।। सा विद्या या विमुक्तये ।।
स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड
"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)
Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade
25 1994 - 2019 SILVER JUBILEE YEAR

## ACADEMIC (1-BOARD OF STUDIES) SECTION

**Phone: (02462) 229542**
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**Website: www.srtmun.ac.in**
**E-mail: bos.srtmun@gmail.com**

**संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९–२० पासून लागू करण्याबाबत.**

# प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक ०८ जून २०१९ रोजी संपन्न झालेल्या ४४व्या मा. विद्या परिषद बैठकीतील ऐनवेळचा विषय क्र.११/४४–२०१९** च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९–२० पासून लागू करण्यात येत आहेत.

1. Bioinformatics
2. Biotechnology
3. Boichemistry
4. Botany
5. Chemistry
6. Computer Management
7. Computer Science
8. Dairy Science
9. Environmental Science
10. Herbal Medicine
11. Information Technology
12. M.C.A.
13. Microbiology
14. Physics
15. Software Engineering
16. System Administration & Networking
17. Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
**जा.क्र.:** शैक्षणिक–१/परिपत्रक/पदव्युत्तर–सीबीसीएस अभ्यासक्रम/२०१९–२०/**४६४**
**दिनांक :** ११.०७.२०१९.

स्वाक्षरित/–
**उपकुलसचिव**
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

**Swami Ramanand Teerth Marathwada University, Nanded**

**SYLLABUS M.Sc. BIOTECHNOLOGY**

**CHOICE BASED CREDIT SYSTEM ( June 2019)**

| Semester | Code | Title of the Course | Hr/Week | Type of Course | Credit | Marks | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | | ESA | MSA | |
| I | BT-I | Cell and Developmental Biology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT-II | Microbiology and Virology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT-III | Biochemistry | 4 | CC | 4 | 75 | 25 | 100 |
| | BT-IV | (A) Techniques in Biotechnology<br>(B) Plant Metabolism and Development | 4 | DSE | 4 | 75 | 25 | 100 |
| | Lab course-I | Practicals based on course BT-I and BT-II | 4+4 | PR | 4 | 100 | | 100 |
| | Lab course-II | Practicals based on course BT-III and BT-IV | 4+4 | PR | 4 | 100 | | 100 |
| | | | | | **24** | **500** | **100** | **600** |

| Semester | Code | Title of the Course | Hr/Week | Type of Course | Credit | Marks | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | | ESA | MSA | |
| II | BT-V | Molecular Genetics | 4 | CC | 4 | 75 | 25 | 100 |
| | BT-VI | Immunotechnology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT-VII | Process Biotechnology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT-VIII | (A) Enzymology<br>(B) Nanobiotechnology | 4 | DSE | 4 | 75 | 25 | 100 |
| | Lab course-III | Practicals based on course BT-V and BT-VI | 4+4 | PR | 4 | 100 | | 100 |
| | Lab course-IV | Practicals based on course BT-VII and BT-VIII | 4+4 | PR | 4 | 100 | | 100 |
| | | | | | **24** | **500** | **100** | **600** |

**M.Sc. BT SY**

| Semester | Code | Title of the Course | Hr/Week | Type of Course | Credit | Marks | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | | ESA | MSA | |
| III | BT- IX | Genetic Engineering | 4 | CC | 4 | 75 | 25 | 100 |
| | BT- X | Industrial Biotechnology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT- XI | Plant Biotechnology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT- XII | English and Science Communication Skills | 2 | SDC | 2 | 40 | 10 | 50 |
| | BT- XIII | Intellectual Property Right/Online certification course NPTEL /SWAYM /MOOC of equivalent credit | 2 | OE | 2 | 50 | | 50 |
| | Lab course- V | Practicals based on course BT-IX and BT-X | 4+4 | PR | 4 | 100 | | 100 |
| | Lab course-VI | Practicals based on course BT-XI | 4 | PR | 4 | 100 | | 100 |
| | | | | | **24** | **515** | **85** | **600** |

| Semester | Code | Title of the Course | Hr/Week | Type of Course | Credit | Marks | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | | ESA | MSA | |
| IV | BT- XIV | Computational Biology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT- XV | Pharmaceutical Biotechnology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT- XVI | Enviromental Biotechnology | 4 | CC | 4 | 75 | 25 | 100 |
| | BT- XVIII (Elective) | (A) Animal Biotechnology<br>(B) Food Biotechnology | 4 | DSE | 4 | 75 | 25 | 100 |
| | Lab course-VII | Practicals based on course BT-XIV + XV+-XVI+XVII | 4+4 | PR | 4 | 100 | | 100 |
| | Lab course-VIII | Project/ Review Writing | 4 | PR | 4 | 100 | | 100 |
| | | | | | **24** | **500** | **100** | **600** |

**Note :**

2. Pattern of Internal Assessment

CC- Core Course, DSE- Discipline Specific Elective, ESA- End Semester Assesment, MSA- Mid Semester Assesment

SDC- Skill Development Course, OE- Open Elective

Total Credits: 96

**BT -I : Cell and Developmental Biology**

**Marks: 75** **M.Sc. BT FY** **Hours: 45**

**Objective:**

To understand the basics of Cell Biology and developmental Biology. To know the communication as well as transportation in cells. To become aware about the stem cell technology

**Outcome:**

Students will understand the basics of Cell Biology and developmental Biology and fundamentals of Cancer genetics. They will Identify the characteristics and basic needs of living organisms and ecosystems

**Unit I: Study of Cell & its architecture**

f cell size and shape, History & Evolution, Cell as the basic unit of life, cell theory, Structural organization of prokaryotes and eukaryotes. Biogenesis of Mitochondria, Chloroplast. Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structure and function of Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility

**Unit II: Cell-Cell interactions**

General principles of cell communication cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrin's. Neurotransmission and its regulation. Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing. Regulation of hematopoiesis,

**Unit III: Cell division & Cancer genetics**

Mechanism of cell division mitosis, meiosis and genetic recombination; regulation of cell cycle; factors and genes regulating cell cycle. Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth

**Unit IV: Developmental Biology**

Gametogenesis, Fertilization, cleavage, blastulation, Gastrulation & formation of germ layers in animals, Concepts of competence, determination, commitment and differentiation (dedifferentiation, re-differentiation, trans-differentiation) developmental plasticity in plant. Sex determination in plants & animals.

**Unit V: Gene patterning & stem cells**

Role of gene/s in patterning and development e.g. *Arabidopsis thaliana* (root, shoot, leaf & flower) *& Drosophila melanogaster* (maternal genes, bicoid, gap genes), Stem cells.

**Text and Reference:**


1. David Sadava; Cell and Molecular biology- Jones & Bartlett Publishers
2. Cell & molecular biology - Gerald karp :John Wills
3. Developmental biology- SF Gilbert Sinauer associates.
4. T.A. Brown – Genomes – Garland Science
5. Molecular Biology of the Cell- Alberts, B –Garland Science
6. Molecular cell Biology - Darnell, Lodish, Baltimore,-W.H. Freeman
7. Reproduction in Eukaryotic cells- DM Prescott, Academic Press.
8. Cell in Developmental and Inheritance- EB Wilson, MacMilan New York.
9. Fertilization-F T logo-Chapman and Hall
10. Molecular Biology of Steroid and Nuclear Hormone Receptors- LP Freedman,
11. Molecular Cloning: a Laboratory Manual- J. Sambrook, -CSHL Press,


**PRACTICALS:**

1. Microscopy: Bright field & phase contrast & fluorescence microscopy
2. Cell types of plants- Microtomy/ maceration of various tissue explants and identification
3. Study of Mitosis and Meiosis (root tips and anthers)
4. Study of karyotypes of genetic disorders and normal
5. Cell fractionation and separation at cell organelles chloroplast and Mitochondria
6. Pigment separation by TLC & Chromatography.
7. Analysis of chlorophyll amount by Spectrophotometer.
8. Drosophila culture: Cultivation, maintenance and *Drosophila* genetics study
9. Study of chick/ Frog/ Plant embryo for developmental study.

**BT -II: Microbiology and Virology**

**Marks : 75** **Hours 45**

**Objective:**

To understand the basic principles of Microbiology and Virology. To learn the cultivation methods of Microorganisms.

**Outcome:**

Students will understand the development of Microbiology and Virology. Also will learn the growth pattern of Microorganisms. They will know the methods of cultivation of bacteria and Viruses for Industrial and Human use

**UNIT I: The Beginning of Microbiology:**

Controversy over spontaneous generation, Development of pure culture methods.

**Bacteria:** Purple and green bacteria, Cyan bacteria, Homoacetogenic bacteria. Budding and append aged bacteria, Spirilla, Spirochetes, Gliding and sheathed bacteria, Pseudomonades; Lactic and prop ionic acid bacteria, Endospore forming rods and cocci, Mycobacterium, Rickettsia's, Chlamydia's and Mycoplasmas.

**Archaea:** Archaea as earliest life forms, Halophiles, Methanogens, Hyper-thermophilic archaea.

**UNIT II: Methods in Microbiology**

Theory and practice of sterilization, - Principles of microbial Nutrition, Construction of culture media. Microbial Evolution, Systematics and Taxonomy Evolution of earth and earliest life forms: Primitive organisms and their metabolic strategies and molecular coding; New approaches to bacterial taxonomy classification including Ribotyping; Ribosomal RNA sequencing; Characteristics of primary domains; Taxonomy, Nomenclature and Bergey's Manual.

**UNIT III: Microbial Growth**

The definition of growth, mathematical expression of growth, growth curve, measurement of Growth and growth yields; Synchronous growth: Continuous culture; Growth as affected by Environmental factors like temperature, acidity, alkalinity, water availability and oxygen.

**UNIT IV: General virology**

Discovery of viruses, Nomenclature, Classification, Structure of viruses, morphology and ultra structure. Virus receptors & entry into cell, Virus related agents Overview of viral replication; Assembly, Maturation & release from cell, Diagnostic Virology; Cultivation of viruses in embryonated eggs, animal cells and experimental animals, transgenic systems, Virus infectivity Assay (chemical and physical methods), PCR based diagnosis of viruses.

**UNIT V: Viruses:**

Life cycle of – Bacterial viruses (Lambda, M13), Plant viruses (TMV, and CMV) Animal viruses (Herpes and Retro)

**Text and Reference:**


1. General Microbiology-Stainer.- MacMillan Press Ltd.
2. Brock, Biology of Microorganisms, Madigan, M.T.. Martinko. -Prentice Hall.
3. Microbiology, Pelczar, M.J. Jr., Chan, E.C.S. and Kreig, N.R., -Tata McGraw Hill.
4. Microbial Genetics, Freifelder, D. -Jones, Bartlett Publishers.
5. Microbiology - A Laboratory Manual, Cappuccino, J.G. and Sherman, N. -Addison Wesley.
6. Bacterial and Bacteriophage Genetics– Edward Birge- Springer
7. Mathews Plant Virology- Academic Press
8. Virology Principles and Applications- John Carter, Venetia A. Saunders-Wiley
9. Introduction to Modern Virology IV l edition- Dimmock, Primrose
10. Plant Virus- M.V. Nayudu- Tata McGraw Hill


**Practical :**

1. Preparation of liquid and solid media for growth of microorganisms.
1. Isolation and maintenance of organisms from soil and water by plating, streaking and serial dilution
2. Plate, Slants and stab cultures, Storage of microorganisms.
3. Study of microbial growth and factors affecting on growth temperature, pH, carbon and nitrogen
4. Staining and Microscopic examination of bacteria, yeast and molds
5. Assay of antibiotics and demonstration of antibiotic resistance.
6. Analysis of potable water and determination of MPN.
7. Biochemical characterization of selected microbes.
8. Measurement of Size of microorganism by Micrometry
9. Cultivation and study of Coli phage and one step growth curve of coli phage.
10. Cultivation study of virus in embryonated chiken eggs, Hemagglutination assay

**BT - III: Biochemistry**

**Marks :75** **Hours: - 45**

**Objective:**

1) Structure, classification and the properties of Biomolecules
2) Functions of biomolecules in Human health
3) Laboratory skills for the study of biomolecules

**Outcomes:**

Students will understand the Structure, classification and the properties of Biomolecules. They will acquire the basic laboratory skills for the isolation and separation of biomolecules

**UNIT I: Chemical foundations of Biology-**

Structure of atoms, molecules and chemical bonds; Ionization of water, properties of water, The pH scale, concept of acids and bases, Henderson- Hasselbach equation, biological buffer systems. Thermodynamic principles in biology, Concept of free Energy and redox potential

**UNIT: II Carbohydrates:**

Classification occurrence, structure, function and properties of monosaccharide, oligosaccharide and polysaccharides.

**Lipids:** Classification, structure and functions of major lipids, Triglycerides, Phospholipids, Steroids and terpenes. Glycolipids and lipoproteins-structure and function. Role of lipids.

**UNIT: III Amino acids**:

Classification and chemical reactions and physical properties. Peptide bond, peptide classification, biologically important peptides.

**Proteins:** Properties and classification, primary, secondary, tertiary and quaternary structure of proteins with example, structural comparison at secondary and tertiary levels. Ramachandran plot.

**Enzymes:** Historical perspectives, general characteristics, nomenclature and classification. Methods of isolation, purification and characterization of enzymes. Concept of enzyme assay, enzyme activity, coenzymes and isoenzymes.

**UNIT: IV Nucleic acids:**

Primary, secondary and tertiary structure of nucleic acids, double stranded DNA and biological significance, forms of DNA, Physical properties of double stranded DNA, Types of RNAs and their biological significance. DNA Supercoiling.

**UNIT:V Hormones:**

Structure and function; **Vitamins**: Types, structure and functions; Prostaglandins; Silk fibroin, coiled coils, collagen triple helix and hemoglobin.

**Text and Reference:**

1. Principles of Biochemistry - Lehninger , Nelson, Cox, CBS publishers
2. Fundamentals of Biochemistry - Voet and Voet- John Wiley and Sons, Inc.
3. Biochemistry - Zubay - WCB publishers
4. Harper's Biochemistry - R.K.Murray, D.K.Granner, P.A.Mayes –McGraw Hill
5. Biochemistry - L. Stryer-W.H. Freeman
6. Biochemistry –Rawn
7. Biochemistry- U Satyanarayana

**Practicals:**

1. Study of General and Safety Rules of Biotechnology Laboratory
2. Concept of Buffers, pH, Morality and Normality (Problem solving and preparation )
3. Reaction of amino acids, sugars, lipids
4. Estimations of Carbohydrates and Sugars
5. Estimation of amino acids, proteins
6. Titration of amino acids and determination of pKa
7. Estimations of DNA & RNA
8. Analysis of oils, iodine number, saponification value, acid number
9. Cholesterol estimation
10. UV visible fluorescence & IR spectroscopy absorption spectra
11. Enzyme assay

**BT- IV A**: **Techniques in Biology**

**Marks 75** **Hours 45**

**Objective:**

To know the basic principles, working and applications of biological techniques like Microscopy, electrophoresis, chromatography and spectroscopy.

**Outcome:**

Students will learn the working principles of biological techniques like microscopy, electrophoresis, chromatography and spectroscopy. They will use these biological techniques in research and development.

**UNIT I : Microscopy:**

Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope. Centrifugation: Principles, RCF and Types of centrifuges, types of rotors, preparative and analytical ultra-centrifuge.

**Electrochemical techniques**: Principles of electrochemical techniques, redox reactions, the pH electrode, ion-sensitive and gas-sensitive electrodes, The Clark oxygen electrode.

**UNIT II: Chromatographic techniques:**

Principles of chromatography, lon-exchange and affinity chromatography. High performance liquid chromatography (HPLC), Gas liquid chromatography (GLC), Thin layer chromatography (TLC), Paper chromatography, GC-MS, LC-MS, Maldi Tof.

**Electrophoresis:** General principles, SDS-PAGE , Native gels, Gradient gel, Iso electricfocusing, 2-D gel electrophoresis (2-D PAGE), Detection, estimation and recovery of proteins, Western blotting. Electrophoresis of nucleic acids: agarose gel electrophoresis of DNA, DNA sequencing gels, Pulse field gel electrophoresis, Capillary electrophoresis.

**UNIT III: Spectroscopic techniques:**

Properties of electromagnetic radiation, interaction with matter. Gamma ray spectroscopy, Xray spectroscopy, UV and Visible spectroscopy, Infrared and Raman spectroscopy, Electron spin resonance spectroscopy, Nuclear magnetic resonance spectroscopy, Circular dichorism spectroscopy, Atomic spectroscopy, x-ray diffraction, x-ray crystallography. Spectrofluorimetry, turbidometry and nephelometry.

**UNIT IV : Radio isotope techniques:**

The nature of radioactivity, detection and measurement of radioactivity: detection based on gas ionization- Geiger Muller counter- principles and applications. Detection based on excitation- Liquid Scintillation counter-principle and applications. Supply, storage and purity of radiolabelled compounds, specific activity, inherent advantages and restrictions of radiotracer experiments, safety aspects, applications- of radio isotopes in biological sciences. Flowcytometry, ELISA, immunoblotting.

**UNIT V: Biosensor**

Principle, construction, mechanism and applications of biosensor with one example. (Enzyme and cell based)

**Text and Reference:**


1. Physical Biochemistry by D. Freifelder W. H. Freeman
2. Practical Biochemistry- Principles and techniques-Wilson & Walker.; Cambridge Press
3. Practial Biochemistry -David T Plummer, Tata McGraw- Hill
4. Instrumental methods of chemical analysis - P.K. Sharma
5. Biophysical chemistry - Upadhyay. Upadhyay and Nath-Himalaya
6. Handbook of Biomedical Instrumentation - R.S. Khandpur, Tata McGraw Hill
7. Principles Of Physical Biochemistry-K Holde, W Johnson-Pearson/Prentice Hall
8. Biosensors-Cooper and Cas- Oxford


**Practicals :**

1. Study of standard operating protocols, validation and calibrations of instruments
2. Electrophoresis of proteins under native and denaturing conditions (PAGE)
3. Separation of proteins / pigments using column chromatography
4. Demonstration of techniques : GC,HPLC and atomic absorption spectroscopy AAS
5. Theory & Principal, operation of microscopes centrifuges, spectrophotometers, chromatographic techniques, electrophoresis, radio isotopic techniques
6. Methods based on centrifugation, electrochemical techniques, spectrophotometer
7. Methods on TLC , Paper Chromatography
8. SDS PAGE , 2D Gel electrophoresis capillary , electrophoresis western blotting,
9. ELISA, Immunoblotting
10. Demonstration of flowcytometry liquid scintillation counter , Geiger Muller counter

**BT-IV B : Plant Metabolism and Development**

**Marks 75** **Hours 45**

**Objective:**

To learn the fundamental process in plant system. To understand the basic aspects of plant physiology.

**Outcome:**

Students will learn the plant water relationship, mechanism of photosynthesis and respiration. They will explain the mechanism of plant reproduction.

**UNIT-I**: PLANT WATER RELATIONSHIP

Physical and chemical properties of water, diffusion, osmosis, plasmolysis, stress physiology, Whole Plants and Inorganic Nutrients, theories of absorption of mineral salt ions – contact exchange theory, carbonic acid exchange theory, mechanism of active absorption, Nutrient Uptake –Transport Systems - Translocation in the Phloem,

**UNIT-II:** PHOTOSYNTHESIS AND RESPIRATION

The Light Reactions - Mode of Action of Some Herbicides - Dark Reactions - Oxidative Photosynthetic Carbon Cycle –C3, C4 and CAM pathway, Respiration: Mitochondrial electron transport; Glycolysis; synthesis of ATP, respiratory pathways- PPP; regulation of Respiration; Photorespiration: Glyoxylate pathway.

**UNIT-III**: LIGHT AND HORMONAL CONTROL OF PLANT GROWTH

Photoperiodism - Phytochrome Regulation of Gene Expression - Blue-Light Responses - Guard Cell Osmoregulation – Auxin - Growth Hormone – Gibberellins - Regulators of Plant Height – Cytokinins - Regulators of Cell Division – Ethylene - Gaseous Hormone - Abscisic Acid - A Seed Maturation and Anti stress Signal - Circadian Rhythms.

**UNIT-IV**: PLANT DEVELOPMENT

Stamen and Androecium - Pollen Development - Carpel and Gynoecium - Ovule and Embryo Sac -Pollination and Pollen-Stigma Interaction – Pollen tube germination, growth and Fertilization - Endosperm- Embryo

**Text and Reference:**

1. David Sadava; Cell and Molecular biology- Jones & Bartlett Publishers
2. Cell & molecular biology - Gerald karp: John Wills
3. Developmental biology- SF Gilbert Sinauer associates.
4. T.A. Brown – Genomes – Garland Science

5. Molecular Biology of the Cell- Alberts, B –Garland Science
6. Molecular cell Biology - Darnell, Lodish, Baltimore,-W.H. Freeman
7. Reproduction in Eukaryotic cells- DM Prescott, Academic Press.
8. Cell in Developmental and Inheritance- EB Wilson, MacMilan New York.
9. Fertilization-F T Logo-Chapman and Hall

**Practical:**

1. Experiment based on osmosis
2. Experiment based on plasmolysis
3. Effect of time on the rate of reaction of enzyme
4. Estimations of proteins
5. Study of pollen germination by hanging/seating drop method
6. Estimation of different plant hormones from plants
7. Study of different Photosynthetic Inhibitors
8. Study of Pollen viability
9. Study of different types of Ovules
10. Separations of photosynthetic pigments
11. Study of Respiratory Quotient (R.Q,)

**BT V: Molecular Genetics**

**Marks 75** **Hours 45**

**Objective:**

To learn the Principles of Mendelian inheritance. To understand the Genome organization and gene regulation of Prokaryotes and eukaryotes.

**Outcome**:

Students will acquire the laboratory skills for the isolation if genetic material. They will learn the biochemistry of DNA and RNA. Students will analyze the gene interactions

**Unit I:**

Principles of Mendelian inheritance and Gene interactions: incomplete dominance, codominance, epistasis, complementary genes, duplicate genes, polymeric genes, modifying genes, lethal genes. Population and gene frequencies; The Hardy Weinberg Law. Genetic diseases due to defects in Autosome and Sex chromosomes. Gene transfer in Prokaryotes, Recombination.

**Unit II:**

Genome organization of Prokaryotes-Bacteria and virus system.

Genome organization of Eukaryotes- Structure and types of chromosome, heterochromatin, eu-chromatin, nucleosome. Variation in chromosome number, chromosome structure. Denaturation and Renaturation DNA, C-value paradox, Cot curve.

**Unit III:**

DNA as genetic material, Genome Replication in prokaryote & eukaryotes, enzymes involved, replication origin and replication fork, mechanism of replication, elongation and termination.

DNA damage and repair mechanisms. Homologous and site-specific recombination, transposition.

**Unit IV:**

RNA synthesis and processing, transcription factors and machinery, RNA polymerases, co and post transcriptional RNA processing. RNA transport, RNA Stability and Half-life period. Protein synthesis- Ribosome, Genetic code, t-RNA, initiation, elongation, termination of translation. Post translational modification of proteins.

**Unit V:**

Gene regulation in prokaryotes-operon concept, Lactose, Tryptophan and Arabinose. Role of cAMP and CRP in lac operon, trp operon. Catabolite repression. Gene regulation in eukaryotes at transcription and translation level. Regulation of gene expression in phages, viruses, role of chromatin in gene expression and gene silencing.

**Reference Books-**

1. Understanding DNA-The molecule how it works - Chris R. Calladine, Elsevier Pub.
2. Gene IX-Benjamin Lewin –Jones and Barrtlett Pub.
3. Principles of Genetics -Simmons and Snustad- Wiley International Pub.
4. Molecular Biology of the Gene -J.D. Watson-Pearson Pub.
5. The Biochemistry of Nucleic Acids -Adams, Knowler And Leader-Chapman Hall Pub.

6. Molecular Biology of the Cell -Lodish, Berk-Freeman Pub.
7. Developmental Biology -Scott F. Gilbert-Sinahauer associate Pub.
8. Developmental genetics-G.S.Miglani-I.K.InternationalPub.
9. Molecular Biology of the Cell- Albert Bruce- Garland Science Publication
10. Genome- T.A. Brown- John Wiley
11. Fundamentals of Cell and Molecular biology-Baig, Telang and Ingle-Amruta
12. Genetics a Molecular Approach- T.A Brown- John Wiley

**Practical:**

1. Problems based on Gene linkage, Sex linked inheritance and Crossing over.
2. Genetic recombination (conjugation, transformation, transduction) in bacteria
3. Study of mutations, Ames test
4. Study and isolation of mutants by Replica plate technique
5. Isolation of antibiotic resistant bacteria by gradient plate method
6. Study to mutation and repair in bacteria /yeast
7. Study of spontaneous mutation by Fluctuation test
8. Isolation of genomic DNA/RNA from bacteria, animal and plant cells.
9. Isolation of plasmid DNA /Phage DNA.
10. Spectroscopic analysis of DNA/ RNA
11. Agarose gel electrophoresis.
12. Study of in vitro transcription and translation

**BT VI: Immuno-technology**

**Marks :75** **Hours : 45**

**Objective:**

To understand the basic concepts of Immune System Cells and organs of immune system.
To learn the vaccines and development in vaccine technology

**Outcome:**

Students will learn the various components and working of immune system. They will acquire the techniques for the development of vaccines

**UNIT I:**

Basic concepts of Immune System Cells and organs of immune system, Immunity Humoral and cell mediated, Hematopoiesis and differentiation.
Antigens- General properties, types, epitope, hapten, adjuvant.
Antibodies- Types, biological functions. Biology of Superantigen. BCR & TCR (structure & properties), MHC Antigen processing and presentation Maturation and Activation of B-cells Maturation and Activation of T-cells

**UNIT II:**

Complement system; complement activation pathways, biological consequences of complement activation.
Hypersensitivity: Components, Mechanisms of degranulation, Mediators, Consequences, Transfusion reactions, Localized reactions, generalized reactions, Delayed type hypersensitivity

**UNIT III:**

Autoimmunity: Organ specific autoimmune diseases (Hashimoto's thyroiditis, Autoimmune anemia, Insulin dependent diabetes mellitus) Systemic autoimmune diseases (SLE, Multiple sclerosis, Rheumatoid arthritis) Treatment of autoimmune diseases Transplantation Immunology: Types of graft, Specificity and memory of rejection response, Mechanisms involved in graft rejection, Clinical manifestations of graft rejection Immunity to infectious diseases, Tumor Immunology

**UNIT IV**

Immunodeficiency: Primary immunodeficiency (SCID, X-linked agammaglobulinemia, Defects in complement system), Secondary immunodeficiency (AIDS), Treatment of immunodeficiency diseases. Immunity to Infectious Agents Bacteria Viruses Malaria Anthrax and Helminthes. Immunological reactions: Precipitation. Agglutination, Radioimmunoassay, ELISA, Western Blotting, Flow cytometry and Fluorescence. Immunoelectron microscopy, RIA

**UNIT V:**

Vaccine technology and recombinant vaccines, Identifications of B and T epitopes for vaccine development. *in situ* characterization of cells in tissues. Hybridoma technology, monoclonal antibody production and applications. Catalytic antibodies, FACS.

**Reference Books**

1. Kuby Immunology- Goldsby, Kindt, Osborne.-W,H Freeman
2. Cellular & Molecular Immunology- Abbas, Lichtman, Pillai.-Elsevier publications.
3. Roitt's Essential Immunology- Deives, Martin, Burton, Roitt-Blackwell publications.
4. Cellular interactions & Immunobiology- Butterwort & Heinemann.
5. Review of Medical Microbiology & Immunology- Warren Levinson.-McGraw Hill
6. Immunology an introduction- Tizard- Thomson publications.
7. Immunology. B, Hannigan- Viva books Pvt. Ltd.
8. Immunology & Serology- K. R. Joshi, N.O. Osamo. Student edition.

**Practical**

1. Determination of ABO Blood group
2. Determination of total leukocyte count
3. Determination of differential leukocyte count
4. Determination of bleeding time & clotting time of blood.
5. Dissection and identification of thymus, spleen & lymph nodes
6. Radial immunodiffusion, double diffusion
7. Study of Ag-Ab reactions Widal, VDRL
8. Immuno electrophoresis
9. Latex agglutination
10. ELISA, Western Blotting
11. Rocket immuno electrophoresis
12. Radioimmunoassay

**BT VII: Process Biotechnology**

**Marks: 75** **Hours: - 45**

**Objective:**

To learn the microbial techniques for the Isolation, Screening, Preservations and maintenance of Microorganisms. To become aware about the designs and types of bioreactors.

**Outcome:**

Students will understand the various laboratory methods for the isolation and preservation of Microorganisms. They will learn the Industrial use of bioreactor and also become aware about the media optimization.

**Unit I**

Isolation, Screening, Preservations and maintenance of Microorganisms, Strain improvement, Mutagenesis, Genetic Engineering for Strain Improvement. Selection of Mutants producing improved level of Primary Metabolites with suitable Example. Isolation of mutants which do not produce feedback inhibitors or repressors. Isolation of mutants which do not recognize presence of inhibitors or repressors. Modification of Permeability.

**Unit II**

Basic aspect of Bioreactor Designing, Types of Bioreactors, Ideal Properties of Bioreactor, Body Construction, Agitator, Impeller, Baffles, etc. Types of Bioreactor: Packed-bed reactor, Air –lift, Trickle bed, Photo bioreactors, Rotating Biological Reactors

**Unit III**

Fluid flow and mixing, Classification of fluids, concept of Reynolds's number, Rheological properties of fermentation process (Viscosity, cell concentration, product concentration etc.) Mass transfer in bioreactors (Oxygen and heat transfer). Measurement and control of Bioprocess parameters, Automation for monitoring and Control (online and offline sensors, Biosensors) Use of Computers: Data logging, data analysis, and process control, Process scale up: factors involved, steps involved, Immobilization techniques for cell and enzyme

**Unit IV**

Media formulation & optimization its need and significance, Sterilization of media and air, exhaust air, Batch sterilization; Del factor D and Z value, Continuous Sterilization: Design and Methods, sterilization kinetics, inoculum development.

**Unit V**

Microbial growth and its kinetics (Batch & Continuous) Types of Processes-Batch, fed batch, continuous, concept of scale up of fermentation. Comparative account of batch and continuous sterilization. Types of fermentation processes, Comparison between SSC and SLC, Factors affecting solid-state fermentations, Economic Applications.

**Reference Books:**

1. Basic Biotechnology- Colin Ratledge – Cambridge Publication
2. Fundamentals of Biochemical Engineering -Bailay & ollis- TataMcGraw Hill
3. Principles of Bioprocess Engineering.-Pauline M. Doran – Elsevier Publication
4. Basic of Bioprocess Engineering- Shuler and Kargi
5. Comprehensive Biotechnology Vol III- Mooyoung Elsevier Publication
6. Principles of Fermentation Technology- Stanbury Whitkar – Elsevier Publication
7. Introduction to Industrial microbiology- Cruger-ACS Publication
8. Industrial microbiology- Casida- ACS Publication

**Practical:**

1. Media formulation and optimization
2. Study of Growth Kinetics of Bacteria and Yeast by turbidometry & SCP
3. Screening of industrially important microorganism- Acids, Antibiotics, Enzymes
4. Study of scale up of fermentation
5. Study of design of bioreactor
6. Determination of TDP
7. Determination of TDT and design of sterilizer
8. Study of types of fermentation process (Surface and submerged)
9. Problems based on: - Growth kinetics, fluid flow, Reynolds's number
10. Visit to fermentation Industry

**BT VIII A: Enzymology**

**Marks :75** **Hours : 45**

**Objective:**

To know the fundamental details of Enzymes. To learn the various methods of enzyme immobilization and enzyme kinetics.

**Outcome:**

Students will learn the role of enzyme in human health and their industrial applications. They will acquire the laboratory knowledge for the industrial enzyme products.

**Unit- I:**

Enzyme Classification, Characteristics of enzymes, enzyme substrate complex. Concept of active centre, binding sites, stereo specificity. Effect of temperature, pH and substrate concentration on reaction rate. Activation energy. Transition state theory. Enzyme catalysis. Factors affecting catalytic efficiency proximity and orientation

**Unit-II:**

Enzyme kinetics: Michaelis – Menten Equation – form and derivation, steady state enzyme kinetics. Significance of Vmax and Km. Bisubstrate reactions. Allosteric Reactions and regulation: Protein ligand binding including measurements, analysis of binding isotherms, Cooperativity, Hill and Scatchard plots and kinetics of allosteric enzymes. Enzyme regulation: Product inhibition, feedback control, enzyme induction and repression and covalent modification.

**Unit–III:**

Enzyme inhibition – types of inhibitors – competitive, non-competitive and uncompetitive, their mode of action and experimental determination. Enzyme activity, international units, specific activity, turnover number, end point kinetic assay.

**Unit –IV:**

Immobilized Enzymes: Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and Km). Various methods of immobilization ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment.

**Unit V:**

Multi-enzyme system: Occurrence, isolation and their properties: Mechanism of action and regulation of pyruvate dehydrogenase complex. Enzyme-enzyme interaction, multiple forms of enzymes with special reference to lactate dehydrogenase

**Reference Books**

1. Fundamentals of Enzymology- Price and Stevens-Oxford
2. Enzymes – Dixon and Webb
3. Fundamentals of Enzyme Kinetics- Athel Cornish-Bowden- Wiley Blackwell
4. Enzyme Kinetics: Principles and Methods- Hans Bisswanger-Wiley

5. Enzymes-Paul F. Cook, W. W. Cleland- Taylor and Francis
6. Enzymes-_Palmer & Bonner – Woodhead Publishing
7. Isoenzymes – By D. W. Moss
8. Nelson and cox- Lehninger Principles of Biochemistry- W.H. Freeman
9. Basic Biochemical Methods- 2nd ed by R.R.Alexander and J.M.Griffith.
10. Hawk's Physiological Chemistry- ed. By Bernard L Oser.
11. A Textbook of Practical Biochemistry –by David Plummer
12. Cohn and stumpt- Outline of Biochemistry- Wiley India

**Practical**

1. Identification and quantitation of activity of Amylase, cellulose, invertase
2. Alkaline phosphatase (salivary/microbial/animal/plant source).
3. Determination of specific activity, in presence of activators/ inhibitors.
4. Study of effect of pH/ temperature /inhibitor on enzyme activity.
5. Separation and identification of amino acid mixture by chromatography technique.
6. Separation and identification of serum proteins by PAGE
7. Separation of proteins (hemoglobin & cytochrome c) chromatography
8. Study of Immobilization of enzymes
9. Purification of protein by ion exchange chromatography. [DEAE cellulose chromatography]
10. Determination of activity of invertase from immobilized cells of Saccharomyces cerevisiae.

**BT-VIII B : Nano-biotechnology**

**Marks :75** **Hours : 45**

**Objective:**

To know the use of Biotechnology at nanoscale and learn the various methods for the development of nanoparticles and IPR

**Outcome:**

Students will understand the use of Nano-biotechnology in various areas like agriculture, medicine, cosmetics and environment. They will learn the rights of Intellectual properties

**Unit I: Nano-Biotechnology**

Introduction, The nanoscale dimension and paradigm. Types of nanomaterials and their classifications. D, 2D and 3D etc. Nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc. Polymer, Carbon, Inorganic, Organic and Biomaterials – Structures and characteristics. Physical and Chemical Fundamentals of Nanomaterial

**Unit II: Nano-Biotechnology Applications**

Proteins - Lipids - RNA and DNA Protein Targeting - Small molecule/Nanomaterial – Protein Interactions Nanomaterial-Cell interactions-Manifestations of Surface Modification (Polyvalency) MRI, Imaging Surface Modified Nanoparticles MEMS/NEMS based on Nanomaterials.

**Unit III :Biological Nanoparticles**

Lipid Nanoparticles for Drug Delivery. Peptide/DNA Coupled Nanoparticles. Inorganic Nanoparticles for Drug Delivery Metal/Metal Oxide Nanoparticles (antibacterial/anti fungal/anti viral) Anisotropic and Magnetic Particles (Hyperthermia)

**Unit-IV**

Applications of Nanotechnology/ Nano-biotechnology in various areas like agriculture, medicine, cosmetics and environment. Intellectual Property Rights:- Concept of IPR, Patents, Trademarks, Copyrights, Secrets. Patenting of biological materials.

**Text & References**


1. Madhuri Sheron, Sunil Pande- Bio-Nano technology concept and applications Ane Books New Delhi
2. Mark Ratner, Daniel Ratner-Nanotechnology-Pearson
3. Ramsden-Nanotechnology- an Introduction-Elsevier
4. Ed. Vincent Rotello – Nanoparticles- Springer
5. C. M. Niemeyer- Nano-biotechnology, C.A. Mirkin, Wiley VCH, 2004
6. T. Pradeep, ―Nano: The Essentials‖, McGraw – Hill education, (2007).
7. P. Boisseau, P. Houdy and M. Lahmani - Nanoscience: Nano-biotechnology and Nano-biology, Springer, 2007.
8. S. M. Lindsay - Introduction to nanoscience, OXFORD publication
9. Anke Krueger- Carbon materials and nanotechnology –Wiley- VCH publication
10. S. K. Kulkarni- Nanotechnology- (3rd Edition)
11. M.H. Fulekar- Nanotechnology: Importance and Applications, IK International 2010.


**Practical**

1. Demonstration of techniques for isolation and synthesis of nanoparticles
2. Isolation and detection of nano particles from plant extract (silver nano particles)
3. To study antibacterial/antifungal activity of nanomaterial
4. Extraction and estimation of protein
5. Isolation of DNA from Bacteria/Plant/Animal material.
6. Spectrophotometric analysis (UV/IR) of nano particles
7. Study of IPR, Patent applications process in concern with nano materials derived from living system