।। 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
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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील द्वितीय वर्षाचे **CBCS Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७–२०२०**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील द्वितीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

1. B.Sc.-II Year-Biophysics	2. B.Sc.-II Year-Bioinformatics
3. B.Sc.-II Year-Biotechnology	4. B.Sc.-II Year-Biotechnology (Vocational)
5. B.Sc.-II Year-Food Science	6. B.Sc.-II Year-Botany
7. B.Sc.-II Year-Horticulture	8. B.Sc.-II Year-Agro Chemical Fertilizers
9. B.Sc.-II Year-Analytical Chemistry	10. B.Sc.-II Year-Biochemistry
11. B.Sc.-II Year-Chemistry	12. B.Sc.-II Year-Dyes & Drugs Chemistry
13. B.Sc.-II Year-Industrial Chemistry	14. B.C.A. (Bachelor of Computer Application)-II Year
15. B.I.T. (Bachelor of Information Technology)-II Year	16. B.Sc.-II Year-Computer Science
17. B.Sc.-II Year-Network Technology	18. B.Sc.-II Year-Computer Application (Optional)
19. B.Sc.-II Year-Computer Science (Optional)	20. B.Sc.-II Year-Information Technology (Optional)
21. B.Sc.-II Year-Software Engineering	22. B.Sc.-II Year-Dairy Science
23. B.Sc.-II Year-Electronics	24. B.Sc.-II Year-Environmental Science
25. B.Sc.-II Year-Fishery Science	26. B.Sc.-II Year-Geology
27. B.Sc.-II Year-Mathematics	28. B.Sc.-II Year-Microbiology
29. B.Sc.-II year Agricultural Microbiology	30. B.Sc.-II Year-Physics
31. B.Sc.-II Year Statistics	32. B.Sc.-II Year-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/पदवी–सीबीसीएस अभ्यासक्रम/२०२०–२१/**३३३**

दिनांक : १५.०७.२०२०.

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.

B.Sc. Biotechnology First Year (First & Second Semester -2019)

Semester	Code	Title of the Course	Hrs./Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
I	AECBT-IA	Functional English	4	AEC	4	75	25	100
	CCBT-1A	Introduction to Biotechnology	4	CC	4	75	25	100
	CCBT-2A	Basic Bioscience	4	CC	4	75	25	100
	CCBT-3A	Microbiology-I	4	CC	4	75	25	100
	Lab course I	Practical's based on AECBT 1A and CCBT1A	03+03	PR	4	100		100
	Lab course II	Practicals based on CCBT 2A and 3A	03+03	PR	4	100		100
					24	500	100	600

Semester	Code	Title of the Course	Hrs./Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
II	AECBT - 2A	Business Communication	4	AEC	4	75	25	100
	CCBT - 1B	Principles of Genetics	4	CC	4	75	25	100
	CCBT - 2B	Biomolecules	4	CC	4	75	25	100
	CCBT - 3B	Microbiology-II	4	CC	4	75	25	100
	Lab Course III	Practicals based onAECBT2A and CCBT 1B	03 + 03	PR	4	100		100
	Lab course IV	Practicals based on CCBT 2B+ 3B	03 + 03	PR	4	100		100
					24	500	100	600

B.Sc. Biotechnology Second Year (Third & Fourth Semester -2020)

Semester	Code	Title of the Course	Hrs./ Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
III	CCBT-1C	Metabolism	4	CC	4	75	25	100
	CCBT-2C	Advanced cell biology	4	CC	4	75	25	100
	CCBT-3C	Molecular Biology	4	CC	4	75	25	100
	DSEBT-4C	I - Bioinstrumentation Techniques II - Plant Physiology	4	DSE	4	75	25	100
	SEC-I	IA) Algal Culture Technology IB) Culturing and Maintenance of Microorganisms.	2	SEC	2	25	25	50
	Lab CourseV	Practicals based on CCBT 1C+2C	4	PR	4	100		100
	Lab Course VI	Practicals based on CCBT 3C+4C	4	PR	4	100		100
					26	550	100	650

Semester	Code	Title of the Course	Hrs./ Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
IV								
	CCBT-1D	Basic Enzymology	4	CC	4	75	25	100
	CCBT-2D	Applied & Medical Microbiology	4	CC	4	75	25	100
	CCBT-3D	Immunology and Virology	4	CC	4	75	25	100
	DSEBT-4D	I - Basics of Computer II - Plant Tissue Culture	4	DSE	4	75	25	100
	Sec-II	IIA) Diagnostic Biology IIB) Enzyme Technology	3	SEC	2	25	25	50
	Lab Course VII	Practicals based on CCBT 1D+ 2D	3+3	PR	4	100		100
	Lab Course VIII	Practicals based on CCBT 3D+ 4D	3+3	PR	4	100		100
					26			650

Metabolism - CCBT-1C

Maximum Marks: 75 **Hours: 45** **Credits: 03**

Course objectives: The course is aimed to impart knowledge of structural and functional aspects of biomolecules in living systems. To understand the role of carbohydrate and fatty acids in providing the energy to the living system by its oxidation. To understand the biosynthesis of carbohydrate and fatty acids

UNIT I: Carbohydrate Metabolism

Photosynthesis: - Trapping of solar energy into chemical energy (PS-I & PS-II) in green plants, utilization of this energy to synthesize carbohydrate (Calvin cycle, cycle in C-4and CAM plants), photorespiration (C-2 cycle).

UNIT II: Carbohydrate Catabolism

Concept of respiration, Aerobic respiration: - Glycolysis, Krebs cycle and electron transport chain and anaerobic respiration

Unit III

Fatty acid oxidation, Oxidation of saturated fatty acids, role of carnitine, oxidation of unsaturated fatty acids & odd carbon fatty acids.

Metabolic breakdown of amino acids, Transamination (mechanism). Oxidative & Non-oxidative Deamination. Urea cycle, metabolic disorders of urea cycle.

Unit IV

Biosynthesis of Fatty acids: The fatty acid synthase complex, regulation, Microsomal & Mitochondrial system of chain elongation and synthesis of unsaturated fatty acids.

Text and Reference:

1. Hayne -Biological thermodynamics -Oxford
2. G Gottschalk-Bacterial Metabolism (2nd Ed) - Springer
3. Nelson & Cox- Lehninger Principles of Biochemistry – W.H. Freeman
4. Lehninger Principles of Biochemistry- Kalyani Publication
5. Stryer- Biochemistry –W.H. Freeman
6. Voet&Voet- Biochemistry – Wiley
7. Cohn and stumpt- Outlines of Biochemistry – Wiley India
8. P.M.Dey- Plant Biochemistry-Academic Press
9. B.P. Pandy- Plant Physiology –Vikas
10. Herper -Biochemistry – McGraw Hill
11. S.K. Verma- Plant Physiology & Biochemistry- S.Chand
12. Bioenergetics by Lehninger- W. A. Benjamin

Practicals :

1. Detection of sugars by Paper chromatography / TLC
2. Separation of Photosynthetic pigments by TLC
3. Demonstration of Hill Reaction
4. Study of Enzymatic hydrolysis of Lipids
5. Demonstration of aerobic and anaerobic respiration in microorganisms
6. Estimation of fatty acids by suitable method.

7. Extraction and Purification of lipids; Thin layer Chromatography
8. Extraction and Purification of amino acids; Thin layer Chromatography

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

1.Know the chemical constituents of cells, the basic units of living organisms.

2.Explain the role of biomolecules in living system.

3.Know the role of biomolecules for orderly structures of the cells/tissues.

Advanced Cell Biology- CCBT-2C

Maximum Marks: 75 **Hours: 45** **Credits: 03**

Course objectives: The course is aimed to impart knowledge of structural and functional aspects of cells as unit of living systems. To understand functions of various organelles and transport of information and matter across cell membrane.

UNIT 1: Introduction to cell:

Diversity of cell size and shape, History & Evolution, Cell as the basic unit of life, cell theory, Structural organization of prokaryotes and eukaryotes.

UNIT 2: Molecular architecture of cell:

Structure organization and function of plasma membrane (Membrane proteins, lipids.), Cell wall, Cell organelles: Endoplasmic Reticulum (Rough & Smooth), Mitochondria, Chloroplast,vRibosome, Golgi apparatus, Lysosome, Melanosome, Nucleus (Nuclear membrane & nuclearv pore, Nucleoplasm, Nucleolus) ,Cytoskeleton: Microtubules, Microfilament, intermediate filaments, Microbodies: Glyoxisome, Peroxisomes. Locomotory organs: Cilia& flagella.

UNIT 3**: Cell transport:**

Cellular transport: Transport across cell membrane, Passive transport: Simple diffusion & osmosis; Active Transport: Endo & Exo cytosis, Phagocytosis, Pinocytosis, Na/Ki on Channel, Vesicular transport.

UNIT 4: Cellular regulation:

Cell division and cell cycle– General events of Mitosis and Meiosis; Apoptosis, neoplasia and cell death; Cell junctions and cell matrix interactions (Plasmodesmata, GAP junction tight junction, Desmosome); Cell signaling: G protein coupled receptor, Autocrine signaling; Brief introduction of Cancer biology.

Textbook and references:

1. Verma Agrawal; Cell Biology-S. Chand.
2. Gerld Carp- Cell and Molecular biology–Wiley
3. David Sadava; Cell and Molecular biology. Jones & Bartlett Publishers
4. P. S. Verma, V. K. Agarwal - Cytology -S. Chand
5. C. B. Powar - Cell biology- Himalaya Pub.
6. Lodish- Cell and Molecular biology -W. H. Freeman
7. Albert Bruce-Molecular Biology of the Cell – Garland
8. De Robertis; Cell and Molecular biology – Lippincott Williams & Wilkins

Practical's:

1. Study of different Cell types
2. Subcellular fraction and isolation of – mitochondria and chloroplast
3. Study of Meiosis by maceration technique
4. Study of Mitosis by maceration technique
5. Study of karyotyping to fid chromosomal position
6. Study of Osmosis, and membrane selective permeability
7. Study of Polytene Chromosome.
8. Study of Microscopy; Bright field Microscope/Light microscope
9. Determination of cell density by turbidometry
10. Demonstration of dialysis

Course Learning Outcomes (CLO): Students will be able to 1. acquire knowledge about the organizational and functional aspects of cell and cell organelles 2. learn about the interactions of the cells with outside environment through exchange of information and transport of molecules.

Molecular Biology - CCBT-3C

Maximum Marks: 75 **Hours: 45** **Credits: 03**

Course Objective: To extend understanding of the molecular mechanisms of gene expression via which genetic information is stored, expressed and transmitted among generations. To understand storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems

UNIT I: DNA structure, replication & repair:
DNA structure: Structure of DNA, Properties of DNA, Cot curve DNA replication: Replication in prokaryotic and eukaryotic cells, models & mechanism of DNA replication, Enzymes involved in DNA replication –Primo some, Replisome, Topoisomerase, DNA polymerase, SSBP & Ligase. DNA Repair- Direct repair – Photo Reactivation, Excision, mismatch, Recombination, repair, SOS repair

UNIT II: Transcription of Prokaryotes and Eukaryotes:
Initiation, Elongation & Termination. Structure of RNA polymerase, Role of sigma factor, Promoter. Transcription in Eukaryotes: Initiation, Elongation & Termination. Upstream & downstream Promoters, Enhancer. RNA Polymerase I, II & III., Co & Post transcriptional modification in m- RNA- 5'capping, Intron Splicing, polyadenylation. RNA processing & Transport.

UNIT III: Translation Prokaryotic and Eukaryotic:
Mechanism, initiation, elongation, termination. Co & post translational modifications in proteins, Heat shock proteins, Chaperons & Chaperonins. Properties of genetic code, Role of mRNA, tRNA, rRNA.

UNIT IV: Gene regulation and operon concept:
Regulation of gene expression, Regulation of transcription in prokaryotes,
Operon concept, trp-operon, lac- operon.

Text and Reference:

1. Kakoli and Upadhya- Molecular Biology- Himalaya
2. Watson – Molecular biology of gene- Pearson
3. David Freifelder - Microbial Genetics – Narosa
4. David Freifelder – Molecular Biology – Jones and Bartlett /Narosa
5. Gardner – Principals of Genetics – Wiley international pub.
6. Simmonds & Snustad – Principles of Genetics IV ed- Wiley international
7. T.A. Brown – Genomes – Garland Science
8. Albert Bruce- Molecular biology of the cell- Garland Science.
9. Loddish - Molecular cell biology – W-H. freeman 10. B. Lewin – Genes- IX- Oxford

Practical's:

1. Study of Ames test
2. Study of fluctuation test
3. Isolation and quantization of DNA from Bacteria, Yeast,
4. Effect of UV radiation on yeast / bacteria
5. Study of DNA repair mechanism by photo reactivation.
6. Agarose gel electrophoresis of genomic DNA & plasmid DNA
7. Isolation of Lac mutants by using Replica plate method.
8. Determination of Tm value of DNA/ Cot curve.

Course Learning Outcomes (CLO): Students will be able to1.explain the properties of genetic materials and storage and processing of genetic information. 2.apply mechanisms of DNA replication, damage and repair in applied molecular genetics.

Bioinstrumentation Techniques - DSEBT-4CI

Maximum Marks: 75 **Hours: 45** **Credits: 03**

Course Objectives: The objectives of this course is to provide the Students with the understanding of various analytical techniques used in biotechnology based research and industry. To understand the principle and working of instrumentation used in Biotechnology

UNIT-I: MICROSCOPY & SPECTROSCOPY:
Light Microscopy: Simple & Compound Microscope, Phase contract Microscope, Electron Microscope (TEM/SEM) (Principle, Theory, ray diagram, Image formation and applications).
Spectroscopy: General principle, Electromagnetic Spectrum, radiation energy & atomic structure, Types of Spectra & their biochemical usefulness. Basic law of absorption, Visible & Ultraviolet Spectroscopy, application in biology.

UNIT-II: CHROMATOGRAPHY
Adsorption chromatography, Partition chromatography: Paper Chromatography, TLC, Column Chromatography, Ion exchange chromatography, GC.

UNIT-III: CENTRIFUGATION
Centripetal Force, Centrifugal force, basic principle of centrifugation, centrifuge type, types of rotor density gradient centrifugation, Nature of density gradient, preparative centrifugation, Differentials centrifugation & applications.

UNIT-IV: ELECTROPHORETIC TECHNIQUES
General Principles, Law & High voltage electrophoresis, Agarose, PAGE & SDS PAGE. Isoelectric focusing (IEF), Pulse field gel electrophoresis. Factors affecting on Electrophoretic Mobility.

Text & References:

1. Biophysical Chemistry- Upadhyay, Upadhyay and Nath-Himalaya
2. Practical Biochemistry- Wilson & Walker -Cambridge
3. Practical Biochemistry- David Plummer- Tata McGraw Hill
4. Principles of Biochemistry- Lehninger –Kalyani Publications
5. Light Microscopy in Biology-A.J. Laccy.
6. Instrumental Methods of Chemical Analysis- Chatwal Anand- Himalaya
7. Instrumental Methods of Chemical Analysis –B.K. Sharma-Goel
8. Physical Biochemistry-D. Friefilder

Practicals:

1. Study and Care of Microscope, Observation of Microscopic samples
2. Study of Colorimeter and determination of Lambda Max.
3. Study of UV-Visible Spectrophotometer
4. Study of Paper Chromatography/ TLC.
5. Separation of Pigments/ Biomolecules by Chromatography.
6. Separation of pigments by column chromatography
7. Demonstraion of GC/ HPLC/ HPTLC
8. Principals and working of different centrifuges.
9. UV Spectroscopic Analysis of DNA, RNA & Proteins
10. Study of Paper/PAGE/ SDS-PAGE/ Agarose Gel Electrophoresis

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Course Learning Outcomes (CLO): Students will be able to1.apply basic principles of different analytical techniques in analytical work. 2. Use microscopy, centrifugation and electrophoretic techniques.3. demonstrate principle and working of various instruments.4.use various techniques for solving industrial and research problems

Plant Physiology - DSEBT-4CII

Maximum Marks: 75 **Hours: 45** **Credits: 03**

Objective: To understand internal activities of plants and to understand the basics of photosynthesis, respiration and nitrogen fixation

UNIT 1: Translocation of organic solutes:
Introduction to plant physiology, Importance of water, Transpiration, Mechanism of translocation- pressure flow theory and diffusion, guttation, Phloem translocation (loading and unloading), composition of phloem sap.

UNIT II: Photosynthesis:
Structure of Chloroplast, Photosynthetic pigments and their role, Photosystem, light reaction, Cyclic and noncyclic Photophosphorylation, Path of carbon in photosynthesis- Calvin cycle, HSK pathway- silent features of C4 plants, CAM pathway, Photo-respiration, Significance of Photosynthesis.

UNIT III: Respiration:
Structure of a mitochondria, Respiratory substrate, types of respiration, Mechanism of aerobic respiration- glycolysis, TCA cycle, ETC, Chemosmotic hypothesis of ATP synthesis, Significance of respiration.

UNIT IV: Stress Physiology:
Concept of abiotic, biotic and xenobiotic, Types of stresses- salinity, drought, Effect of stress on plant growth.

UNIT V: PGRs and NPK fixation:
Auxin, Cytokines, Gibberellins, Abscisic acid, Ethylene, Phytohormones and role of Microbes in N, P, K utilization.

Textbooks and references:
1. S. N. Pandey and B. K. Sinha, Plant physiology, vikas publication House Pvt, Ltd, India.
2. R. G. S. Bindwell- plant physiology (revised)
3. Verma S. K. and Verma Mohit (2007), A. T. B. of plant physiology, biochemistry.
4. Lehninger Principles of Biochemistry- Kalyani Publication
5. Nelson & Cox- Lehninger Principles of Biochemistry – W.H. Freeman

Practical's:
1. Estimation of Chlorophyll-a and Chlorophyll-b by spectrometric/colorimetric method.
2. Separation of Photosynthetic pigments by TLC/ paper chromatography.
3. To determine diurnal fluctuation in TAN and CAM plants.
4. Qualitative test for phyto hormones.
5. To study effect of stress on plant growth.
6. Isolation of N, P, K fixing bacteria.

Course Learning Outcomes (CLO): Students will be able to:1. Acquire the knowledge about the Plant cell and its physiology. 2. Metabolic process such as Photosynthesis, Respiration and Nitrogen fixation

Algal Cultural Technology – SEC-IA

Maximum Marks:25 **Hours: 15** **Credits: 01**

Course Objective: The objective of this course is to enable Students to develop basic skills such as culturing of algae.

Unit I

-Introduction to the Algae (Habitat, cell structure and reproduction)

-Roles of Algae in Biogeochemistry

-Role of Algae in Food Webs and other biotic Associations

Practicals

1. Collection and microscopic observation of algae.

2. Quantification of cultured algae.

Unit II

-Algal culturing techniques in the laboratory

-Introduction of Photo bioreactor and raceway ponds.

-Indoor and mass culture methods of economically important algae

Practicals:

1. Isolation, identification of economically important algae

2. Inoculum development and pilot scale production of any one economically important algae.

Unit III

-Products of Algae: SCP, Vitamins, Essential fatty acids

-Algae as a bio fertilizer

Practicals:

1. Quantitative estimation proteins from algae.

2. Chromatographic separation of essential biomolecules from algal extract

Unit IV

-Recent developments and future of algal biotechnology: Algal biofuels – algal biodiesel, bio-ethanol and biological hydrogen production,

-Role of Algae in global warming

Practicals:

1. Visit to nearby industry actively engaged in algal technology.

2. Project on algal biotechnology.

References:

1. Algal Culturing Techniques (1st Edition) Elsevier Publication
2. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, (2nd Edition) Authors: Amos Richmond, Qiang Hu (Wiley Publication

Course Learning Outcomes (CLO): Students will be able to acquire the knowledge about the Algal culturing techniques in the laboratory, Lab. organization & nutritional importance of algae.

Culturing and Maintenance of Microorganism – SEC 1B

Maximum Marks: 25 **Hours: 15** **Credits: 1**

Course Objectives: To provide fundamental understanding of the microbial world, basic structure and functions of microbes and practical skills for cultivation and maintenance of MOs through various techniques.

UNIT 1: Introduction and safety aspects of microbiology lab

- Instructions and handling of microbiology equipment's & tools such as
    - Colony counter
    - Shaker with incubator

Practical's:

1. Safety rules of Microbiology Laboratory
2. Counting of colony by using Colony Counter

UNIT 2: Microbial culture media and its importance

- Isolation of microorganisms from soil, Air and water
- Serial dilution Method

Practical's:

1. Isolation of microorganisms from air.
2. Isolation and enumeration of microorganisms from soil sample by using serial dilution method.

UNIT 3: Maintenance of Pure culture

- Techniques used in maintenance:
    - Lyophilization
    - Deep freezer
    - Cryopreservation

Practical's:

1. To Maintain pure culture of *E. coli* in deep freezer
2. To activate Lyophilized microbes

UNIT 4: Sub culturing of microbes in solid and liquid media

- Morphological behavior of microbes
- Identification by Biochemical test

Practical's:

1. Morphological study of isolated microorganisms.
2. Biochemical study of isolated microorganisms.

References:

1. Experiments in Microbiology, Plant Pathology and Biotechnology by K.R.Aneja., New age International Publishers.
2. Experiments in Microbiology by R.C.Dubey

Course Learning Outcomes (CLO): Students will be able to acquire the knowledge about the culturing techniques of microorganisms and their maintenance in the laboratory, Also able to construct an ideal microbiology laboratory.

Basics of enzymology - CCBT-1D

Maximum Marks: 75 **Hours: 50** **Credits: 3**

Course Objective: To provide a deeper insight into enzyme structure, function and kinetics to deal with current and future application of enzymes.

Unit I- Introduction to Enzymes

Nomenclature and classification of enzyme, general aspects of enzyme: coenzymes and cofactor, Enzyme activity: specific activity, enzyme unit (Katal and IU), chemical nature of enzyme. Metalloenzymes and metal activated enzymes. Enzyme activity- chemical nature of enzymes, Protein nature of enzymes and Non protein enzymes- Ribozymes and metal activated enzymes.

Unit II- Enzyme Catalysis

Mechanism of Enzyme action: Enzyme specificity, active site; mechanism oat active site. Lock and key, Induced fit and Transition State Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, etc. Reversible inhibition and irreversible inhibition- competitive, Non-competitive, Uncompetitive inhibition.

Unit III- Isolation and purification

Isolation and purification of enzyme- salt precipitation, dialysis, ultrafiltration, ion exchange chromatography, Molecular weight determination: PAGE, SDS-PAGE

Immobilization of Enzyme: Application of immobilized enzymes, use in medicine, Therapeutics and other uses

Unit IV: Enzyme Kinetics

Factors affecting the enzyme activity- Concentration, pH and temperature. Michealis-Menten Equation, Km, Vmax, Turnover number, Kcat. LB plot. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes.

Textbooks and reference:

1. Fundamentals of Enzymology: Nicholas Price & Lewis Stevens
2. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry- Trevor Palmer
3. Biochemistry text books by Stryer, Voet and Lehninger (Relevant Chapters)
4. Proteins by Gary Walsh

Practical's:

1. Isolation of enzyme from different biological source.
2. Study of Enzyme activity: Amylase/ Cellulase
3. Effect of pH /temperature/ Substrate concentration on Enzyme activity
4. Study of Michaelis-Menten equation
5. Production and purification of enzyme (amylase/protease)
6. Qualitative analysis of enzyme in cell.

Course Learning Outcomes (CLO): Students will be able to1.know about domains and motifs in a protein and the basis of their prediction. 2. know relationship between structure and function of a protein. 3.know the principles of isolation and purification of enzymes from various sources. 4. comprehend various methods involved in enzyme technology and their commercial applications

Applied and Medical Microbiology – CCBT-2D

Maximum Marks:75 **Hours: 45** **Credits: 03**

Course Objective: To understand isolation techniques of microorganisms present in air, soil and food. And also understand the applications of microorganisms in different areas.

UNIT I: Soil Microbiology: Types of Microorganisms in soil and their Importance. Biogeochemical cycles: Carbon Cycle, Nitrogen Cycle and symbiotic and non- symbiotic nitrogen fixation, Sulphur Cycle and Phosphorus Cycle.

Air Microbiology: - Significance of microorganisms in air, enumeration of microorganisms and control of airborne microorganisms

UNIT II: Water Microbiology: Types of water, bacteriological examination of water (presumptive confirmative, complete test) MPN, SPC, membrane filter technique, indicator of fecal pollution, significance of index organism (E. coli), fecal/ non fecal coli forms (IMViC)

Food Microbiology: Scope of food microbiology, microbial spoilage of food, microbial examination of food, preservation of food by high temperature, chemicals, irradiation, physical techniques. Major food born infections and toxins.

UNIT III: Medical Microbiology: Etiological Agent, Virulence, Pathogenesis epidemiology (Sporadic, endemic, pandemic) Reservoirs of infection, Normal flora, commensals, opportunistic pathogens, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, bio safety levels. Concept of waterborne, airborne, nosocomial infections

UNIT IV: Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive Measures and chemotherapy for Typhoid, Tuberculosis, Malaria, Cholera, Chikungunya, Swine flu and AIDS.

Text and Reference:

1. Alexander – Soil Microbiology-John Wiley
2. N.S. Subbarao – Soil Microbilogy – Oxford
3. Atlas &Bartha – Microbial Ecology IV Ed., Tata McGraw Hills Pub.
4. A.J. Salle- Fundamental Principles of Bacteriology IIEd., Tata McGraw Hill Pub.
5. Adams & Moss- Food Microbilogy Royal Society of Chemistry
6. Frazier- Food Microbiology- Tata Mc Graw Hill
7. Text book of Microbiology- Anantnarayan&Panikar-Orient Longman
8. General Microbiology- Powar and Daginawala- Himalaya

Practicals :

1. Enumeration of microorganisms from Soil.
2. Isolation of Symbiotic and Non Symbiotic N2 fixing microorganisms/ PSB from soil.
3. Enumeration and Study of air Micro flora
4. Microbial examination of water, enteric pathogen from water sample. (IMViC test)
5. Isolation & Enumeration of microorganisms from food sample.
6. Isolation of micro flora from human skin and throat etc.
7. Analysis of contaminated food material and analysis of toxins

8. Visit to food and Dairy Industry.

Course Learning Outcomes (CLO): Students will be able to1.define the science of microbiology, its development and importance in human welfare.2. describe some of the general methods used in the study of microorganisms.3. demonstrate aseptic microbiological techniques in the laboratory and check sources of microbial contamination and their control.

Immunology and Virology – CCBT-3D

Maximum Marks:75 **Hours: 45** **Credits: 03**

Course Objectives: The objective of this course is to provide the detail understanding of different cells of the immune system and their role in immune protection as well as application of immunological techniques. The course will provide knowledge about the basics of virology

Unit I: Basics of Immunology

General concept of Immunity, Innate and Acquired Immunity, Humoral and cellular Immunity. Hematopoiesis, Primary and Secondary lymphoid organs, Types and role of Cells of Immune System.

Unit II: Antigen and Antibody: Immunogenicity and factors that influence immunogenicity, Antigenicity, Adjuvants, Epitopes, Haptens. Structure and functions of Immunoglobulins. Antigen- Antibody interactions: Precipitation and Agglutination reactions, Complement fixation.

Unit III: Basics of Virology

Brief introduction / outline on discovery of viruses. Nomenclature & classification of Viruses (ICTV,LHT,Baltimore), ultra-structure, viral nucleic acid, nucleo-capsid structure and envelope, viroids, prions, cultivation of viruses.

Unit IV: Life cycle and replication of RNA and DNA Viruses. Bacteriophages-Lambda, T,M13. Animal Viruses- Adenovirus, Retrovirus. Plant Viruses- TMV, CaMV. Brief outline of Vaccines, antivirals, Interferon. Detailed account on Corona and Ebola Viruses. Detailed account on nCOVID-2019

Text and Reference:

1. Immunology – Kuby- W.H. Freeman
2. Essentials of Immunology- Roitt I. M.- Blackwell
3. Immunology- Nandini Shetty- New Age International
4. Textbook of Microbiology – Anantnarayan and Panikar-Orient Longman
5. Immunology- A.K. Abbas- Elsevier
6. An Introduction to Viruses- Amita Biswas- Vikas Publication
7. Bacterial and Bacteriophage Genetics– Edward Birge- Springer
8. Microbial Genetics-David Freifelder- Narosa
9. Virology Principles and Applications- John Carter, Venetia A. Saunders-Wiley
10. Introduction to Modern Virology IV l edition- Dimmock, Primrose
11. Plant Virus- M.V. Nayudu- Tata McGraw Hill

Practicals:

1. Immunodiagnostics (demonstration using Kits- Widal, VDRL, Blood Group etc)
2. Immunodiffusion, Immuno Electrophoresis, Western Blotting, Differential Leukocyte Count
3. Lymphoid organ, Cell and their microscopic observation
4. Immunization, collection of Serum
5. Purification of Ig G from Serum
6. Isolation of bacteriophage from sewage/Titration / one step growth curve of bacteriophage
7. Enumeration of Bacteriophage by PFU method
8. Cultivation of Virus in Embryonated egg, Heamagglutination test
9. ELISA study and demonstration
10. Isolation and study of plant virus.

Course Learning Outcomes (CLO): Students will be able to1.explain the role of immune cells and their mechanism in body defense mechanism.2. demonstrate immunological techniques.3. Structure, Multiplication and role of genetic material in viruses.

Basics of Bio Stats and Computer – DSEBT-4DI

Maximum Marks:75 **Hours: 45** **Credits: 03**

Objective: To develop skills of Biostatistics and Computers in the field of biotechnology.

Unit- I: Graphical representation and measures of central tendency

Definition of Biostatistics, Data& types. Graphical representation (Histogram, frequency polygon, frequency curve). Diagrammatic representation (simple Bar, Subdivided bar)

Central Tendency: Concepts, definition, formulas of ungrouped and grouped data examples of Mean, Median, Mode.

Unit- II: Measures of Variation

Concept, Definition, formula, examples of Range, Standard Deviation. Definition, examples of Variance and Coefficient of Variation.

Unit III: Basics of Computer

Introduction to computer system, Number System: Binary, Decimal, Octal & Hexadecimal number system & their conversions, Introduction to O.S.: Windows & Linux O.S.

Unit IV: Introduction to MS-Word, MS- Excel, Power Point & Internet

Introduction to MS word, Excel, Power point.

Internet concept & definition, WWW, URL, http, Browsers, Search engines etc.

Text Reference

1. Statistical Methods – Gupta - Himalaya
2. Fundamental of Biostatistics–P.Hanamantrao
3. Introduction to Biostatistics Dr. Pranabkumar Banerjee
4. Introduction of Computer Science-Pcushman& R. Mata Toledo,McGraw Hill
5. Computer fundamentals – P.K. Sinha – BPBNew Delhi.
6. Microsoft Office – 2000Complete – BPBPracticals

Practical's:

1. Problem based on Measures of central tendency.
2. Problem based on Measures of variation.
3. Study of word processing MS-word.
4. Preparation of chart & graphs by MS – Excel and MS word.
5. Making presentation in MS power point.
6. Internet – E-mail, Search Engines.

Course Learning Outcomes (CLO): Students will be able to1.Use the computer knowledge and biostatistics in the study of Biotechnology.2. use the knowledge of computer in biotechnology research.

Plant tissue culture- DSEBT-4DII

Maximum Mark: 75 **Hours: 50** **Credits: 3**

Course Objective: To understand the basic techniques and applications of Plant cell culture. The Students will acquire knowledge on various recombinant DNA techniques to produce genetically modified organisms with novel traits.

Unit 1: Plant Tissue Culture:

Introduction and Principles of plant tissue culture, history, Laboratory Organization, Sterilization Techniques, Cleanliness and care, Nutrition and physiology, Media components, Stock solutions, Totipotency, De Differentiation, Re-differentiation

Unit II: Types of culture:

Callus culture, Types of cultures: Cell suspension culture, embryo culture, organ culture, Anther and Pollen Culture, Plant protoplast culture and somatic hybridization, micro propagation. Utilization of micro propagation for commercial crops like banana, strawberry, ginger and ornamental plants.

Unit III: Genetics and its role in plant tissue culture

Somaclonal & Gametoclonal Variation: applications and limitations. (Exploitation for selecting superior phenotypes-disease resistant, stress tolerant, high secondary metabolite production), Screening procedures. Haploid production (Anther, Ovule, Pollen cultures). Cryopreservation and ex-situ conservation of germplasm. In vitro pollination and fertilization, embryo rescue, embryo culture, endosperm culture and production of seedless plants. Somatic hybridization (Symmetric, Asymmetric, and Cybrids) Commercial production of secondary metabolite –Use of bioreactors, immobilized cells, biotransformation's, elicitors. Applications and limitations, Metabolic Engineering for secondary metabolite production,

Unit III: Applications of Plant Tissue Culture:

Plant improvement for agriculture, horticulture and forestry, production of secondary metabolites, Preservation of plant genetic resources and germplasm conservation.

Textbooks and references:

1. Poehlmann M. (1959) Breeding of field crops, Henry Holt and Co., New York.
2. Strickberger M.W. (1985) Genetics, Pearson Education Inc. , and Dorling Kindersley Publ., Inc. 3. Reinert J.R. and Bajaj Y.P.S.(1997) Applied and fundamental aspects of plant cell, tissue and organ culture. Springer and Verlag, Berlin.
3. Allard R. D. (1999) Princ'iples of Plant Breeding, John Wiley and Sons, Inc.
4. Purohit S.S. (1999) Agricultural Biotechnology. Agro Botanica. India
5. Levin B. (2000) Genes VII, Oxford Uni. press.
6. Sharma K.V.S. (2002) Statistics made simple: Do it yourself on PC, PHI.

Practicals:

1. Nutrient media composition, preparation and sterilization
2. Selection of explants, surface sterilization, establishment and maintenance of different types of plant cultures for callus induction and regeneration
3. Initiation and establishment of suspension cultures
4. Micro propagation of dicot and monocot plants via axillary shoot Proliferation
5. Micro propagation via adventitious shoot proliferation
6. Micro propagation via somatic embryogenesis
7. Preparation of synthetic seeds.
8. Anther/microspore culture.
9. Embryo/ovule culture.

10. Protoplast isolation and culture
11. Histological and cytological techniques for plant cultures

Course Learning Outcomes (CLO): Students will be able to:1. Acquire the knowledge about the techniques of Plant Tissue Culture, Lab. organization & measures adopted for aseptic manipulation and nutritional requirements of cultured tissues.

2.Learn the techniques of culturing tissues, single cells, protoplasts & anther culture, germplasm conservation and cryobiology. 3.Learn the large scale clonal propagation of plants through various micro propagation techniques, Production of secondary metabolites under in vitro-conditions

Diagnostic biology – SEC IIA

Maximum Marks: 25 **Hours: 15** **Credits: 1**

Course Objective: To understand the basic diagnostic techniques and their applications in disease diagnosis. Also to understand the composition of whole blood.

Unit I

- Introduction to Immunology. Cells of the immune systems.
- Blood, compositions, blood cells, plasma, serum etc.
- Anticoagulants

Practical

1. Separation of plasma and serum from blood.
2. Differential leukocyte count.
3. Staining of blood cells.

Unit II

- Antigen, antibody
- Structure and function.
- Antigen – Antibody interaction: Precipitation and agglutination reactions.
- Indoor and mass culture methods of economically important algae

Practical:

1. WIDAL Test
2. ELISA Test

Unit III

- Different Biochemical Tests
- Liver tests, Kidney function test, Endocrine function tests, Lipid profile, Blood Glucose test, etc.

Practical:

1. Liver tests/ Kidney function test/ Endocrine function tests/Lipid profile/ Blood Glucose test (Any two tests)

Unit IV

- Instrumentation in Medical diagnostics.
- Use of Molecular diagnostics in disease identification.

Practical:

1. PCR
2. PAGE/ Immunoelectrophoresis
3. Colorimetry/ Spectrophotometry

References:

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Gerald Collee J, Andrew G Fraser, Barrie P Marmion, Mackie and McCartney's Practical Medical Microbiology, Elsevier. 2006.

Course Learning Outcomes (CLO): Students will be able to acquire the knowledge about the diagnostics techniques and become able to work in pathology laboratory.

Enzyme Technology – SEC - IIB

Maximum Marks: 25 **Hours: 15** **Credits: 1**

Course Objective: To understand the basic concept of enzymes and their isolation techniques. Also to understand the applications of enzymes for living systems.

Unit I- Introduction to Enzymes

General introduction: - Nomenclature and Classification of Enzymes, Chemical nature of enzymes. Factors affecting the enzyme activity**.**

Practical

1. Isolation of Alpha/Beta Amylase
2. Determination of enzyme activity

Unit II- Enzyme Catalysis

Enzyme Inhibition and Enzyme Regulation pathway.

Practical

1. Effect of temperature on Enzyme kinetics.
2. Effect of time on Enzyme kinetics
3. Effect of pH on Enzyme kinetics

Unit III

Industrial Enzymes

Production, recovery, stability and formulation of enzymes

Enzymes used in various fermentation processes: - Amylase and proteases

Practical

1. Production and recovery of amylase
2. Production and recovery of Proteases.

Unit IV
Clinical enzymes

Production, recovery, stability and formulation of enzymes: -, Transaminases and Cholinesterase's,

Practicals

1. Production and recovery of transaminase
2. Production and recovery of Cholinesterase's.

Course Learning Outcomes (CLO): Students will be able to acquire the knowledge about the isolation and commercial production techniques of enzymes and become able to work in enzyme related industry.