty acid biosynthesis, oxidation, ketone bodies, and cholesterol metabolism.
4. Demonstrate comprehension of nucleic acid metabolism: biosynthesis, conversion, degradation, salvage pathways, regulatory roles.
5. **Map** the pathways of carbohydrate metabolism (glycolysis, TCA, PPP, etc.) and **relate** them to energy production/biosynthesis.

Programme Outcomes (POs):

1. Biochemical Knowledge: Master core metabolic pathways and their regulation.
2. Clinical/Biotech Application: Link metabolism to diseases (e.g., diabetes, gout) or bio production.
3. Critical Thinking: Analyze metabolic adaptations (e.g., fasting, exercise).
4. Experimental Design: Propose methods to study metabolic pathways.
5. Interdisciplinary Skills: Connect metabolism to genetics, nutrition, and medicine.

Reference Books:

1. Nelson, D. L., Cox, M. M., & Lehninger, A. L. (2017). Lehninger Principles of Biochemistry (7th Edition). W. H. Freeman.
2. Berg, J. M., Tymoczko, J. L., & Gatto Jr, G. J. (2021). Stryer's Biochemistry (9th Edition). W. H. Freeman.
3. Wilson, K., & Walker, J. (2019). Principles and Techniques of Biochemistry and Molecular Biology (8th Edition). Cambridge University Press.
4. Murray, R. K., Bender, D. A., Botham, K. M., Kennelly, P. J., Rodwell, V. W., & Weil, P. A. (2018). Harper's Illustrated Biochemistry (31st Edition). McGraw-Hill Education.

DATABASE MANAGEMENT SYSTEM

Course code: ELBT503 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Introduction: Characteristics of database approach, Advantages, Database system architecture, Overview of different types of Data Models and data independence, Schemas and instances, Database languages and interfaces; E-R Model : Entities, Attributes, keys, Relationships, Roles, Dependencies, E-R Diagram.

Introduction to Relational model, Constraints: Domain, Key, Entity integrity, Referential integrity; Keys: Primary, Super, Candidate, Foreign; Relational algebra: select, project, union, intersection, cross product, different types of join operations.

SQL: Data Types, statements: select, insert, update, delete, create, alter, drop; views, SQL algebraic operations; Stored procedures: Advantages, Variables, creating and calling procedures, if and case statements, loops, Functions, Triggers.

Normalization: Definition, Functional dependencies and inference rules, 1NF, 2NF, and 3NF; Transactions processing: Definition, desirable properties of transactions, serial and non-serial schedules, concept of serializability, conflict-serializable schedules.

Concurrency Control: Two-phase locking techniques, dealing with Deadlock and starvation, deadlock prevention protocols, basic timestamp ordering algorithm; Overview of database recovery techniques; concept of data warehousing.

Text Book:

1. Database System Concepts By Korth, Silberschatz, Sudarshan (Mcgraw Hill)
2. An Introduction to Database Systems by Bipin C. Desai (Galgotia Publication.)
3. SQL, PL/SQL Programming By Ivan Bayross (BPB)

Reference Book:

Fundamentals of Database Systems, Ramez A. Elmasri, Shamkant Navathe, 5th Ed (Pearson)

SEMESTER 6

PLANT BIOTECHNOLOGY

Course code: MJDBT612 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT I

Introduction and Infrastructure: History and scope of plant tissue culture. Aseptic techniques in preparation, sterilization of glassware, laboratory fumigation, surface disinfection.

UNIT II

General laboratory setup: Significance and importance of laboratory equipment, instruments, glassware and other requirements in plant tissue culture laboratory.

UNIT III

Culture Techniques: Concept of totipotency, Culture media composition with significance and preparation. Culture techniques – callus, suspension, organ culture, Endosperm culture, Protoplast culture: Protoplast isolation, gene transfer in protoplast, fusion, cell wall regeneration & culture.

UNIT IV

Somaclonal variation: Introduction, terminology, origin and mechanism selection at plant level, selection at cellular level. Production of hybrids & cybrids. Micropropagation: through callus and its Stages, auxiliary Branching, Adventitious buds, Factors affecting, limitations & applications of micropropagation.

UNIT V

Organogenesis: somatic embryogenesis, factors affecting somatic embryogenesis. Plant hardening, artificial seed production. Cryopreservation & its advantages.

Course Outcomes (CLO):

1. Molecular markers and marker-assisted selection.
2. Understand traditional and modern plant breeding methods for crop improvement.
3. Develop transgenics resistant to biotic and abiotic stresses, and quality characteristics and understand their role in crop improvement.
4. Evaluate transgenic plants for traits like pest resistance, improved yield, and abiotic stress tolerance.
5. Apply plant biotechnology techniques in crop improvement and bioproduction for enhanced agricultural sustainability and productivity.

Programme Outcomes (POs):

1. Demonstrate a comprehensive understanding of plant tissue culture principles, techniques, and applications in agriculture, horticulture, forestry, and conservation.
2. Acquire hands-on skills in aseptic techniques, media preparation, micropropagation, callus induction, and regeneration protocols.
3. Apply scientific methods and critical thinking to troubleshoot issues in tissue culture experiments, such as contamination or poor regeneration.
4. Design and conduct experiments independently or in teams for the development of novel plant tissue culture techniques and applications.
5. Prepare for roles in commercial plant propagation, biotech firms, and agro-based industries, or to establish a plant tissue culture enterprise.

SUGGESTED READING

1. Introduction to plant tissue culture- M.K. Razdan

2. Plant tissue culture-Theory & practice-S. S. Bhojwani & M.K. Razdan

3. Plant tissue culture-Kalyankumar Dey

4. Biotechnology- B.D. Singh

5. A text book of Biotechnology- R.C. Dubey

ENVIRONMENTAL SCIENCE & BIORESOURCES

Course code: MJDBT613 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT I:

Introduction to environmental Science: Environmental ethics: Environmentalism, Environment & Religion, Environmental education, Need for environmental education. Environmental Pollution: Classification of pollutants, Air pollution and their properties, Gaseous pollutants, water pollutants and their properties. Noise pollution, Soil pollution, thermal pollution, marine pollution, solid water pollution.

UNIT II:

Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes. Biotechnological processes: Bioconversion, Bioaccumulation, Bio concentration, Bio magnification, Biodegradation.

UNIT III:

Energy & Biofuels: Non-conventional or renewable sources of energy, Energy from Biomass, Biofertilizers, Biosensors and biochips, Biofilters, Biofuel cells,

UNIT IV:

Biofertilizers, Biopestisides and Integrated pest management: Bacterial biofertilizers, algal biofertilizers, Aquatic ferns as biofertilizers, Fungi as biofertilizers, earthworm as biofertilizers, biopestisides, Integrated pest management.

Course Learning Outcomes (CLOs):

1. Explain key ecological concepts (abiotic/biotic factors, ecosystems, and pollution types) and their environmental significance.
2. Analyze energy flow in ecosystems (food chains, pyramids) and biogeochemical cycles (N, P) using case studies.
3. Evaluate the causes, effects, and mitigation strategies for air, water, noise, and thermal pollution.
4. Propose solutions for water scarcity and wastewater treatment (e.g., rainwater harvesting, aerobic/anaerobic processes).

Programme Outcomes (POs):

1. Demonstrate understanding of ecological principles and human impacts on ecosystems.
2. Apply knowledge of resource management (water, waste) to sustainable practices.
3. Interpret data on pollution and ecosystem dynamics to assess environmental health.

References:

1. Anderson L and Tilman D A. (1997) Fuels from waste, Academic Press.

2. Christon, J. Harst (1997) Manual of Environmental Microbiology, ASM Press, Washington DC

INTELLECTUAL PROPERTY RIGHTS (IPR)

Course Code: MJDBT614 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit 1: Introduction to Intellectual Property Rights (IPR)

Definition and importance of IPR, Types of Intellectual Property (IP), Historical development of IPR

International organizations (WIPO, WTO, TRIPS Agreement), Indian IPR framework

Unit 2: Patents

Concept of patents and patentability criteria

Types of patents (Product vs. Process patents)

Patent filing procedure (National & International)

Patent infringement and remedies

Case studies on patents

Unit 3: Copyrights and Related Rights

Meaning and scope of copyright

Subject matter of copyright (literary, artistic, musical works, software, etc.)

Rights of copyright owners and exceptions (Fair Use, Public Domain)

Copyright registration process

Digital copyright issues (Piracy, DRM)

Unit 4: Trademarks and Industrial Designs

Definition and functions of trademarks

Types of trademarks (Word mark, Logo, Service mark, etc.)

Registration and protection of trademarks

Industrial designs – Definition, registration, and protection

Case studies on trademark disputes

Unit 5: Geographical Indications (GI) & Trade Secrets

Concept of GI and examples (Darjeeling Tea, Basmati Rice, etc.)

GI registration process

Trade secrets – Definition and protection

Difference between patents and trade secrets

Unit 6: Biotechnology and IPR

IP protection for biotechnological inventions

Patenting of microorganisms, genes, and GM crops

Ethical and legal issues in biotech patents

Course Outcomes (COs):

1. Explain the fundamentals of IPR, its types, and global frameworks (WIPO, TRIPS).
2. Analyze patentability criteria and the patent filing process in India and internationally.
3. Evaluate copyright laws, fair use, and digital rights management in creative works.
4. Apply trademark and GI laws to real-world cases of brand protection.
5. Discuss ethical issues in biotech patents and traditional knowledge protection.

Programme Outcomes (POs):

1. Knowledge Application – Use IPR principles to solve innovation-related problems.
2. Ethical Awareness – Recognize ethical implications of IP infringement.
3. Communication – Present IP case studies effectively

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Reference Books for IPR

1. Intellectual Property Rights: Text and Cases"Author: Deborah E. Bouchoux Publisher: Cengage Learning
2. Comprehensive, includes real-life case studies, patents, copyrights, trademarks, trade secrets."Intellectual Property: The Law of Copyrights, Patents and Trademarks" Author: William Cornish, David Llewelyn & Tanya Aplin Publisher: Sweet & Maxwell

BIOETHICS

Course Code: MJDBT615 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit 1: Introduction to Ethics

Definition, scope, and importance of ethics; Difference between ethics, morals, and values; Branches of ethics (Metaethics, Normative Ethics, Applied Ethics) ; Ethical theories: Utilitarianism, Deontology, Virtue Ethics;

Unit 2: Research Ethics

Ethical principles in research (Honesty, Integrity, Objectivity) ; Plagiarism, data fabrication, and falsification ; Informed consent and confidentiality ; Animal ethics in scientific research (3Rs: Replacement, Reduction, Refinement)

Unit 3: Bioethics

Ethical issues in biotechnology (GMOs, cloning, stem cell research) ; Human subject research (Clinical trials, Nuremberg Code, Declaration of Helsinki) ; Privacy and genetic data

Unit 4: Environmental Ethics

Anthropocentrism vs. Ecocentrism; Sustainable development and ethical responsibilities; Climate change ethics ; Case studies (e.g., Chipko Movement, Bhopal Gas Tragedy) ;

Unit 5: Technology and Ethics

AI and machine learning ethics (Bias, accountability) ; Big data privacy concerns ; Cyberethics (Hacking, digital piracy)

Course outcomes:

1. Compare ethical theories (Utilitarianism, Deontology) in scientific contexts.
2. Adhere to research ethics (informed consent, animal welfare guidelines).
3. Debate bioethical issues (GMOs, human cloning) with reasoned arguments.
4. Propose solutions for environmental and technological ethical dilemmas.
5. Demonstrate ethical decision-making in professional scenarios.

Programme outcomes

1. Ethical Awareness – Uphold integrity in scientific work.
2. Social Responsibility – Address societal impacts of scientific advancements.
3. Leadership – Advocate for ethical practices in team projects.

Suggested readings:

1. Practical Ethics by Peter Singer
2. Research Ethics: A Reader by Deni Elliott

PYTHON PROGRAMMING

Course code: MID06 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Overview of Programming: Structure of a Python Program, Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator).

Creating Python Programs: Input and Output Statements, Control statements (Branching, Looping, Conditional Statement, Exit function, Difference between break, continue), Defining Functions, default arguments, Errors and Exceptions.

Iteration and Recursion: Conditional execution, Alternative execution, Nested conditionals, The return statement, Recursion, Stack diagrams for recursive functions, Multiple assignment, The while statement, Implementing 2-D matrices.

Strings and Lists: String as a compound data type, Length, Traversal and the for loop, String slices, String comparison, Looping and counting, List values, Accessing elements, List length, List membership, Lists and for loops, List operations, List deletion. Cloning lists, Nested lists .

Object Oriented Programming: Introduction to Classes, Objects and Methods, Standard Libraries. Overview of stacks and queues.

Text Books:

1. T. Budd, Exploring Python, TMH, 1st Ed, 2011
2. Introduction to computation and programming python, by John Guttag, MIT Press.
3. Learning Python, Lutz and Ascher, O'Reilly publications

Web Resources:

1. http://files.swaroopch.com/python/byte_of_python.pdf
2. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3. http://greenteapress.com/thinkpython/thinkpython.pdf

Biotechnology Laboratory Techniques – VI

Course code: SEC06 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

1. Determination of Soil pH by pH Meter
2. Determination of Soil Moisture Using the Gravimetric Method
3. Enumeration of Bacteria from Vermicompost Soil and Wash
4. Enumeration of Fungi from Vermicompost Soil and Wash
5. Determination of Soil Organic Matter Content Using the Walkley-Black Method
6. Determination of the Amount of Plant-Available Phosphorus in the Soil by Olsen Method (for Alkaline Soils)
7. Determination of Soil Carbonates Using Acid Titration Method
8. Isolation of Soil Metagenomes
9. Agricultural Field Visit

Semester 7 (HONS)

ANIMAL BIOTECHNOLOGY

Course code: MJDBT716 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT I:

Animal Cell Culture: Equipments and materials for animal cell culture technology. Various systems of tissue culture, their distinguishing features, advantages and limitations.

UNIT II:

Culture medium: natural media, synthetic media, sera. Introduction to balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of carbon di oxide, serum and supplements.

UNIT III:

Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors.

UNIT IV:

Primary Culture: Behavior of cells, properties, utility. Explant culture; suspension culture.

UNIT V:

Established cell line cultures: Definition of cell lines, maintenance and management; cell adaptation.

Course Learning Outcomes (CLO):

1. Identify essential equipment and materials for animal cell culture and explain their functions in maintaining aseptic conditions.
2. Compare various tissue culture systems (e.g., monolayer, suspension, explant) and evaluate their advantages, limitations, and applications.
3. Classify culture media types (natural, synthetic, sera) and explain the roles of constituents (salts, buffers, supplements, CO_2) in cell metabolism.
4. Describe cellular characteristics (contact inhibition, anchorage dependence, senescence) and relate them to cell behavior in vitro.

5. Establish primary cultures using explant/suspension methods and analyze cell behavior, properties, and utility. Manage established cell lines: maintain subcultures, adapt cells to new conditions, and **apply** protocols for long-term storage.

Programme Outcomes (POs):

1. **Technical Knowledge**: Apply foundational principles of biotechnology to solve practical problems.
2. **Laboratory Skills**: Demonstrate proficiency in core biotechnological techniques and instrumentation.
3. **Critical Analysis**: Evaluate experimental designs, data, and literature to draw evidence-based conclusions.
4. **Problem Solving**: Troubleshoot technical challenges (e.g., contamination, media optimization).
5. **Ethical Awareness**: Recognize ethical implications of biological research (e.g., animal-derived sera).

References:

1. Ganga. G & Slochanachetty, An Introduction to Sericulture (2nd edition), Oxford and IBH Publishers Pvt. Ltd., Delhi, 2012.
2. John M. Walker and Ralph Rapley, Molecular Biology and Biotechnology (5th edition), Royal Society of Chemistry, 2014.
3. Michael Wink, An Introduction to Molecular Biotechnology: Fundamentals, Methods and Applications (2nd edition), John Wiley and Sons, 2013.

ENZYME TECHNOLOGY

Course code: MJDBT717 Total Marks: 100 (IA 25+EA75) Credits: 4

UNIT -I (10 hours)

Introduction to Enzymes: General introduction and historic background, General Terminology, Nomenclature, and Classification of Enzymes, Non- protein enzymes: Ribozymes and DNA Enzymes, Metalloenzymes and metal- activated enzymes, Coenzymes and Cofactors: Prosthetic group

UNIT -II (10 hours)

Enzyme Catalysis: Lock and key, Induced fit, and Transition state Hypotheses, , Mechanism of enzyme catalysis: Acid-base catalysis, covalent catalysis, Metal ion catalysis,

UNIT -III (10 hours)

Enzyme Kinetics and Inhibition: Kinetics of a single-substrate enzyme- catalyzed reaction: Michaelis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat, Kinetics of Enzyme Inhibition and Allosteric enzymes.

UNIT -IV (15 hours)

Factors affecting enzyme activity: Concentration, pH, and temperature, Reversible Inhibition: Competitive, Non-competitive, Uncompetitive, Mixed, Substrate, Allosteric, and Product Inhibition, Irreversible Inhibition

UNIT -V (15 hours)

Industrial and Clinical Uses of Enzymes (Applied Enzymology): Industrial Enzymes: Thermophilic enzymes, amylases, lipases, enzymes in industry, enzymes used in various fermentation processes, cellulose-degrading enzymes, Metal-degrading enzymes,

Course Learning Outcomes (CLO)

1. Describe the basic concepts, nomenclature, and classification of enzymes, including their chemical nature and roles as catalysts.

2. Explain various hypotheses and mechanisms of enzyme catalysis, including specific examples like serine proteases and proenzymes.

3. Apply principles of enzyme kinetics, inhibition, and factors affecting enzyme activity to interpret and predict enzyme behavior.

4. Describe the regulation of enzyme activity through feedback mechanisms, allosteric regulation, and covalent modifications, including enzyme localization and degradation.

5. Understand the practical applications of enzymes in both industrial and clinical settings, including enzyme engineering and immobilization techniques.

Programme Outcomes (POs):

1. Science/Engineering knowledge
2. Conduct investigations of complex problems
3. Environment and sustainability
4. Conduct investigations of complex problems

Suggested Readings:

1. Price, N. C., & Stevens, L. (1999). Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins (3rd ed.). Oxford University Press.
2. Fersht, A. (1999). Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding (3rd ed.). W. H. Freeman and Company.
3. Segel, I. H. (1993). Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems. Wiley-Interscience.

THERAPEUTIC MEDICAL BIOTECHNOLOGY

Molecular Therapeutics and Drug Discovery

Course code: MJDBT718 Total Marks: 100 (IA 25+EA75) Credits: 4

Unit I

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery. Gene silencing technology; siRNA- Concept, delivery and therapeutic applications in treatment of influenza and HIV/AIDS; Tissue and organ transplantation; Transgenics and their uses; Cloning; Ethical issues

Unit II

Proteomics and drug discovery: High throughput screening for drug discovery; Identification of drug targets; Pharmacogenomics and pharamacogenetics and drug development; Toxicogenomics; Metagenomics.

Unit III

Nanobiotechnology for drug discovery, protein and peptide based compounds for cancer and diabetes, drug delivery - nanoparticle based drug delivery, lipid nanoparticles, vaccination, cell therapy, Gene therapy. Ethical, safety and regulatory issues of nanomedicine. Physicochemical characteristics of nanomaterials, Nanoparticle interaction with biological membrane, Neurotoxicology.

Unit IV

Drug Discovery & Clinical research Introduction and importance of clinical research, Drug Development and phases of Clinical trials, Designing clinical Trials, Protocol designing, Ethical issues in clinical research, ICH-GCP Guidelines.

Unit V

Informed consent process, Role of CRC and CRA in clinical trials, Pharmacovigilance, Standard operating procedures, Guidelines to undertake clinical trials in India.

Course Learning Outcomes (CLO)

1. Understand the principles and applications of gene therapy, gene delivery systems, and transgenics.
2. Explain proteomics techniques and their role in drug target identification and pharmacogenomics.
3. Analyze the role of Nano biotechnology in drug delivery, diagnostics, and therapeutic applications.
4. Evaluate the design and ethical considerations of clinical trials and drug development processes.
5. Apply knowledge of regulatory guidelines, pharmacovigilance, and biosafety in biomedical research.

Programme Outcomes (POs):

1. Science/Engineering knowledge
2. Conduct investigations of complex problems
3. Environment and sustainability
4. Conduct investigations of complex problems

Texts/References:

1. Bernhard Palsson and Sangeeta N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004.

2. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Sringer, 2008.

3. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006. 4. H. Rehm, Protein Biochemistry and Proteomics, 4th Edition, Academic Press, 2006

ARTIFICIAL INTELLIGENCE

Course code: ELBT705 Total Marks: 100 (IA 25+EA75) Credits: 4

Unit I

AI History and Applications: Defining AI: Acting Humanly (Turing Test Approach), Thinking Humanly (Cognitive Modeling Approach), Thinking Rationally (laws of thought approach), Acting Rationally (Rational Agent Approach); Foundations of Artificial Intelligence; History of AI, AI techniques, Expert Systems.

Unit II

Problem Solving by Search: Defining the problem as a State Space Search Strategies: Breadth – first Search, Depth- first search. Heuristic Search Techniques: Hill Climbing, Simulated Annealing, Best First Search: OR Graphs, Heuristic Functions, A* Algorithm.

Unit III

Knowledge Representation: Representations and mappings, Approaches to knowledge Representation, Procedural versus Declarative knowledge; Predictive Logic: Representing Simple facts, Instance and Isa relationships in Logic, Proposition versus Predicate Logic, Computable Functions and Predicates- not, Rules of Inferences and Resolution-not, Forward versus Backward Reasoning, Logic Programming and Horn Clauses.

Unit IV

AI Programming Languages (PROLOG): Introduction, How Prolog works, Backtracking, CUT and FAIL operators, Built –in Goals, Lists, Search in Prolog.

Course Outcomes

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Demonstrate proficiency developing applications in an 'AI language', expert system shell, or data mining tool.
5. Demonstrate proficiency in applying scientific method to models of machine learning.

Program Outcomes

1. To understand the AI & Expert Systems.
2. To learnt the Heuristic techniques and reasoning.
3. To provide the most fundamental knowledge to the students so that they can understand what the AI.
4. To eliminate theoretic proofs and formal notations as far as possible, so that the students can get the full picture of AI easily.

Text Books:

1. Stuart Russel and Peter Norvig: Artificial Intelligence – A Modern Approach, 2nd Edition Pearson Education
2. N.P. padhy: Artificial Intelligence and Intelligent Systems, Oxford Higher Education, Oxford University Press

References:

1. George F Luger: Artificial Intelligence- Structures and Strategies for complex Problem Solving, 4th Ed. Pearson Education
2. Ivan Bratko: PROLOG Programming 2nd Ed., Pearson Education

INDUSTRIAL BIOTECHNOLOGY

Course code: AMJ701 Total Marks: 100 (IA 25+EA75) Credits: 4

UNIT I:

Bioreactors:

Bioreactor function, utility, types of bioreactor. Modes of bioreactor operations. Main components of the bioreactor and their functions.

UNIT II

Types of Bioreactors:

Continuous stirred tank and plug flow reactors. Packed bed and fluidized bed reactors.Trickle bed, immobilized bed, air lift, rotary disc reactors. Reactors with cell recycle.

UNIT III:

Cell Disruption Methods:

Various cell disruption methods, need for cell disruption for (Homogenizer, French press & Dynomill) intracellular products, cell disruption equipment.

UNIT IV:

Applications in bio-processing:
Flocculation: Principles of flocculation various flocculating agents,
Coagulation: Principles of coagulations and its applications in bio-processing

UNIT V:

Scope of Downstream Processing:

Importance of Down Stream Processing (DSP) in biotechnology, characteristics of products, criteria for selection of bio-separation techniques. Role of DSP methods in bioprocess economics.

Course Outcomes (CLO):

1. Explain the function, utility, and components of bioreactors, including probes for process monitoring.
2. Compare bioreactor types (CSTR, PFR, packed bed, airlift, etc.) and **select** appropriate systems for specific bioprocesses.
3. Design batch, fed-batch, and continuous bioreactor operations, including aerobic/anaerobic conditions.

4. Evaluate immobilized reactor systems (cells/enzymes) and **solve** kinetic problems for immobilized enzymes.

5. Demonstrate knowledge of downstream processing (DSP) principles, including cell disruption, flocculation, and coagulation.

Programme Outcomes (POs):

1. **Technical Knowledge**: Apply bioprocess engineering principles to bioreactor design and DSP.
2. **Problem Solving**: Optimize bioreactor operations (e.g., mode selection, immobilization).
3. **Analytical Skills**: Interpret kinetic data and process monitoring parameters.
4. **Economic Awareness**: Assess cost implications of bioreactor/DSP choices.
5. **Ethics & Safety**: Adhere to biosafety protocols in bioreactor/DSP operations.

References:

1) Nielsen, Jens, and John Villadsen. Bioreaction Engineering Principles, 3rd edition, Springer, 2019.
2) Rehm, Hans-Jürgen, and Gerald Reed. Biotechnology, Volume 10: Special Processes, Wiley-VCH, 2001.
3) Lee, Yuan Kun. Bioprocessing for Value-Added Products from Renewable Resources: New Technologies and Applications, Elsevier, 2007.
4) Flickinger, Michael C., and Stephen W. Drew. Encyclopedia of Industrial Biotechnology: Bioprocess, Bioseparation, and Cell Technology, Wiley, 2010.

Semester 7 (Hons with Research)

Research Methodology

Course code: MJDBT716 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit-I: Conceptual Framework of Educational Research

Research as a Process of Acquiring Knowledge Meaning, Nature and Scope of Educational Research, Types of Educational Research: Quantitative Descriptive, Historical/Philosophical,

Unit-II:

Developmental, Casual comparative, Correlational, Experimental (Weak, true and quasi-experimental and Action Research.), Qualitative Phenomenology, Ethnography, Case Study, Grounded Theory, Narrative Analysis. (Purpose, Characteristics, Steps with common errors committed in planning and conducting the research).

Unit-III: Planning of Good Research/Preparing and Research Proposal

Formulation of the problem for research (Sources, Specification, Forming Research Questions, problem-analysis procedures, evaluation of the Problem), Building Rationale for the Study (Review of related literature, identifying the emerging trends from the review, building a strong rationale for selecting the problem.), Specifying objectives and hypotheses of the Study, Choosing appropriate design and stating the procedure (Selecting appropriate methods, instruments/tools/techniques, deciding about the subjects for the study, conditions for conducting the study including procedures of data collection and data processing)

Unit-III:

Operational definitions of the concepts and terms used (with the statements of underlying assumptions, perceived limitations and specific delimitations of the study). Basic Methods of Educational Research.

Unit-IV Sampling -Types and Techniques of sampling. Hypothesis and Testing of Hypothesis, Sources of Hypotheses ,Type of Hypotheses (Null, Directional, Statistics),

Characteristics of good hypothesis ,Hypothesis. Testing and Theory, Errors in Testing Hypothesis. Tools & Techniques of Educational Research.

Unit- V

Tools, preparing, piloting and finalizing, Tests, Tasks, Attitude Scales, Check lists, Questionnaires/ Opinionnaire, Interview Schedules for interview and observation, Inventory, Semantic Differentiate Scale, Use of ICT Techniques Observation, Interview, focused Group Discussion, Ethnography, Document Study, Anecdotal. Role play and Simulation, Case Study

Course Outcomes (COs)

1. Distinguish between quantitative and qualitative research methods and select appropriate approaches for educational studies.
2. Develop a research proposal by formulating clear objectives, hypotheses, and methodology aligned with the problem statement.
3. Apply appropriate sampling techniques and justify their use to ensure research validity.
4. Design and validate data collection tools (e.g., questionnaires, interviews) using ICT and ethical considerations.
5. Analyze research findings using hypothesis testing and identify potential errors (Type I/II).

Programme Outcomes (POs)

1. Understand diverse research paradigms (quantitative/qualitative) in education.
2. Formulate research problems, hypotheses, and select appropriate designs.
3. Apply sampling techniques, data collection tools, and hypothesis testing.
4. Adhere to ethical guidelines in educational research.

References:

1. **"Research Methodology: Methods and Techniques" Author:** C.R. Kothari (latest editions co-authored with Gaurav Garg) **Publisher:** New Age International

2. **"Research Methodology: A Step-by-Step Guide for Beginners"Author:** Ranjit Kumar **Publisher:** SAGE Publications

ENZYME TECHNOLOGY

Course code: MJDBT717 Total Marks: 100 (IA 25+EA75) Credits: 3(T) +1(P)

Unit -I

Introduction to Enzymes: General introduction and historic background, General Terminology, Nomenclature, and Classification of Enzymes, Non- protein enzymes: Ribozymes and DNA enzymes, Metalloenzymes and metal- activated enzymes, Coenzymes and Cofactors: Prosthetic group

Unit -II

Enzyme Catalysis: Lock and key, Induced fit, and Transition state Hypotheses, , Mechanism of enzyme catalysis: Acid-base catalysis, covalent catalysis, Metal ion catalysis,

Unit -III

Enzyme Kinetics and Inhibition: Kinetics of a single-substrate enzyme- catalyzed reaction: Michaelis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat, Kinetics of Enzyme Inhibition and Allosteric enzymes,

Unit -IV

Factors affecting enzyme activity: Concentration, pH, and temperature, Reversible Inhibition: Competitive, Non-competitive, Uncompetitive, Mixed, Substrate, Allosteric, and Product Inhibition, Irreversible Inhibition

Unit -V

Industrial and Clinical Uses of Enzymes (Applied Enzymology): Industrial Enzymes: Thermophilic enzymes, amylases, lipases, enzymes in industry, enzymes used in various fermentation processes, cellulose-degrading enzymes, Metal-degrading enzymes,

Course Learning Outcomes (CLO):

1. Describe the basic concepts, nomenclature, and classification of enzymes, including their chemical nature and roles as catalysts.

2. Explain various hypotheses and mechanisms of enzyme catalysis, including specific examples like serine proteases and proenzymes.

3. Apply principles of enzyme kinetics, inhibition, and factors affecting enzyme

activity to interpret and predict enzyme behavior.

4. Describe the regulation of enzyme activity through feedback mechanisms, allosteric regulation, and covalent modifications, including enzyme localization and degradation.

5. Understand the practical applications of enzymes in both industrial and clinical settings, including enzyme engineering and immobilization techniques.

Programme Outcomes (POs)

1. Knowledge of basic science and engineering fundamentals
2. Ability to identify, formulate, and analyze problems
3. Design solutions for problems considering health, safety, society, and environment
4. Conduct investigations using research-based knowledge

Suggested Readings:

1. Price, N. C., & Stevens, L. (1999). Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins (3rd ed.). Oxford University Press.
2. Fersht, A. (1999). Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding (3rd ed.). W. H. Freeman and Company.
3. Segel, I. H. (1993). Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems. Wiley-Interscience.

THERAPEUTIC MEDICAL BIOTECHNOLOGY

Molecular Therapeutics and Drug Discovery

Course code: MJDBT718 Total Marks: 100 (IA 25+EA75) Credits: 4

Unit I

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery. Gene silencing technology; siRNA- Concept, delivery and therapeutic applications in treatment of influenza and HIV/AIDS; Tissue and organ transplantation; Transgenics and their uses; Cloning; Ethical issues

Unit II

Proteomics and drug discovery: High throughput screening for drug discovery; Identification of drug targets; Pharmacogenomics and pharamacogenetics and drug development; Toxicogenomics; Metagenomics.

Unit III

Nanobiotechnology for drug discovery, protein and peptide based compounds for cancer and diabetes, drug delivery - nanoparticle based drug delivery, lipid nanoparticles, vaccination, cell therapy, Gene therapy. Ethical, safety and regulatory issues of nanomedicine. Physicochemical characteristics of nanomaterials, Nanoparticle interaction with biological membrane, Neurotoxicology.

Unit IV

Drug Discovery & Clinical research Introduction and importance of clinical research, Drug Development and phases of Clinical trials, Designing clinical Trials, Protocol designing, Ethical issues in clinical research, ICH-GCP Guidelines.

Unit V

Informed consent process, Role of CRC and CRA in clinical trials, Pharmacovigilance, Standard operating procedures, Guidelines to undertake clinical trials in India.

Course Learning Outcomes (CLO)

1. Understand the principles and applications of gene therapy, gene delivery systems, and transgenics.
2. Explain proteomics techniques and their role in drug target identification and pharmacogenomics.
3. Analyze the role of Nano biotechnology in drug delivery, diagnostics, and therapeutic applications.
4. Evaluate the design and ethical considerations of clinical trials and drug development processes.
5. Apply knowledge of regulatory guidelines, pharmacovigilance, and biosafety in biomedical research.

Programme Outcomes (POs):

1. Science/Engineering knowledge
2. Conduct investigations of complex problems
3. Environment and sustainability
4. Conduct investigations of complex problems

Texts/References:

1. Bernhard Palsson and Sangeeta N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004.

2. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Sringer, 2008.

3. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006. 4. H. Rehm, Protein Biochemistry and Proteomics, 4th Edition, Academic Press, 2006.

ARTIFICIAL INTELLIGENCE

Course code: ELBT705 Total Marks: 100 (IA 25+EA75) Credits: 4

Unit I

AI History and Applications: Defining AI: Acting Humanly (Turing Test Approach), Thinking Humanly (Cognitive Modeling Approach), Thinking Rationally (laws of thought approach), Acting Rationally (Rational Agent Approach); Foundations of Artificial Intelligence; History of AI, AI techniques, Expert Systems.

Unit II

Problem Solving by Search: Defining the problem as a State Space Search Strategies: Breadth – first Search, Depth- first search. Heuristic Search Techniques: Hill Climbing, Simulated Annealing, Best First Search: OR Graphs, Heuristic Functions, A* Algorithm.

Unit III

Knowledge Representation: Representations and mappings, Approaches to knowledge Representation, Procedural versus Declarative knowledge; Predictive Logic: Representing Simple facts, Instance and Isa relationships in Logic, Proposition versus Predicate Logic, Computable Functions and Predicates- not, Rules of Inferences and Resolution-not, Forward versus Backward Reasoning, Logic Programming and Horn Clauses.

Unit IV

AI Programming Languages (PROLOG): Introduction, How Prolog works, Backtracking, CUT and FAIL operators, Built –in Goals, Lists, Search in Prolog.

Course Outcomes

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Demonstrate profciency developing applications in an 'AI language', expert system shell, or data mining tool.
5. Demonstrate profciency in applying scientifc method to models of machine learning.

Program Outcomes

1. To understand the AI & Expert Systems.
2. To learnt the Heuristic techniques and reasoning.
3. To provide the most fundamental knowledge to the students so that they can understand what the AI.
4. To eliminate theoretic proofs and formal notations as far as possible, so that the students can get the full picture of AI easily.

Text Books:

1. Stuart Russel and Peter Norvig: Artificial Intelligence – A Modern Approach, 2nd Edition Pearson Education
2. N.P. padhy: Artificial Intelligence and Intelligent Systems, Oxford Higher Education, Oxford University Press

References:

1. George F Luger: Artificial Intelligence- Structures and Strategies for complex Problem Solving, 4th Ed. Pearson Education
2. Ivan Bratko: PROLOG Programming 2nd Ed., Pearson Education

Semester 8 (HONS)

BIOLOGICAL DATA ANALYSIS

Course Code: MJDBT819 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT I

Basic Statistics for Biological Data Analysis: Descriptive statistics: mean, median, mode, variance, standard deviation, Probability concepts and distributions: Normal, Binomial. Hypothesis testing: p-values, significance levels , Parametric tests: t-test, ANOVA. Non-parametric tests: Wilcoxon test, Mann-Whitney U test.

UNIT II

Introduction to R Programming: Setting up R and RStudio, R syntax and data structures: vectors, data frames, Writing R scripts, Data manipulation with `dplyr`, Plotting with `ggplot2`, Statistical tests: `t.test()`, `wilcox.test()`, Linear regression with `lm()`.

UNIT III

Introduction to Python for Biological Data Analysis: Installing Python and Jupyter Notebook, Python libraries: NumPy, pandas, Matplotlib, Python syntax and data structures, Data manipulation with pandas, Data cleaning and preprocessing, Descriptive statistics with pandas, Plotting with Matplotlib,

UNIT IV

Advanced Data Analysis Techniques: Generalized linear models (GLMs), Logistic regression, Clustering techniques: k-means, Dimensionality reduction: Principal Components Analysis (PCA), Time series analysis: decomposition, forecasting

Course Learning Outcomes (CLOs)

1. Compute descriptive stats (mean, SD) and select appropriate tests (t-test, ANOVA, Wilcoxon).
2. Perform data wrangling and visualization in R (dplyr, ggplot2) and Python (pandas, Matplotlib).
3. Build predictive models (linear/logistic regression) and apply dimensionality reduction (PCA).

Programme Outcomes (POs)

1. (Statistical Literacy): Apply descriptive/inferential statistics to biological datasets.
2. (Coding Proficiency): Implement statistical analyses using R and Python.

3. (Advanced Modeling): Utilize GLMs, clustering, and PCA for biological data interpretation.
4. (Visualization Skills): Create publication-quality plots for data communication.

References

1. Whitlock & Schluter. *The Analysis of Biological Data* (3rd ed.).
2. Wickham & Grolemund. *R for Data Science* (2nd ed., O'Reilly).
3. McKinney. *Python for Data Analysis* (3rd ed., O'Reilly).

AGRICULTURAL BIOTECHNOLOGY

Course Code: MJDBT820 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit -I

Microbes in soil fertility and plant-microbe interactions. Exploration of microbial applications in agriculture, including bioremediation and bio control agents.

Unit -II

Nutrient Cycles: Exploration of carbon, nitrogen, phosphorus, and sulphur cycles in Soil. Biological Nitrogen Fixation: Symbiotic, associative, and asymbiotic nitrogen fixation, including the role of Azolla, blue-green algae, and mycorrhiza.

Unit -III

Marker-Assisted Selection (MAS). Transgenic Crops: Principles of transgenic breeding, genetic modification in agriculture, and the ecological impact of transgenic plants. Genome Editing Technologies: genome editing tools in crop improvement and trait modification

Unit -IV

Principles of Organic Farming: Organic farming practices, including crop rotation, composting, and biological pest control. Integrated Farming Systems: Integration of crop farming with livestock rearing, aquaculture, and agroforestry for sustainable agriculture. Agro ecology and Biodiversity: Understanding agro ecosystems, promoting biodiversity, and enhancing ecosystem services in agricultural landscapes.

Unit -V

Economic Perspectives in Agriculture: Principles of agro-economics, cost benefit analysis, and market dynamics in agricultural biotechnology. Innovative Technologies: Exploration of emerging technologies such as precision agriculture, vertical farming, and digital agriculture in improving agricultural productivity and sustainability.

Course Outcomes (CLO):

1. Demonstrate an understanding of microbial diversity and its significance in agriculture.
2. Apply marker-assisted selection techniques and transgenic breeding methods for crop improvement.

3. Evaluate the principles and practices of organic and integrated farming systems for sustainable agriculture.
4. Analyse the economic implications of agricultural biotechnology and Innovative technologies in agro ecosystems.
5. Develop practical skills in soil analysis, microbial enumeration, and agricultural field assessment.

Programme Outcomes (POs):

1. Demonstrate a comprehensive understanding of agricultural biotechnology, including plant tissue culture, transgenic technology, molecular markers, and bioinformatics applications in agriculture.
2. Apply biotechnological techniques to solve agricultural problems such as pest resistance, low yield, and climate resilience through genetic modification and sustainable practices.
3. Design and conduct experiments using molecular biology, genetic engineering, and other biotechnological tools to develop innovative agricultural products or improve crop quality and productivity.
4. Integrate knowledge from plant sciences, microbiology, soil science, and molecular biology to address complex agricultural challenges.
5. Effectively communicate scientific ideas and biotechnological solutions to stakeholders, farmers, and scientific communities through reports, presentations, and publications.

References:

1. Brady, Nyle C., and Ray R. Weil. The Nature and Properties of Soils, 15th edition, Pearson, 2017.

2. Nair, P. K. R. Agro ecological Innovations: Increasing Food Production with Participatory Development, Earthscan, 2007.

3. Arora, Naveen K., et al. Advances in Plant Breeding Strategies: Breeding, Biotechnology and Molecular Tools, Springer, 2015.

DATA MININIG

Course Code: ELBT806 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit -I

Understand the concept of Online analytical processing (OLAP) and its implementation. Definition and applications in biotechnology. Data mining Introduction: Definition, Data mining tasks, Data mining as a step of Knowledge discovery process, Applications of Data mining in biotechnology and life sciences; Data types and biological data objects, recalling mean, median, mode and weighted arithmetic mean.

Unit -II

Data quality, Importance of data quality in biological experiments and databases, overview of data pre-processing. Classification analysis- definition, Overview of various classification techniques; Decision tree induction- working, examples, specifying attribute test conditions.

Differences between Operational Database and Data Warehouse- Multi-dimensional Data Model - From Tables to Data Cubes. Schemas, Measures, DW Implementation - Efficient Computation of Data Cubes.

Unit -III

Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept of Hierarchy Generation, Task relevant Data, Background Knowledge, Presentation and Visualization of Discovered Patterns.

Unit -IV

Association Rule Mining, Classification and Prediction - Decision Tree, Decision tree induction and simple examples (e.g., phenotype classification) Bayesian Classification Back Propagation, Cluster Analysis, Clustering techniques for grouping biological samples, Outlier Analysis. Data visualization methods for biological pattern interpretation

Unit -V

Introduction to Web mining: mining scientific literature and databases Spatial data mining: applications in epidemiology and ecology Temporal data mining: analysis of time-series biological data (e.g., patient monitoring, gene expression over time) Sequence mining and pattern detection in DNA/protein sequences.

Course Outcomes (CLO):

1. Understand OLAP, data mining concepts, and their applications in biotechnology and life sciences.
2. Apply data preprocessing techniques including data cleaning, transformation, and integration in biological contexts.
3. Analyze and implement classification and clustering techniques to biological data such as gene expression or phenotypes.
4. Interpret data patterns using visualization methods and evaluate mining techniques like association rule mining and outlier detection.
5. Apply web, spatial, temporal, and sequence mining to solve real-life biological problems such as epidemiology and gene analysis.

Programme Outcomes (POs):

1. Science/Engineering knowledge
2. Problem analysis
3. Design/development of solutions
4. Conduct investigations using research-based knowledge
5. Use of modern tools

DIAGNOSTIC MEDICAL BIOTECHNOLOGY
Molecular and Nanomolecular Diagnostics

Course code: AMJ802 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

Unit I

Host pathogen interactions in disease process (Bacterial: Tuberculosis and Staphylococcal Diseases & Viral: Influenza and HIV/AIDS); Disease pathology and clinical spectrum; Clinical diagnosis of diseases; Molecular Genetics of the host and the pathogen. Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; Bioinformatic tools for molecular diagnosis.

Unit II

Concept of Genomics, Human disease genes; DNA polymorphism including those involved in disease (Ex: Hemoglobin and the anemias); Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; 'disease' gene vs. 'susceptibility' gene; SNP detection: hybridization based assays (allele specific probes);

Unit III

Outline of a typical proteomics experiment, clinical proteomics and disease biomarkers. Isolation of proteins and other molecules associated with disease; 2D analysis of such proteins by sequencing individual spots by Mass Spectrometry; Protein Microarray; Present methods for diagnosis of Specific diseases like Tuberculosis and AIDS; Ethics in Molecular Diagnosis

Unit IV

Nanomolecular diagnostics and Biosensor: Introduction to Nanodiagnostics, Nanoarrays for diagnostics, detection of single DNA, self-assembled protein nanoarrays, protein nanobiochip nanoparticles for molecular diagnostics, DNA nanomachines, Nanobiosensor, CNT biosensor, DNA nanosensor, Nanowire biosensor, application of nanodiagnostics.

Course Learning Outcomes (CLOs)

1. Understand host–pathogen interactions, disease pathology, and molecular mechanisms involved in diseases like TB, HIV/AIDS.
2. Explain the molecular genetics behind inherited and infectious diseases and use bioinformatics tools for molecular diagnosis.
3. Differentiate between monogenic and multigenic disorders, and analyze SNPs and polymorphisms using hybridization-based assays.
4. Apply proteomics techniques to identify disease biomarkers and understand diagnostic methods for diseases like AIDS and TB.
5. Demonstrate knowledge of nanodiagnostics tools like biosensors, DNA nanomachines, and nanoarrays for disease detection.

Programme Outcomes (POs):

1. Investigations using research-based knowledge
2. Understanding of health, society, and safety impacts
3. Environment and sustainability awareness
4. Design and development of solutions

Texts/References

1. George Patrinos and Wilhelm Ansorage, Molecular Diagnostics, 1st Edition, Academic Press, 2005. 2. Willey J. Prescott, Harley, and Klein's Microbiology-7th international ed./Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton. New York: McGraw-Hill Higher Education; 2008.

3. Lela Buchingham and Maribeth L Flawsm, Molecular Diagnostics: Fundamentals, Methods and Clinical.

BIOPROCESS TECHNOLOGY

Course code: AMJ803 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT -I

Principles of Bioprocess technology – Introduction and history of traditional and modern bioprocess technology.

UNIT -II

General concepts of fermentation technology – Outline of an integrated bioprocess and various unit operations. Industrially important microbes: Isolation, Screening & Preservation techniques – Slant culture, spore culture, overlaying culture with mineral oil, Lyophilization, Cryopreservation.

UNIT -III

Introduction to fermentation - Types of fermentation processes (Submerged & solid static) - Media formulation - Synthetic and complete media, Sterilization (batch & continuous)

UNIT -IV

Microbial growth and death kinetics - Bioprocess control & monitoring of various factors, temperature, agitation, pressure, pH, dissolved oxygen and foam sensing – online measurements, Control systems – Manual control, Automatic control - on/off control & PID control, Computer applications in fermentation technology - Scale up & Scale down of microbial reactions.

UNIT -V

Down- stream processing: Removal of microbial cells and solid matter – Precipitation, Filtration, Centrifugation, Liquid – Liquid extraction, Chromatography and membrane processes, BOD and COD measurements, Disposal of industrial wastes.

Course Learning Outcomes (CLO): Students will be able to

1. Understand principles, history, and types of bioprocess technology and fermentation.
2. Learn microbial growth kinetics, bioprocess control, and fermenter design.
3. Apply downstream processing techniques and waste measurement methods.
4. Analyze microbial growth kinetics and implement control strategies (pH, DO, temperature) using manual/PID systems.
5. Design downstream processing steps (filtration, chromatography) for product recovery and waste management.

Programme Outcomes (POs):

1. Technical Knowledge: Master bioprocess unit operations (fermentation, DSP).

2. Laboratory Skills: Handle fermenters, sterilizers, and monitoring systems.
3. Process Optimization: Troubleshoot bioprocess parameters (e.g., DO, foam).
4. Sustainability: Address waste disposal (BOD/COD) and eco-friendly practices.
5. Industry Readiness: Scale processes from lab to industrial levels.

Reference Books:

1. Stanbury P.F., Whitaker. A & Hall. S. J., Principles of Fermentation Technology (2nd edition), Aditya Books Private Ltd., 2000.
2. Crueger, W. and Crueger, A., Biotechnology: A Textbook of Industrial Microbiology (2nd edition), Panima Publishing Corporation, New Delhi, 2000.
3. Waites M.J., Morgan N.L., Rockey J.S., Industrial Microbiology (2nd edition), Blackwell Science, 2002.
4. Demain L. & Davies E., Manual of Industrial Microbiology and Biotechnology (2nd edition), ASM Press, Washington, 2004.

Semester 8 (HONS with Research)

BIOLOGICAL DATA ANALYSIS

Course Code: MJDBT819 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT I

Basic Statistics for Biological Data Analysis: Descriptive statistics: mean, median, mode, variance, standard deviation, Probability concepts and distributions: Normal, Binomial. Hypothesis testing: p-values, significance levels , Parametric tests: t-test, ANOVA. Non-parametric tests: Wilcoxon test, Mann-Whitney U test.

UNIT II

Introduction to R Programming: Setting up R and RStudio, R syntax and data structures: vectors, data frames, Writing R scripts, Data manipulation with `dplyr`, Plotting with `ggplot2`, Statistical tests: `t.test()`, `wilcox.test()`, Linear regression with `lm()`.

UNIT III

Introduction to Python for Biological Data Analysis: Installing Python and Jupyter Notebook, Python libraries: NumPy, pandas, Matplotlib, Python syntax and data structures, Data manipulation with pandas, Data cleaning and preprocessing, Descriptive statistics with pandas, Plotting with Matplotlib,

UNIT IV

Advanced Data Analysis Techniques: Generalized linear models (GLMs), Logistic regression, Clustering techniques: k-means, Dimensionality reduction: Principal Components Analysis (PCA), Time series analysis: decomposition, forecasting

Course Learning Outcomes (CLOs)

1. Compute descriptive stats (mean, SD) and select appropriate tests (t-test, ANOVA, Wilcoxon).
2. Perform data wrangling and visualization in R (dplyr, ggplot2) and Python (pandas, Matplotlib).
3. Build predictive models (linear/logistic regression) and apply dimensionality reduction (PCA).

Programme Outcomes (POs)

1. (Statistical Literacy): Apply descriptive/inferential statistics to biological datasets.
2. (Coding Proficiency): Implement statistical analyses using R and Python.

3. (Advanced Modeling): Utilize GLMs, clustering, and PCA for biological data interpretation.
4. (Visualization Skills): Create publication-quality plots for data communication.

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1. Whitlock & Schluter. *The Analysis of Biological Data* (3rd ed.).
2. Wickham & Grolemund. *R for Data Science* (2nd ed., O'Reilly).
3. McKinney. *Python for Data Analysis* (3rd ed., O'Reilly).

AGRICULTURAL BIOTECHNOLOGY

Course Code: MJDBT820 **Total Marks:** 100 (IA 25+EA75) **Credits:** 4

UNIT -I

Microbes in soil fertility and plant-microbe interactions. Exploration of microbial applications in agriculture, including bioremediation and bio control agents.

UNIT -II

Nutrient Cycles: Exploration of carbon, nitrogen, phosphorus, and sulphur cycles in Soil. Biological Nitrogen Fixation: Symbiotic, associative, and asymbiotic nitrogen fixation, including the role of Azolla, blue-green algae, and mycorrhiza.

UNIT -III

Marker-Assisted Selection (MAS). Transgenic Crops: Principles of transgenic breeding, genetic modification in agriculture, and the ecological impact of transgenic plants. Genome Editing Technologies: genome editing tools in crop improvement and trait modification

UNIT -IV

Principles of Organic Farming: Organic farming practices, including crop rotation, composting, and biological pest control. Integrated Farming Systems: Integration of crop farming with livestock rearing, aquaculture, and agroforestry for sustainable agriculture. Agro ecology and Biodiversity: Understanding agro ecosystems, promoting biodiversity, and enhancing ecosystem services in agricultural landscapes.

UNIT -V

Economic Perspectives in Agriculture: Principles of agro-economics, cost benefit analysis, and market dynamics in agricultural biotechnology. Innovative Technologies: Exploration of emerging technologies such as precision agriculture, vertical farming, and digital agriculture in improving agricultural productivity and sustainability.

Course Outcomes (CLO):

1. Demonstrate an understanding of microbial diversity and its significance in agriculture.

2. Apply marker-assisted selection techniques and transgenic breeding methods for crop improvement.
3. Evaluate the principles and practices of organic and integrated farming systems for sustainable agriculture.
4. Analyse the economic implications of agricultural biotechnology and Innovative technologies in agro ecosystems.
5. Develop practical skills in soil analysis, microbial enumeration, and agricultural field assessment.

Programme Outcomes (POs):

1. Demonstrate a comprehensive understanding of agricultural biotechnology, including plant tissue culture, transgenic technology, molecular markers, and bioinformatics applications in agriculture.
2. Apply biotechnological techniques to solve agricultural problems such as pest resistance, low yield, and climate resilience through genetic modification and sustainable practices.
3. Design and conduct experiments using molecular biology, genetic engineering, and other biotechnological tools to develop innovative agricultural products or improve crop quality and productivity.
4. Integrate knowledge from plant sciences, microbiology, soil science, and molecular biology to address complex agricultural challenges.
5. Effectively communicate scientific ideas and biotechnological solutions to stakeholders, farmers, and scientific communities through reports, presentations, and publications.

References:

1. Brady, Nyle C., and Ray R. Weil. The Nature and Properties of Soils, 15th edition, Pearson, 2017.

2. Nair, P. K. R. Agro ecological Innovations: Increasing Food Production with Participatory Development, Earthscan, 2007.

3. Arora, Naveen K., et al. Advances in Plant Breeding Strategies: Breeding, Biotechnology and Molecular Tools, Springer, 2015.