।। 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
ACADEMIC (1-BOARD OF STUDIES) SECTION
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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर 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 पदव्युत्तर 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. M.Sc.-II Year-Botany
2. M.Sc.-II Year-Herbal Medicine
3. M.Sc.-II Year-Analytical Chemistry
4. M.Sc.-II Year-Biochemistry
5. M.Sc.-II Year-Organic Chemistry
6. M.Sc.-II Year-Physical Chemistry
7. M.Sc.-II Year-Computer Management
8. M.Sc.-II Year-Computer Science
9. M.Sc.-II Year-Information Technology
10. M.C.A. (Master of Computer Applications)-II Year
11. M.Sc.-II Year-Software Engineering
12. M.Sc.-II Year-System Administration & Networking
13. M.Sc.-II Year-Dairy Science
14. M.Sc.-II Year-Environmental Science
15. M.Sc.-II Year-Applied Mathematics
16. M.Sc.-II Year-Mathematics
17. M.Sc.-II Year-Microbiology
18. M.Sc.-II Year-Physics
19. M.Sc.-II Year-Zoology
20. M.Sc.-II Year-Biotechnology
21. M.Sc.-II Year-Bioinformatics

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/२०२०–२१/**३३५**

दिनांक : १६.०७.२०२०.

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.

Swami Ramanand Teerth Marathwada University, Nanded
Syllabus M.Sc. Biotechnology II year (Affiliated Colleges)
CBCS (Choice Based Credit system) Pattern- June-2020

M.Sc. Biotechnology First Year (First & Second Semester -2019

Sem	Code	Title of the Course	Hrs./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 (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
	Total for Sem -I				**24**	**500**	**100**	**600**
Sem	**Code**	**Title of the Course**	**Hrs./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 (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
	Total for Sem -II				**24**	**500**	**100**	**600**

M.Sc. Biotechnology Second Year (Third & Fourth Semester June -2020 onwards)

M.Sc. BT SY								
Sem	**Code**	**Title of the Course**	**Hrs./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 (Minimum of 4 weeks)	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 and BT-XII	4	PR	4	100		100
	Total for Sem-III				**24**	**515**	**85**	**600**
Sem	**Code**	**Title of the Course**	**Hrs./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	Environmental Biotechnology	4	CC	4	75	25	100
	BT- XVII (Elective)	(A) Animal Biotechnology	4	DSE	4	75	25	100
		(B) Food Biotechnology						
	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
	Total for Sem- IV				**24**	**500**	**100**	**600**

CC- Core Course, DSE- Discipline Specific Elective, ESA- End Semester Assesment, MSA- Mid Semester, Assessment SDC- Skill Development Course, OE- Open Elective
Total Credits: 96.

BT -IX: Genetic Engineering

Marks: 75 **Hours: 45** **Credit:3**

Course objectives: The objective of this course is to make clear the students with concept of rDNA, clone and gene cloning, cloning strategies, tools and techniques, applications and advantages and alternatives to transgenic etc.

UNIT-I: Molecular Tools in Genetic Engineering

Restriction Endonucleases, Modification methylases and other enzymes needed in genetic engineering. Cloning vectors: Plasmids and plasmid vectors, Phages and Phage derived Vectors, Phagemids, Cosmids, artificial chromosome vectors (YAC, BAG).

Animal virus derived vectors -SV40 and retroviral vectors. Ti, Ri plasmid vectors.

UNIT-II: Molecular cloning

Construction of Genomic DNA and cDNA libraries, screening of recombinants. DNA analysis: labeling of DNA and RNA probes. Southern and fluorescence in situ hybridization, DNA fingerprinting, chromosome walking. Techniques for gene expression: Northern and Western blotting, gel retardation technique, DNA foot printing. SI mapping, Reporter assays.

UNIT-III: Techniques in Molecular cloning

Chemical synthesis and Sequencing of DNA. Polymerase chain reaction and its applications Protein Engineering and Applications: Site-directed mutagenesis, PCR based methods of mutagenesis, DNA Shuffling. Strategies for production and purification of recombinant proteins

UNIT-IV: Strategies of Gene Expression

Physical methods of Gene transfer: Gene gun, Microinjection, Electroporation, Liposomes. Expression strategies for heterogonous genes: in prokaryotes, plant, animal cells. Genetic and Physical Mapping of genome.

Use of transposons in genetic analysis: Transposon tagging and its use in identification and isolation of genes.

Unit V: **Applications of Genetic Engineering**

Transgenic Animals, Plants, production of recombinant proteins, recombinant vaccines and pharmaceuticals, concept of Bio-pharming. Gene Therapy: Gene replacement, gene augment. Bio safety regulation: Physical and Biological containments.

Text & Reference:

1. Nicoll D.S.T. -An Introduction to Genetic Engineering. - Cambridge University Press,
2. Watson J.D. -Recombinant DNA. Scientific American Books, USA.
3. Brown T. A. - Gene Cloning*:* An Introduction. – Stanley Thornes.
4. Glick B.R. and Pasternak J.J. -Molecular Biotechnology– ASM Press, USA.
5. Sambrook J. & Russell D.W.- Molecular Cloning: A Laboratory Manual. Cold Spring Harbor
6. Innis, and Gelfand -PCR Applications: Protocols for Functional Genomics. Academic Press,
7. D.M. Glover Genetic Engineering, Cloning DNA. Chapman and Hall, New York,
8. Alcamo I.E. -DNA Technology: The Awesome Skill. Academic Press, USA.
9. Winnacker- From Genes to Clones- Panima

10. Genomes- T.A. Brown- John Wiley

PRACTICALS: (Lab Course Work V)

1. Bacterial culture and antibiotic selection media. Preparation of competent cells
2. Isolation of plasmid DNA, Lambda phage DNA.
3. Quantitation of nucleic acids.
4. Agarose gel electrophoresis and restriction mapping of DNA.
5. Construction of restriction map of plasmid DNA
6. Cloning in plasmid/phagemid vectors.
7. Preparation of helper phage and its titration
8. Preparation of single stranded DNA template.
9. Oligonucleotide synthesis and DNA sequencing.
10. Gene expression in *E coli* and analysis of gene products
11. Study of PCR and PCR based markers AFLP/RAPD/SNP

Learning Outcomes (LO): Students will become aware about rDNA technology, its advantages and disadvantages in addition to tools and techniques. It will help in avoiding spread of misconception about GMO in society.

BT -X: Industrial Biotechnology

Marks: 75 **Hours: 45** **Credit:3**

Course Objectives:
To learn the analytical techniques for the identification of microbial products. To understand the Microbial production of Organic Acids and Solvents. To learn the Concept of quality control and quality assessment.

Unit I

Down Stream Processing:
Removal and Recovery of cell mass: Precipitation, Filtration and Centrifugation
Cell disruption - Physical and Chemical methods.
Purification of Product Liquid-liquid extraction: Solvent Recovery.
Chromatography: Adsorption, Ion-exchange, HPLC, GC-MS
Membrane processes: Ultrafiltration and Reverse Osmosis. Drying and Crystallization

Unit-II:
Microbial production: Microbial production of Organic Acids and Solvents, alcohol by fermentation Production, recovery and applications: Glycerol, Acetone, Citric acid
Production, recovery and applications of amino acids: L-Glutamic acid, L-Tryptophan
Production, recovery and applications of antibiotics: Penicillin
Unit III Production, recovery and applications of polysaccharides: Xanthan, Dextran and Alginate Polyhydroxyalkanoates: Chemistry and properties, Polyhydroxybutyrate (PHB), biodegradable plastic. Microbial recovery of petroleum. Production and applications of: Proteases, Pectinases, Cellulase.

Unit IV•
Microbial transformations: Basic concept involved, Types of bioconversion reactions: Oxidation, Reduction, Hydrolytic reactions, Condensations. Transformation of steroids and sterols.
Transformation of non-steroid compounds: L-Ascorbic acid, Prostaglandins, Antibiotics

UNIT- V:
Concept of QC and QA: Introduction and overview of QC and QA QC testing of products: Purity, Sterility, Toxicity, Carcinogenicity, Pyrogen testing.
Fermentation Economics: Cost Estimates, Process Design, Capital Cost Estimates, Operating Cost Estimates.

Text & Reference:
1. Peppler H.J and Perlman D - Microbial Technology, Vol I and II-Elsevier
2. Stanbury P.F., Whitaker A. and Hall S.J - Principles of Fermentation Technology-Elsevier
3. Casida L.E - Industrial Microbiology- New Age

4. Crueger W and Crueger A - Biotechnology: A Textbook of Industrial Microbiology-Panima
5. Patel A.H. - Industrial Microbiology, Macmillan India
6. Prescott and Dunn's- Industrial Microbiology-CBS
7. Ed. G. Subramaniam- Bioseparation & Bioprocessing - Wiley –VCH
8. Paul A. Belter, Cussler- Bioseparation : Downstraem Processing for Biotechnology - Academic Press
9. Larl Schuger-Solvent Extraction in Biotechnology - Spinger
10. Roger Harrison-Bioseparation Science & Engineering-Oxford
11. Product Recovery in Bioprocess Technology, 'BIOTOL series, Butter worth Heinemann 1992

Practical (Lab course work V)

1. Production and isolation of bacterial exo-polysaccharides
2. Production and estimation of alkaline protease from bacterial source
3. Production and estimation of Bacterial enzymes lipase, Pectinase/ Cellulase/ Amylase
4. Production of sauerkraut by microorganisms
5. Production and estimation of lactic acid by Lactobacillus Sp.
6. Production and characterization of citric acid using *A. niger.*
7. Microbial transformations of steroids/antibiotics
8. Comparison of ethanol production using various Organic wastes /raw Material
9. Production and purification of fungal enzymes Amylase /Pectinase
10. Production of kojic acid.
11. Visit to fermentation industry

Learning Outcomes (LO): On completion of this course, the students shall:

1. Demonstrate the knowledge about the techniques of microbial productions and acquire comprehensive knowledge on quality contro and quality assessment.
2. Acquire knowledge in Production and purification of fungal enzymes Amylase Pectinase and other industrial products.
3. Able to work in the section of quality control of Food industry.
4. Shall develop scientific skills to work in Pharmaceutical and Research laboratories.

SRTM University, Nanded

BT -XI: Plant Biotechnology

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

Course objective:

1. To acquaint the students with basic principles and various methods of Tissue Culture.
2. To impart knowledge about varied methods of gene transfer and transgenic plant development.
3. To underhand basics of secondary metabolites and their engineering.
4. To acquire knowledge about molecular markers and their use in plant breeding.

Unit-I: Plant Tissue Culture

Structure and organization of Plant tissue culture laboratory. Tissue culture media: Types, Composition and preparation. Initiation and maintenance of callus and suspension culture.
Somatic embryogenesis, Shoot tip culture, Protoplast culture. Embryo culture and embryo rescue. Anther, Pollen and Ovary culture for production of haploid plants. Cryopreservation, slow growth and DNA banking for germ plasm conservation
Commercial application of tissue culture technology, examples: banana and Sugarcane.

Unit-II: Transgenic Crops

Crops with resistance to biotic stresses, viruses, fungal and bacterial diseases: strategy and examples Crops with resistance to abiotic stresses (Herbicides and drought conditions): strategy and examples. Terminator technology.
Ecological risk assessment of genetically modified crops

Unit-III: Microbes for Sustainable Agriculture

N2 fixing bacteria as microbial bio fertilizers: Symbiotic and non-symbiotic bacteria. Microbial inoculants for sustainable agriculture: Microorganisms, Physiology and Production technology of (i) Cyanobacteria (ii) Plant growth promoting rhizobacteria (iii) Phosphate solubilizing microorganisms (iv) Mycorrhizae.

Unit IV molecular markers & Plant Pathology.

Molecular marker aided breeding: RFLP, RAPD, Microsatellites, AFLP etc.
Classification of Plant Diseases based on Symptoms. Plant Diseases: Causative agent, Symptoms, Mechanism of Action and Control Measures against plant diseases (Chemical and Biological)

Unit-IV: Bio pesticides and Integrated Pest Management

Biological control, Plant bio pesticides and botanicals and microorganisms pest control. Bio pesticides v/s chemical pesticides: advantages and disadvantages. Examples of bio pesticides: Bt-based bio pesticides, Baculoviruses, Trichoderma.
concept of Integrated Pest Management (IPM), Present status and future needs for making bio pesticides

References:

1. Introduction to plant tissue culture – M.K. Razdan-Oxford and IBH
2. Biotechnological innovations in crop improvement- BIOTOL- Elsevier
3. Plant Cell and Tissue Culture: A Tool in Biotechnology- Karl-Hermann, A. Kumar-Springer
4. Plant Tissue Culture-Bhojwani and Razdan-Elsevier
5. Methods in Plant Tissue culture- U Kumar- Agrobios India
6. Purohit S.S. (1999) - Agricultural Biotechnology. Agro Botanica, India.
7. Endress R. (1994) - Plant Cell Biotechnology. Springer Verlag, Germany
8. N.S. Subbarao – Soil Microbilogy – Oxford
9. Melhotra and Agarwal- Plant Pathology- TataMcGraw Hill
10. Gupta P.K. - Genetics and Biotechnology in Crop Improvement, Rastogi Publications

Practicals

1. Preparation of Tissue culture Media.
2. Callus Culture, Organ Culture, organogenesis.
3. In vitro rooting and acclimatization.
4. Protoplast isolation and culture.
5. Anther Culture/ Production of haploids.
6. *Agrobacterium* culture, selection of tranformants, GUS assay.
7. Somatic embryogenesis
8. Isolation of nitrogen fixing rhizobia, *Azotobacter*
9. Isolation of phosphate solubilizing bacteria and determination of efficiency
10. Estimation of leg hemoglobin from root nodule of leguminous plant
11. Study of Bio pesticides: *Trichoderma*
12. Visit to commercial plant tissue culture laboratory

Learning Outcomes (LO): On completion of this course, the students shall:

1. Demonstrate the knowledge about the techniques of Plant Tissue Culture and acquire comprehensive knowledge on GM technology for quality characteristics and their role in crop improvement.
2. Acquire knowledge in metabolic engineering and industrial products.
3. Develop skills in molecular markers studies and their use in plant breeding.
4. Shall develop scientific skills to work in Plant tissue culture, Pharmaceutical and Research laboratories.

SRTM University, Nanded

BT -XII: English and Science Communication Skills

Marks: 50 **Hours: 30** **Credits: 02**

Course Objective: To provide the students with the essential skills required for effective communication and to provide a comprehensive view of business communication and its role in the corporate environment.

Detail Contents:

Unit-I Essentials of Communication: Meaning, Definition, process, feedback, emergence of communication as a key concept in the corporate and global world, impact of technological advancements on communication. **Channels of Communication:** Formal and Informal: Vertical, horizontal, diagonal, and grapevine.

Unit-II Methods and Modes of Communication: Verbal and nonverbal, Verbal Communication: Characteristics of verbal communication, Non-verbal Communication: Characteristics of non-verbal communication, kinesics, proxemics and chronemics.

Unit-III Soft Skills

a) Importance of listening skills, cultivating good listening skills

a) Interpersonal skills.

b) Negotiation skills.

c) Time management skills.

d) Stress management skills.

Unit-IV: Written Communication: Business letters, memos, minutes of meeting, notices, e-mails, agendas and circulars.

Technical Report Writing: Types of Reports, contents of reports. Formatting, writing styles and documentation.

Practicals:

Interviews and Group Activities Personal interviews, group discussion and panel discussion

Creative writing: Paragraph and Essay writing, Book reviews, Movie Reviews, Editorials and articles.

Self-Learning: Paper writing: Styles of paper writing: Short Communication, Review papers and Research papers, referencing styles: MLA, Chicago Style and APA.

Learning Outcome (LO): Students will be able to: 1. understand and demonstrate the use proper writing techniques relevant to the present day technological demands, including anticipating audience reaction. 2. write effective and concise letters and memos, prepare informal and formal reports, proofread and edit copies of business correspondence. 3. develop interpersonal skills that contribute to effective personal social and professional relationships.

Text Books: *1. Lehman C. M., DuFrene D.D., & Walker. B-BCOM-An Innovative Approach to Learning and Teaching Business Communication. Cengage Learning New Delhi*

2. McMurrey A.M& Buckley J., Handbook for Technical Writing. Cengage Learning,New Delhi.

Reference Books: *1. Lesikar R.V & Flately M.E.,Basic Business Communication-Skills for Empowering the Internet Generation. Tata McGraw-Hill Publishing Company Limited. New Delhi.*

BT –XIII B: Intellectual Property Right (IPR)

Marks: 50 **Hours: 30** **Credits: 2**

Course Objective: To provide the students with the essential knowledge of Intellectual Property Right and patenting of Biological materials.

UNIT I: - Research: Definition, Importance and Meaning of Research, Objectives of research, Characteristics of Research, Types of Research. Steps in Research; Identification, Selection and Formulation of Research Problem, Research Design, Formulation of Hypothesis, Review of Literature. Sampling Techniques: Sampling theory, Types of Sampling, Steps in Sampling, Sample Size, Advantages and limitations.

UNIT II: - Thesis and Manuscript writing: Abstract, Introduction, Materials and Methods, Results and Discussion, Summary and Conclusion, References (IMRAD). Preparation of Manuscript; Author instructions, modes of paper communication, criteria for publication. Presentation of a scientific Paper.

UNIT III: - Introduction to IPR and Patents: Intellectual property, Protection of Intellectual property, World organizations, forms of protection- patent, copyright, trademark, geographical indications, trade secrets. Criteria and procedure of patenting.

UNIT IV: - Patenting biological material. Patent procedure in India. Types of patenting, Patenting of biological materials with examples. Patent infringement- meaning, scope, litigation and examples.

UNIT V: - Plant breeder's right: concept of UPOV, Breeders exemption, Plant variety protection in India. Farmer's right, advantages and disadvantages of PBR. Technology transfer- Introduction, types of technology transfer and Indian scenario.

Text & References

1. Research Methodology, Method and Techniques by C.R. Kothari

2. Research Methodology, Method and Techniques by Santosh Gupta.

3. Research Methodology by Gurumani.

4. Text book of Biotechnology, P K Gupta

5. Text book of Biotechnology, B D Singh

Learning Outcome (LO): Students will be able to: 1. understand the procedure of patenting of biological inventions. 2. Thesis and Manuscript writing 3. Plant breeder's right and Farmer's right.

SRTM University, Nanded

BT - XIV: Computational Biology & Biostatistics

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

Course objective: To understand the concept of genomics, proteomics, biostatics and their applications. In addition, they will learn about methods of studying genetic materials obtained from various environmental samples. The will also provide understanding of basic concepts of sequences, structural alignment, database searching, protein structure prediction and computer-based drug designing.

UNIT-I: Biological Data Bases

The need for computation in Biology: An introduction to Bioinformatics, Historical overview, the principles involved, development of tools, internet based access.

Introduction to Biological Databases, Database Browsing and Data Retrieval - Sequence databases, Structural databases, Literature and other databases

UNIT-II: **Applications of Bioinformatics**

Application of Bioinformatics Approaches for analysis and interpretation of Sequence Data and using: Homology Searches, Sequence Alignments, Pattern Searching.

Application of Bioinformatics Approaches for analysis and interpretation of Genome data such as – Gene prediction, Full Genome comparison etc. Introduction to computational structural biology: Protein structure prediction using computational methods, Structure analysis, Classification of Proteins etc.

UNIT-III: Proteomics

Strategies in Proteomics: 2 D PAGE, Mass spectrometry. Databases and search engines in proteomics. Proteomics applications: Understanding the mechanism of pathogenesis, Drug discovery, Disease diagnosis, identification and characterization of novel proteins.

Protein-Ligand Docking: Introduction; Docking problems, methods for protein- ligand docking, validation studies and applications

UNIT-IV: Genomics

Introduction sequencing strategies for whole genome analysis, sequence data analysis. Comparative Genomics: Protein evolution from exon shuffling, Protein structural genomics, Gene function by sequence comparison Global expression profiling: whole genome analysis of mRNA and protein expression, microarray analysis, types of microarrays and their applications Functional genomics, Toxic genomics, Pharmacogenomics, Metagenomics. Metabolic engineering

UNIT V: Biostatistics

Brief description and tabulation of data and its graphical representation Measurement of central tendency and dispersion- mean, mode, median, range Mean deviation, standard deviation, variance.

Text & Reference:

1. Teresa Attwood, David Parry-Smith - Introduction to Bioinformatics Prentice Hall
2. Jin Xiong- Essentials of Bioinformatics- Cambridge
3. Pierre Baldi, Søren Brunak -Bioinformatics: The Machine Learning Approach MIT Press
4. Rashidi H.H and Buahler L.K - Bioinformatics: Applications in Biological Science and Medicine-CRC
5. Andreas D. Baxevanis, B.F. Francis Ouellette - Bioinformatics: A Practical Guide, J. Wiley
6. Philip E. Bourne, Helge Weissig - Structural Bioinformatics Wiley,
7. Peter Clote, Rolf Backofen - Computational Molecular Biology: An Introduction, Wiley, 2000.
8. Warren J. Ewens, Gregory R. Grant - Statistical Methods in Bioinformatics: An Introduction Springer,
9. Timo Koski, Hidden Markov - Models for Bioinformatics Kluwer Academic Publishers
10. Arthur M Lesk - Introduction to Bioinformatics, Oxford University Press
11. David W. Mount - Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory
12. Pavel A. Pevzner - Computational Molecular Biology 13. Fundamental of Statistics- S.C. Gupta
14. Statistical Method S. P. Gupta
15. Mathematical Statistics- S.C. Gupta & Kapoor

Practical (Lab course work VII)

1. NCBI/EBI: Data access – standard search engines: data retrievals tools – Entrez, DBGET and SRS, PubMed etc.
2. Software for data building. Submission of sequence to databases.
3. Sequence homology as product of molecular evolution, sequence similarity searches,
4. Sequence alignment-global, local, end free-space; measurement of sequence similarity
5. Homology Modeling
6. Phylogeny reconstruction by using biological data
7. Getting an amino acid sequence, nucleotide sequence by BLAST
8. Protein identification & characterization with peptide mass fingerprinting data.
9. Primary/ secondary structure analysis of proteins.
10. Tertiary structure analysis of proteins (3D structure prediction)
11. Experiments based of biostatistics and assumed data sets
12. Measures of central tendency and dispersion mean median, mode, range, standard deviation variance, standard error

Learning Outcomes (LO): Students will be able to

1 Construct the phylogenetics of different sequences.
2 Analyze sequence and structure of bio-macromolecule data
3 Edit the three dimensional structure of protein using structural bioinformatics tools
4 Explain the properties of genetic materials and storage and processing of genetic information.
5Analyze genomic data.
6 Explain biological phenomena based on comparative genomics

SRTM University, Nanded

BT - XV: Pharmaceutical Biotechnology

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

Course objective: The objective of this course is to apply the basic concepts in the specific field of pharmaceutical biotechnology. The student will gain insights into identification and design of drugs that could be potentially useful in the identification of candidate drug which have efficacy in cell culture or animal models and thus the most effective compound could be employed based on the above results to put into clinical trials.

UNIT -I: Chemotherapy

Antimicrobial Drug. Mechanism of action of antimicrobial agents.

Microbial Resistance to antibiotics and antimicrobial agents (Types and Mechanism).

Types of Antibiotics: Classification of antibiotics with example. General characteristics of a Secondary Metabolites: Types and Medicinal Applications

UNIT-II: Chemotherapeutics Agents

Structure, Mechanism of Action and Applications of Antibacterial drug: Sulfonamides, Quinolones. Antiviral drug: Amantadine, Azido thymidine. Antifungal drug: Nystatin, Griseofulvin. Mechanism of action of Anticancer drugs, Drugs acting on CNS, Insulin, Blood factor VIII. Detailed account on Corona and Ebola viruses. Detailed account on nCOVID-2019

UNIT-III: Protein Engineering

Methods of protein sequencing: mass spectrometry, Edman degradation, Tryptic and/or Chymotryptic Peptide Mapping. Isolation and purification of proteins, Stability and activity based approaches of protein engineering, Chemical and Physical Considerations in Protein and Peptide Stability, Different methods for protein engineering, Site-directed mutagenesis, gene shuffling, and direct evolution. Mapping of protein interactions: Two hybrid, phage display etc.

Unit -IV Computer aided drug design Overview of computer assisted drug discovery (CADD), Concept and steps involved in pharmacophore modeling, Molecular modeling functions, types of molecular modeling, limitations of CADD

Unit V: Clinical Trials

Phases of Clinical trials of drugs, Preclinical drug evaluation of its biological activity, potency and Toxicity-Toxicity test in animals including acute, sub-acute and chronic toxicity, ED50 and LD50 determination, special toxicity test like teratogenicity and mutagenicity.

Introduction to Indian, International Pharmacopoeia and global regulatory guidelines.

Text & References:

1. Hugo W. B. and Russell A. D. - Pharmaceutical Microbiology -Wiley India
2. Ashutosh Kar-Pharmacology and Pharmacobiotechnology-New Age
3. FSK Barar- Pharmaceutical- Essentials of Pharmaceuticals- S.Chand
4. B.Glick and J Pasernak -Molecular Biotechnology –ASM Press.
5. Doble- Drug Designing-McGraw Hill
6. S.P. Vyas, Dixit- Pharmaceutical Biotechnology-CBS
7. B.Razdan-Medicinal Chemistry-CBS
8. Satoskar, Bhandarkar- Pharmacology and Pharmacotherapeutics- Popular

9. Purohit, Saluja- Pharmaceutical Biotechnology-Student Edition
10. Ramawat K.G; Merillon J.M - Biotechnology: Secondary Metabolites-Oxford
11. Ed. R.H. Thomson-Chemistry of Natural Products-Springer
12. Jogdand S.N - Biopharmaceuticals, Himalaya Publishing

Practical: (Lab course work VII)

1. Estimation of penicillin/streptomycin by biological assay.
2. Estimation of penicillin/streptomycin by chemical assay.
3. Assay of antimicrobial activity of Penicillin, Chloramphenicol, streptomycin
4. Determination of Minimum Inhibitory Concentration (MIC) of Antibiotic
5. Determination of shelf life of antibiotics (Expired drugs)
6. Sterility testing of commercial pharmaceuticals.
7. Study of microbial spoilage of pharmaceuticals.
8. Sterility testing of injectable as per IP.
9. Effect of chemical disinfectant on growth of bacteria
10. Study of Pharmacopeia and global regulatory guidelines in pharma industry
11. Study of dug action by using Zebra fish (*Danio rerio)* as model organism
12. Visit to Pharmaceutical industry

Learning Outcomes (LO): Students will be able to

1 Explain the strategies and various steps of new drug discovery process.

2 Explain the concept of pharmacodynamics and pharmacokinetics

3 Apply the knowledge of pharmaceutical manufacturing in the production of biopharmaceuticals like antibiotics, vaccines, proteins and hormones

4 Carry out the quality control procedures in the production of various biopharmaceuticals

5 Explain the regulatory aspects in the development of pharmaceuticals.

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BT - XVI: Environmental Biotechnology

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

Course Objective:The course content aims to make the Students understand how biotechnology can help in monitoring or removing the pollutants and developing an understanding of new trends such as biofuels, renewable energy sources, or microbial technologies which can minimize the harmful impact of pollutants in the environment.

UNIT -1: Ecology & Environment: Interactions between environment and biota; Concept of habitat and ecological niches; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, N.P.C and S cycles in nature. Concepts and theories of evolution - Population ecology - community structure. Global environmental problems: ozone depletion, UV-B greenhouse effect and acid rain, their impact in biotechnological approaches for management.

UNIT – II Biofuels: Environmental Biotechnology and biofuels: biogas; bioethanol; biodiesel; bio hydrogen; Description of the industrial processes involved, microorganisms and biotechnological interventions for optimization of production; Microbiologically enhanced oil recovery (MEOR); Bioleaching of metals; Production of bioplastics; Production of bio surfactants: bio emulsifiers.

UNIT – III: Environmental pollution: Types of pollutions, Methods for the measurement of pollution. Methodology of environmental management - the problem solving approach, its limitations.

Air pollution and its control through Biotechnology. Water Pollution and control:

Need for water management, Measurement and sources water pollution. Kind of aquatic habitats, (fresh and marine), distribution and impact of environmental factors on the aquatic biota, productivity, mineral cycles and biodegradation different aquatic ecosystems.

UNIT – IV: Waste water treatment: Waste water collection, Physico-chemical properties of water, physical, chemical and biological treatment processes. Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds.

Anaerobic digestion, anaerobic filters, up flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries. Management of estuarine, coastal water systems and man-made reservoirs; Biology and ecology of reservoirs.

Unit V: Xenobiotic: Ecological considerations, decay behavior and degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides.

Bio pesticides in integrated pest management. Bioremediation of contaminated soils and wastelands.

Solid waste: Sources and management, Municipal waste management (composting, vermiculture and methane production). Environmental mutagenesis and toxicity testing.

Text & References

1. Fundamental of Ecology-Eugene Odum, Gary W. Barrett – Cengage Learning/Brooks/Cole
2. Cell biology, genetics, Molecular Biology Evolution, Ecology- Verma, Agarwal- S.Chand
3. Environmental Biology –Principles of Ecology- Verma and Agarwal- S.Chand
4. Environmental Biotechnology by Alan Scragg. Pearson Education Limited
5. Environmental biotechnology by S.N. Jogdand. Himalaya Publishing House
6. Wastewater Engineering - Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., TMH.
7. Environmental chemistry by A.K. De Wiley Eastern Ltd. New Delhi.
8. Introduction to Biodeterioration by D. Allsopp and K.J. Seal, ELBS/Edward Arnold.
9. Environmental Biotechnology Principles & Applications Rittmann and McCarty-, McGraw
10. Introduction to Environmental Biotechnology Chatterji A.K., , Prentice Hall of India
11. Environmental Biotechnology Indushekhar Thakur- -I K International
12. Text book of Environmental Biotechnology P. Mohapatra- -I K International

Practical (Lab course work VII)

1. Measurement of sounds by DB meter in silent, industrial, residential, commercial zones.
2. Estimation of TS, T.D.S., form given water sample.
3. Estimation of Hardness, Ca and Mg from given water and soil sample.
4. Estimation of Chlorides by Silver nitrate method.
5. Estimation of Na and K from given water and soil sample by flame photometrically.
6. Estimation of Sulphate/ Phosphates from given water and soil
7. Determination of Dissolved Oxygen and Biological Oxygen Demand of polluted water.
8. Determination of Chemical Oxygen Demand of polluted water.
9. Demonstration of Total Nitrogen estimation by Kjeldahl's Method.
10. Field Visit to MSW management/ STP Sewage treatment plant (one day)

Course Learning Outcomes (CLO): Students will be able to 1. comprehend environmental issues and role of biotechnology in the cleanup of contaminated environments2. Comprehend fundamentals of biodegradation, biotransformation and bioremediation of organic contaminants and toxic metals 3. apply biotechnological processes in waste water and solid waste management. 4. Comprehend biofuels/bioenergy systems; attributes for biofuel / bioenergy production.5. demonstrate innovative biotechnological interventions to combat environmental challenges.

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BT –XVII (A): Animal Biotechnology

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

Course objective: The objective of this course is to enable students to develop basic skills for vertebrate cell culture, maintenance of cell lines and *in vitro* application of cell and molecular techniques and also to understand the principles of animal cloning and its applications.

UNIT- I Animal Cell Culture

Equipments and Materials for animal Cell Culture Technology, Design of Tissue Culture Laboratory Equipments: Laminar Flow Hoods, CO2 incubator, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous small items of Equipments, Materials, filters, Miscellaneous Items. Basic Aseptic Techniques **Cells and tissue types**: Behavior of cells in culture: Primary cell lines permanent/Established cell lines/Transformed cell lines

UNIT- II Animal Cell Culture

Physical requirements and Nutritional Requirements of Cells and growth media. Natural media: Basal salt solution (BSS)-Various types, Minimum Essential Medium(MEM), Serum dependent and Serum independent defined media – Cell specific media, pH, CO2, O2 tension Ascorbic acid, sugars etc.

Basic Techniques of mammalian cell culture: Primary Cell culture – Isolation and separation of cells, viable cell count, maintenance of cell culture, maintenance of stock culture, Types of cell cultures – Monolayer, Suspension and Embryonic

UNIT- III Animal Cell Culture

cell synchronization. Cryopreservation. Biology and characterization of cultured cells: tissue typing; cell-cell interaction; Scale up, measuring parameters of growth; measurement of cell death; Apoptosis and its determination; cytotoxicity assays

UNIT- IV Molecular techniques in cell culture: -

Cell transformation; physical, chemical and biological methods; Viral gene delivery systems: hybridoma technology and its applications; cell fusion methods; vaccine production; gene therapy. Application of animal cell culture - Engineered cell culture as source of valuable products and protein production

Unit V - Transgenic: - Transgenic animal: production and application; transgenic animals as models for human diseases; transgenic animals in live-stock improvement; expression of the bovine growth
hormone; transgenic in industry; chimera production; Ethical issues in animal biotechnology.

Text & References

1. Animal cell culture; A practical approach, - Freshney. R.I.- John Wiley publication.
2. Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford
3. Exploring genetic mechanism; Ed. Maxine Singer and Paul Berg.
4. Principles of genetic manipulation; - Old and Primrose- Blackwell science
5. Biotechnological innovations in Animal productivity- BIOTOL - Elsevier
6. An introduction to embryology. WB Sounders company, Philadelphia, Balinsky. BI,
7. Arora M.P.- Biotechnology-Himalaya Publishing.
8. Gangal Sudha- Principles and Practice of Animal Tissue Culture-Universities
9. Animal Cell Culture – John Masters- Oxford University Press
10. In Vitro Cultivation of Animal cells- Butterworth- Heinemann, BIOTOL, Elsevier
11. Developmental biology- SF Gilbert -Sinauer associates.

Practicals

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of reagents and media for cell culture.
3. Primary culture technique for chicken embryo fibroblast.
4. Secondary culture of chicken embryo fibroblast.
5. Cultivation of continuous cell lines.
6. Quantification of cells by trypan blue exclusion dye.
7. Isolation of lymphocytes and cultivation of lymphocytes
8. Study of effect of toxic chemicals on cultured mammalian cells

Learning Outcomes (LO): Students will be able to

1 Explain the fundamental scientific principles that underlie cell culture
2 Acquire knowledge for isolation, maintaince and growth of cells.
3 Develop proficiency in establishing and maintaining of cell lines.
4 Acquire knowledge in animal cloning and its applications

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BT – XVII (B): Food Biotechnology

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

Course objective: To provide basic knowledge about food biotechnology and preliminary preparation of food before actual processing steps. To know the effect of microorganisms on food and to make the clear understanding about chemical and microbiological properties of food etc. To understand the concept of food born infections and awareness about laws and standards in food biotechnology.

Unit-I: Biotechnology of microbial polysaccharides, flavors in food.
Food safety: HACCP System to food protection, Responsibility for food safety.
Food Additives: Definition, Types and Functional characteristics.

Unit II: Natural Colors: Types, Applications, Advantages of natural colors over Artificial Colors. Sweeteners: Types and Applications and Advantages. Causes of food spoilage, processing and packaging for food preservation.

Unit-III:
Genetic engineering of baker's yeast. wine yeast. Diagnostics methods in food biotechnology, Genetic mechanisms involved in regulation of mycotoxin biosynthesis. Biosensors for food quality assessment. Biotransformation applicable to food industries.
SCP, Spirulina and Chlorella as food source. Functional foods: Concept of Prebiotics, Probiotics and Nutraceuticals.

UNIT IV:
Fermented dairy products: Cheese and yoghurt, Spoilage of fermented dairy products and their control, Production of Baker's yeast, Food enzymes and food additives. Biotechnological approaches to improve nutritional quality and shelf life of fruits and vegetables

Unit-IV

Food safety Laws and Standards: Food quality & analysis: Pre and Post-harvest factors in food quality, Physical, Chemical and Microbiological factors of quality, proximate analysis of foods, Sample and sample preparation in foods. Food laws: Voluntary and Mandatory food laws in India. Food Certification Agencies.

Reference Books:
1. Industrial Microbiology by Prescott and Dunn.
2. Industrial Microbiology by L.E. casida
3. General Microbiology, Vol. II by Power and Daginawala
4. Biotechnology by U. Satyanarayana
5. Outlines of dairy technology by Sukumar De
6. Nutrition and dietetics foods by Arnold E. Bender

7. Nutrition and dietetics by Shubhangini A. Joshi
8. Basic nutrition in health and disease by P. S. Howe,W.B.Saunders

Practicals:

1. Survey and Characterization of available market food products (Two)
2.Preparation of Tomato and Mix veg soups.
3. Production of fermented products like vinegar / cider / wine.
4.Production of Milk products
5. Qualitative and quantitative analysis of milk and products.
6. Analysis of ghee – RM value, Boudomin‟s and other tests foradulterations
7. Production of Idli, Dosa etc.
8. Evaluation of quality of dairy products: Specific gravity of milks.
9. Microbial production of Polysachharides.
10 . Visit to dairy Industry

Learning Outcomes (LO): Students will be able to
1 Comprehend the different microorganisms roles involved in food biotechnology with different food items.
2 Define and explain different preliminary steps before and after food fermentation.
3 Comprehend phenomenon of food degradation and spoilage by microorganisms with change in the properties of food.
4 To create awareness about different laws and standards in food biotechnology.