Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Biotechnology

SEMESTER PATTERN

(w.e.f. Academic Year 2016-17)

SYLLABUS FOR

M.Sc.II Year (Biotechnology)

JUNE -2016

Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)

Department of Biotechnology

Choice Based Credit System

Course Structure of M.Sc. Biotechnology Second Year (w.e.f. June 2016)

M. Sc. II [Biotechnology] Semester III

Code No.	Title of the course	Hours/ Week	Marks (100)		Credits
			In Sem	End Sem	
P-GEE-334	**Genetic Engineering**	04	40	60	04
P-MIB-335	**Microbial biotechnology**	04	40	60	04
P-EPE-336	**Enzyme Technology and Protein Engineering**	04	40	60	04
P-PLB-337	**Plant Biotechnology**	04	40	60	04
P-LAC-338	**Lab Course IX(Practical Based on BTT3.1)**	04	20	30	02
P-LAC-339	**Lab Course X (Practical Based on BTT 3.2)**	04	20	30	02
P-LAC-340	**Lab Course XI (Practical Based on BTT 3.3)**	04	20	30	02
P-LAC-341	**Lab Course XII (Practical Based on BTT 3.4)**	04	20	30	02
P-ADC-342	**Add on course: Summer Training (At least 10 days Programme)**			50	02
	Total Credits				26

M.Sc. II[Biotechnology] Semester IV

CodeNo.	Title of the course	Hours/ Week	Marks (100)		Credits
			In Sem	EndSem	
P-GEM-432	**Genomics and Metabolomics**	04	40	60	04
P-BBE-433	**Bioethics, Biosafety, IPR and Entrepreneurship Development**	04	40	60	04
P-FOB-434	**Food Biotechnology**	04	40	60	04
P-ENB-435	**Environmental Biotechnology**	04	40	60	04
P-LAC-436	**Lab Course XIII (Practical Based on BTT4.1 + BTT4.2)**	04	20	30	02
P-LAC-437	**Lab Course XIV (Practical Based on BTT 4.3 + BTT 4.4)**	04	20	30	02
P-PRW-438	**Lab Course XV Dissertation**	04		100	04
	Total Credits				24

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M.Sc. Biotechnology (Semester Pattern)

III Semester

Course Title: Genetic Engineering **Course Code: P-GEE-334**

Marks 100 **Hours 45** **Credit: 04**

Learning objectives:

1. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
2. To expose students to application of recombinant DNA technology in biotechnological research.
3. To train students in strategizing research methodologies employing genetic engineering techniques.
4. Gain an understanding of basic molecular and cellular biology concepts and techniques.
5. Gain an understanding of current experimentation in biotechnology and genetic engineering.
6. To understand Genetic testing and genetic therapies
7. Control of gene expression and the process of development in eukaryotes

Course outcomes:

1. Technical know-how on versatile techniques in genetic engineering like PCR, Blotting, molecular diagnosis, cell profiling etc.
2. An understanding on application of genetic engineering techniques in basic and applied experimental biology.
3. Proficiency in designing and conducting experiments involving genetic manipulation.
4. Understand the concept of recombinant DNA technology or genetic engineering
5. Describe DNA fingerprinting, and restriction fragment length polymorphism (RFLP) analysis and their applications
6. Describe the steps involved in the production of biopharmaceuticals in microbial and mammalian cell systems

Unit-I Isolation of DNA and RNA.Quantification of nucleic acids.Radiolabelling of nucleic acids: End labelling, nick translation,labelling by primer extension, DNA sequencing: Maxam-Gilbert(Chemical) and Sanger- Nicolson (dideoxy/ enzymatic) sequencingmethod, Pyrosequencing.

(10 L)

Unit-II Restriction endonucleases: Types of restriction endonucleases,classification and uses. Restriction mapping. DNA modifyingenzymes: Nucleases, Polymerases, Phosphatases and DNA ligases.Prokaryotic host. Plasmid vectors, Bacteriophage, other vectors,expression vectors, Construction of genomic and c-DNA libraries,Joining of DNA Fragments to vectors,Homo polymer tailing,cohesive and blunt end ligation, adaptors, linkers.

(12 L)

Unit-III Selection, screening and analysis of recombinants. Principle ofhybridization.Northern blotting, Southern blotting, Westernblotting. Polymerase chain reaction, Restriction fragments lengthpolymorphism, RAPD, AFLP, MAP.

(12 L)

Unit-IV Vector Engineering and codon optimization, host engineering.Strategies of gene delivery, *in vitro* translation, expression inbacteria and yeast, expression in insects and insect cells, expressionin mammalian cells, expression in plants.Chromosomeengineering, Targeted gene replacement, gene editing, gene regulation & silencing. (12 L)

Reference:-

1. Principles of Gene manipulation (1994) Old R.N. and Primrose S.B.
2. From Genes to Clones (1987) Winnaeker E.L.
3. Recombinant DNA (1992) Watson J.D., Witreowski J., Gilman M. AndZooller M.
4. An Introduction to GeNETIC Engineering: Nicholl, D.S.T.
5. Molecular Biotechnology (1996) Pasternak
6. The Biochemistry of Nucleic acid(1996)Adam et al
7. Genetic Engineering (1998)Janke k. swtlow

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M.Sc. Biotechnology (Semester Pattern)

III Semester

Course Title: Lab Course IX **Course Code: P-LAC-338**

Marks 50 **Hours 45** **Credit: 02**

Course outcomes:

- Technical know-how on versatile techniques in genetic engineering like PCR, Blotting, molecular diagnosis, cell profiling etc.
- An understanding on application of genetic engineering techniques in basic and applied experimental biology.
- Proficiency in designing and conducting experiments involving genetic manipulation.
- Understand the concept of recombinant DNA technology or genetic engineering

PRACTICALS

1) Isolation of nuclei and analysis of chromatin- i) determination ofmononucleosomal size ii) chromatin gel electrophoresis

2) Endonuclease digestion of nuclei and analysis of DNA fragments by agarose gelelectrophoresis

3) Thermal melting of DNA

4) Isolation of plasmid DNA-i) minipreparation ii) large-scale isolation

5) In *vitro* DNA ligation, transformation of *E.coli.*

6) Techniques: a) DNA blotting technique b) DNA hybridization.

7) Isolation of cytoplasmic RNA.

8) Electrophoresis of RNA on denaturing gels.

9) Northern blotting technique.

10) Separation of poly A+RNA on oligo-dT column.

11) cDNA synthesis and cloning.

12) RNA hybridization-dot and northern blots.

13) In *situ* detection of RNA in embryos/tissue.

14) *In vitro*translation.

15) Sequencing and computer analysis.

16) PCR/RFLP technique.

CHOICE BASED CREDIT SYSTEM
M.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Microbial Biotechnology **Course Code: P-MIB-335**
Marks 100 **Hours 45** **Credit: 04**

Learning Objectives

1. The objective of the course is to create general understanding amongst the students in the subject of Microbial Technology through in-depth lectures & laboratory practicals.
2. The objective of the course is to understand them a general overview, concepts and basic principles in the subject of Microbial Technology with emphasis on Upstream and Downstream process.

Course Outcome

1. understand the various concepts of fermentation; know the differences between aerobic and anaerobic fermentation
2. Understand the growth of microorganism and their role in producing foods and drinks.
3. (skills) isolate and identify microorganisms from fermenting fruits, cereals and milk;
4. produce some drinks and foods e.g. bread, beer, wine and vinegar resulting from alcoholic fermentation; produce some foods and drinks e.g. cheese, butter, yoghurt resulting from acidic
5. fermentation; and design a simple containment system (Bioreactor / fermentor)
6. The course concept of microbial growth, metabolism and applications of microbial technology in varied fields. The theory course structure will be complimented by practical sessions. This course will provide a strong understanding of applied microbiology and will help the students to explore work opportunities in Biotechnology Companies and Industries as well.

Unit-I : **11L**

- **Microbial Production of Organic Acids:** Production, recovery and applications of: Citric acid, Lactic acid.
- **Microbial Production of Organic Solvents:** Production, recovery and applications of: Glycerol, Acetone, Alcohol
- **Microbial Production of Vitamins:•** Production, recovery and applications of vitamins: Vitamin-B12 and Riboflavin

Unit-II: **11L**

- **Microbial Production of Amino Acids:** Production, recovery and applications of amino acids: L-Glutamic acid, L-Lysine, L- Tryptophan
- **Production of insulin and erythropoietin**
- **Biogas production from biomass:** Methane

- **Bioleaching:** Mechanism of Bioleaching with example.
- **Biosorption and Microbial recovery of petroleum**

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Unit-III: 11L

- **Production of Chemotherapeutic Agents** :Production, recovery and applications of antibiotics: Penicillin, Tetracycline, Erythromycin
- **Production of microbial polysaccharides**:Production, recovery and applications of polysaccharides: Xanthan, Dextran and Alginate
- **Production of Polyhydroxyalkanoates**: Polyhydroxybutyrate (PHB), Biopol-a biodegradable plastic

Unit-IV: **12L**

- **Enzyme Technology:** Immobilization of enzymes and cells, Production and applications of : Proteases, Pectinases, Cellulase, amylase.
- **Biotransformation:** Types of bioconversion reactions: Oxidation, Reduction, Hydrolytic reactions, Condensations, Transformation of steroids and sterols, Transformation of nonsteroid compounds: L-Ascorbic acid, Prostaglandins, Antibiotics.

Text & Reference:

1. Satyanarayana U. (2005) Biotechnology. Uppala Author Publisher Interlinks,Vijaywada, India.
2. Microbial technology peppler&perlman. Vol- I, II Academic Press
3. Gupta P.K. (2004) - Biotechnology and Genomics. Rastogi Publications, Meerut, India.
4. Crueger W. and Cruger A. (2000) Biotechnology: A Textbook of Industrial Microbiology.2nd Edition, Panima Publishing Corporation, New Delhi.
5. Bu'Lock J. and Kristansen B. (Eds) (1987) Basic Biotechnology. Academic Press Inc Ltd, London.
6. Demain A.L., Davies J.E. (Ed in Chief) (1999) Manual of Industrial Microbiology andBiotechnology. 2nd Edition, ASM, Washington, USA.
7. Biology of Industrial Microorganisms by A.L. Demain.
8. Industrial Microbiology by G. Reed (Ed), CBS Publishers (AVI Publishing Co.)
9. Biotechnology, A textbook of industrial Microbiology by Creuger and Creuger, Sinaeur associates.
10. Manual of industrial Microbiology and Biotechnology 2nd edition by Davis J.E. Demain A.L. ASM publications.
11. Comprehensive biotechnology Cooney &Humphery. Vol-3.Pergamon press.
12. Text book of biotechnology H.K Das 3rd ed. Willey India
13. Industrial microbiology A.H Patel Macmillan Publication.

CHOICE BASED CREDIT SYSTEM
M.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Lab Course X **Course Code: P-LAC-339**
Marks 50 **Hours 45** **Credit: 02**

Course Outcome

- Understand the various concepts of fermentation; know the differences between aerobic and anaerobic fermentation
- Isolate and identify microorganisms from fermenting fruits, cereals and milk;
- Produce some drinks and foods e.g. bread, beer, wine and vinegar resulting from alcoholic fermentation; produce some foods and drinks e.g. cheese, butter, yoghurt resulting from acidic
- Fermentation; and design a simple containment system (Bioreactor / fermentor)

Practicals

1. Production and isolation of bacterial exo-polysaccharides
2. Production and estimation of alkaline protease from bacterial source
3. Production and estimation of bacterial lipase
4. Production of sauerkraut by microorganisms
5. Production and estimation of lactic acid by Lactobacillus Sp.
6. Production of fermented milk by *Lactobacillus acidophilus.*
7. Comparison of ethanol production using various Organic wastes /raw Material
8. Laboratory scale production of biofertilizers
9. Amylase production by bacteria
10. Amylase production by fungi

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M.Sc. Biotechnology (Semester Pattern)

III Semester

Course Title: Enzyme TechnologyAnd Protein Engineering

Course Code: P-EPE-336

Marks 100 **Hours 45** **Credit: 04**

Learning Objective:-

The objective of the course is to provide a deeper insight into the fundamentals of enzyme structure and function and kinetics of soluble and immobilized enzymes. Also it deals with current applications and future potential of enzymes.

Course Outcome:-

- The student will be able to describe structure, functions and the mechanisms of action of enzymes.
- The student will learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory process.
- The student will be able to perform immobilization of enzymes.
- The student will get exposure of wide applications of enzymes and their future potential

UNIT-I INTRODUCTION TO ENZYMES & ENZYME KINETICS: The Enzyme-Introduction, nomenclature and classification, applications in Industrial, Medical, Analytical, Chemical, Pharmaceutical and Food Sectors. (2 Lectures)

UNIT – II ENZYME KINETICS: Enzyme kinetics, Michaelis - Menten equation, Brigg's-Haldane equation,Graphical procedures in enzymology - advantages and disadvantages of alternate plotting, estimation of constants using graphical technique, Kinetics for reversible reactions, basics of enzymatic reaction, collision theory and transition state theory and role of entropy in catalysis, presteady state kinetics, Significance of Vmax and Km, Kinetics of multi-substrate reactions, Allosteric enzymes – The Monad – Changeux – Wyman model (MCW) and The Koshland – Nemethy – Filmer (KNF) model, 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 (20 lectures).

UNIT-III EFFECT OF PHYSICAL FACTORS & ENZYME KINETICS IN BIPHATIC REACTION: Temperature dependence of rate constants of enzymatic reaction, thermal deactivation, pH effect on rate constants and protein structure. pH dependence: ionization of Acids and Bases. Enzyme kinetics in biphasic liquid systems, stabilization of biphasic aqueous- organic systems, equilibria in biphasic aqueous- organic systems(8 lectures).

UNIT-IV ENZYME IMMOBILIZATION, KINETICS OF IMMOBILIZATION& PROTEIN ENGINEERING: Immobilization of Biocatalysts an Introduction, Electrostatic Effect, effect of charged and uncharged support, Kinetics of immobilized enzymes –Effect of external and internal mass transfer, Damkohler number, effectiveness factor, Intraparticle diffusion kinetics, Biotnumber.Biosensors - glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors, Introduction to protein engineering, structure prediction sequence structure relationship. Recombinant proteins using fusion protein strategies for enhanced recovery, Engineering protein for the affinity purification,(engineering of streptavidin) Stabilization of enzymes by protein engineering(eg. pseudomonas isoamylase) (15 Lectures)

REFERENCE BOOKS:

1. Bailey JE, Ollis, DF: Biochemical Engineering Fundamentals
2. Blanch HW and Clark DS: Biochemical Engineering Marcel Decker
3. Schugerl K., Bellgart KH (Eds): Biorection Engineering, modeling and control: Springer-Verlag, Berlin.
4. Enzymes by palmer,
5. Wiseman, A: Handbook of Enzyme Biotechnlogy, 3rd Edition, Ellis Horwood Publication
6. Moser, A: Bioprocess technology, kinetics and reactors: Springer Verlag
7. Biochemical Engineering Principles and functions by SyedTrnveer Ahmed Inamdar, PHI Learning Private limited.

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M.Sc. Biotechnology (Semester Pattern)

III Semester

Course Title: Lab Course XI **Course Code: P-LAC-340**

Marks 50 **Hours 45** **Credit: 02**

Course Outcome:-

- The student will learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory process.
- The student will be able to perform immobilization of enzymes.
- The student will get exposure of wide applications of enzymes and their future potential

PRACTICALS:

1. Isolation of high yielding microbial strains for the production of commercially important enzymes.
2. Production of commercially important enzymes from microbial sources.
3. Standardization of medium composition for the optimum production of enzymes.
4. Determination of enzyme activity and specific activity.
5. Partial purification of isolated enzymes.
6. Characterization of enzymes-Effect of pH,temperature and inhibitors on enzyme activity etc.
7. Molecular weight determination of enzyme by Gel filtration method.
8. Method of checking the purity of the enzyme -SDS-PAGE
9. Immobilization of enzymes –Different Techniques such as adsorption, entrapment, encapsulation and cross- linking.
10. Strain improvement techniques- physical, chemical and genetic manipulation methods.
11. Development of enzyme assay methods.
12. Formulation of enzyme stability.

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M.Sc. Biotechnology (Semester Pattern)

III Semester

Course Title: Plant Biotechnology **Course Code: P-PLB-337**
Marks 100 **Hours 45** **Credit: 04**

Learning Objectives: The course is designed to give insights in to the advancements in the field of biotechnology with respect to plants. After taking this course, students should be able to follow the modern techniques and their applications in crop improvements, such as tissue culture and transgenics.

Course Outcome:-

- Concepts, principles and processes in plant biotechnology.
- Applications. Presentation of ongoing research.
- Reflexion. The ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological, pharmaceutical, medical and agricultural applications.
- Transmissible skills. Critic usage of literature and other sources, collection and interpretation of data, scientific and technical terminology.

UNIT I **(10 Lectures)**

Plant Tissue Culture-I

- Introduction to cell and tissue culture
- Tissue culture media: Types, Composition and Preparation.
- Initiation and maintenance of callus and suspension culture
- Organogenesis: Principles Concept and Applications of Somatic embryogenesis
- Shoot tip culture
- Rapid clonal propagation and production of virus free plants.

UNIT II **(10 Lectures)**

Plant Tissue Culture-II

Protoplast culture: Importance, Isolation of protoplasts, method of protoplast culture,culture media, Growth and division of protoplast, regeneration of plants,

- Embryo culture and embryo rescue
- Anther, Pollen and Ovary culture for production of haploid plants and homozygouslines
- Cryopreservation, slow growth and DNA banking for germ plasm conservation
- Commercial application of tissue culture technology, examples: banana and Sugarcane.

Unit-III: (15 Lectures)

Plant molecular biology

- Gene structure, expression, and regulation in plants
- *Agrobacterium tumefaciens* and the genetic engineering of plants
- Mechanism of gene transfer from*Agrobacterium* to plants
- Strategies for gene transfer in plants
- Molecular markers and marker assisted selection

Unit-VI: (10 Lectures)

Transgenic Crops

- Crops with resistance to biotic stresses, viruses, fungal and bacterial diseases: strategyand examples
- Crops with resistance to abiotic stresses (Herbicides and drought conditions): strategyand examples
- GM crops, medical applications of GM plants
- Terminator technology
- Ecological risk assessment of genetically modified crops

Reference

1. Gupta P.K. (2004) - Biotechnology and Genomics. Rastogi Publications, Meerut, India.

2. Owen M.R.L. and Pen J. (Eds) (1996) - Transgenic Plants: A Production System for Industrial and Pharmaceutical Proteins. John Wiley & Sons, England.

3. Purohit S.S. (1999) - Agricultural Biotechnology. Agro Botanica, India.

4.Endress R. (1994) - Plant Cell Biotechnology. Springer Verlag, Germany

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M.Sc. Biotechnology (Semester Pattern)

III Semester

Course Title: Lab course XII **Course Code: P-LAC-341**
Marks 50 **Hours 45** **Credit: 02**

Course Outcome:-

- Students would be more aware about PTC technique and lab organization with necessary explanations.
- By studying all these student would be more empower with the special skills of PTC to establish own business and create employment in the field of seed and processing and related technique in various research organizations

Practicals

1. Plant tissue culture laboratory design
2. Aseptic techniques
3. Media preparation
4. Micro propagation
5. Anther culture
6. Hairy root culture
7. Plant DNA isolation
8. Protoplast isolation
9. Embryo culture
10. RAPD

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M.Sc. Biotechnology (Semester Pattern)

IV Semester

Course Title: Genomics And Proteomics **Course Code: P-GEM-432**
Marks 100 **Hours 45** **Credit: 04**

Learning Objectives

1. To understand basic and applied aspects in genomics and pharmacogenomics and proteomics
2. To Understand applications of genomics and pharmacogenomics in clinical settings
3. Provide an example of pharmacogenomics
4. Appreciate possible ethical and legal issues

Course outcomes

1. Be able to describe the development of Omics technologies, with emphasis on genomics and proteomics;
2. Be able to synthesize information to discuss the key technological developments that enabled modern genomic and proteomic studies;
3. Be able to describe advanced genomics and proteomics technologies and the ways in which their data are stored;
4. Be able to use bioinformatics techniques to query examples of genomic and proteomic databases to analyze cell biology;
5. Be able to describe the different types of genome variation and their relationship to human diseases;
6. Be able to discuss how biological systems information relating to genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells.
7. Gain the ability to use information technology to acquire relevant knowledge for their understanding of the current status of the field and its relevance to society.
8. Gain the capacity to integrate knowledge across other disciplines in biotechnology.

Unit 1

Introduction to Bioinformatics: the fundamentals of protein and nucleic acid Sequence analysis, Database searching, pairwise alignments, database searching including BLAST, Sequence analysis with PERL, Multiple sequence alignments, phylogenetic analysis, Profile searches of databases, revealing protein motifs, 3D structural comparisons, predictions and modeling. (12 L)

Unit II

Genomics: What is genomics, Genetics to genomics, Whole genomes sequencing. Genome Sequence Acquisition and Analysis, Evolution and Genomes, Biomedical Genome Research:

genomic sequences to make new vaccines, new types of antibiotics, new types of medications.Genomic Variations: Variation in the human genome, known examples of SNPs that cause diseases, Pharmacogenomics, Ethical Consequences of Genomic Variations. (10 L)

Unit III

Expression Data Analysis: DNA/RNA Microarrays, The oligo microarray/chip technology, Affymetrix protocol and data generation, The spotted microarray technology, cDNA and oligo spotted arrays, Biomedical applications; Cancer and genomic microarrays. Nanotechnology, Gene therapy. (10 L)

Unit IV

Proteomics: Introduction, Protein 3D Structures, Protein identifications (2-hybrid system, 2-D gel electrophoresis, mass spectrometry/MALDI-TOF, other arrays). Statistical models and stochastic processes in Proteomics, Signal Processing for Proteomics, Protein Interaction Networks, measuring protein interactions, Large-scale databases of information for protein sequences, structures, functions and interactions; mining of protein databases, applications to human disease studies. Structural and Functional Genomics Studies: Plant genome: Arabidopsis genome covering identification and characterization of genes controlling flowering, vernalization, photoperiod, circadian clock. (13 L)

Reference

1. Discovering Genomics, Proteomics, & Bioinformatics. Campbell &Heyer (2003) Pearson Education, ISBN: 0-8053-4722-4

2. Bioinformatics, Methods of Biochemical Analysis Series Vol. 43, Baxevanis& Ouellette (2001) John Wiley & Sons, ISBN 0-471-38391-0

3. Computational Molecular Biology.Pevzner, P.A. (2000) MIT Press, ISBN: 0262161974

4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Andreas D. Baxevanis& B. F. Francis Ouellette (2004). 3rd Edition. Wiley & Sons, ISBN:0-471-47878-4

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M.Sc. Biotechnology (Semester Pattern)

IV Semester

Course Title: Bioethics, Biosafety, IPR and Entrepreneurship Development
Course Code: P-BBE-433
Marks 100 Hours 45 Credit: 04

Learning Objective:-
To introduce basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights. To understand balanced integration of scientific and social knowledge in sustainable development.

Course Outcome:-

- Students will gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas.
- They will able to devise business strategies by taking account of IPRs
- They will be able to assists in technology upgradation and enhancing competitiveness.
- They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health
- They will gain more insights into the regulatory affairs.

UNIT I (15 Lectures)

Bioethics:

- Introduction to Bioethics and Biosafety.
- Human genome project and its ethical issues.
- Ethical issues in genetically modified food and crops.
- Ethical issues involved in stem cell research.
- Ethical issues of organ transplantation.
- ICMR Ethical Guidelines for Biomedical Research on Human Subjects.
- Good clinical practice for clinical research.

Biosafety:

- Introduction and history.
- Biosafety guidelines and regulations.
- Risk assessment, regulation and containment.
- Potential effect on Environment and Human health by transgenic plants.

UNIT II (10 Lectures)

Biopiracy :

- Biopiracy and traditional knowledge.
- Case studies of biopiracy:
- RiceTec Patent No. 5663484 in the USPTO.
- Monsanto's biopiracy of Indian wheat.
- Neem.
- Curcuma.

UNIT III (10 Lectures)

Intellectual Property Rights:

- Introduction and history.
- Protection of intellectual property rights.
- Patent laws and procedure of patenting.
- Limits of a patent.
- Plant variety protection.

UNIT IV (10 Lectures)

Entrepreneurship

- **Introduction:** Concept and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs.
- **Project management**: Search for a business idea, concept of project and classification, project identification, project formulation, project design and network analysis, project report, project appraisal.
- **Setting up a small scale industry:** Location of an enterprise, steps for starting a small industry, incentives and subsidies, exploring export possibilities.

References:

1. Bioethics and Biosafety, M.K.Sateesh, I.K.International 2008
2. Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2005
3. Projects: Planning, Analysis, Selection, Implementation & Review, Prasannan Chandra, Tata McGraw-Hill Publishing Co. 1997.
4. www.icmr.nic.in (ethical guidelines for biomedical research).

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M.Sc. Biotechnology (Semester Pattern)

IV Semester

Course Title: Lab Course XIV (Based on P-FOB-434 and P-ENB-435)

Course Code: P-LAC-437

Marks 50 **Hours 45** **Credit: 02**

Course outcomes

- Be able to discuss how biological systems information relating to genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells.
- Gain the ability to use information technology to acquire relevant knowledge for their understanding of the current status of the field and its relevance to society.
- Gain the capacity to integrate knowledge across other disciplines in biotechnology.
- To understand the social issues and Problems related to Biological Fields.
- Skills in writing Research, Business Proposals.

Pracicals

1. Isolation and Characterization of food fermenting organism from idli,butter.
2. Estimation of ascorbic acid from given food sample by titrimetric method.
3. Analysis of mycotoxin (Aflatoxin) in fungus contaminated food material.
4. Microscopic examination of Food/Milk by breed method.
5. Estimation of lactose from milk.
6. Quality characterization of pasteurized milk by MBRT method.
7. To judge efficiency of pasteurization of milk by Phosphatase test.
8. Detection of microbial count in Milk by SPC method.
9. Isolation and biochemical testing of probiotic cultures (Lactobacilli) from food samples (curd, intestine, sauerkraut, dosa, etc)
10. Check the potential of bacterial culture as probiotic culture by testing bile i) salt toleranceii) acid tolerance iii) heat tolerance
11. Isolation and characterization of heavy metal resistant microbes
12. Plate assays for determination of MIC of heavy metals
13. Bioaccumulation of heavy metals
14. Biosorption of heavy metals
15. Isolation and characterization of microbes degrading xenobiotics
16. Isolation and characterization of microbes degrading PAH
17. Synthesis of nanoparticles using microbes
18. Waste water analysis - pH, COD, BOD, Hardness, halides, Total solids, alkalinity and chloride

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M.Sc. Biotechnology (Semester Pattern)

IV Semester

Course Title: Food Biotechnology **Course Code: P-FOB-434**

Marks: 100 **Hours 45** **Credit: 04**

Learning Objective: The course involves diverse areas of food biotechnology with strong focus on Biochemistry and Molecular Biology which will form the basis for designing food ingredients for better health and microbial food safety.

Course Outcome:-

- Discuss applications, advantages and limitations of enzymes in the food industry.
- Describe developments in the field of functional dairy products.
- Describe examples of the application of omics techniques in food analysis: food authenticity, food safety.
- Critique strategies to engineer flavour profiles in plants and food materials.
- Plan a safety assessment strategy for food developed through genetic engineering.
- Outline the major technical considerations for detecting GM foods and for species identification in meat products.

Unit-I:

Biotechnology for Food Ingredients **10L**

• Metabolic engineering of bacteria for food ingredients
• Technologies used for microbial production of food ingredients
• Production of amino acids: physiological and genetic approach
• Biotechnology of microbial polysaccharides in food
• Microbial biotechnology for food flavor production

Unit-II: **12L**

Aspects of Food Production.

• Food safety: HACCP System to food protection, Responsibility for food safety.
• Food Additives: Definition, Types and Functional characteristics.
• Natural Colors: Types, Applications,
• Sweeteners: Types and Applications.
• Causes of food spoilage
• Food Preservation Methods

Unit-III: **11L**

Fermented Food Products

• Fermentation technology for traditional food of the Indian subcontinent

• Solid state fermentations for food applications
• Genetic engineering of bakers yeast
• Biotechnology of wine yeast
• Biotechnology of _-carotene from Dunaliella
• SCP: Spirulina and Chlorella

Unit-IV: **12L**

• Molecular evolution and diversity of food borne pathogens
• Application of microbial molecular techniques for food systems
• Genetic mechanisms involved in regulation of mycotoxin biosynthesis
• Application of ELISA assays for detection and quantitation of toxins in foods and *E.coli* in food
• Biosensors for food quality assessment
• Biotechnological approaches to improve nutritional quality and shelf life of fruits and vegetables
• Biotransformation applicable to food industries
• Functional foods: Concept of Prebiotics, Probiotics and Neutraceuticals

Text & References:

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Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

M.Sc. Biotechnology (Semester Pattern)

IV Semester

Course Title: Environmental Biotechnology Course Code: P-ENB-435

Marks 100 Hours 45 Credit: 04

Learning Objectives:

1. To have understanding of environment
2. To know technical aspects of biotechnology to improve environment.
3. To help the students to build interdisciplinary approach
4. To inculcate sense of scientific responsibilities and social and environment awareness.

Course Outcome

- Explain the importance of microbial diversity in environmental systems, processes and biotechnology
- Understand and explain the importance of molecular approaches in environmental microbiology and biotechnology.
- Describe existing and emerging technologies that are important in the area of environmental biotechnology;
- Describe the principles and techniques underpinning the application of biosciences to the environment;
- Describe biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling;
- Analyse case-studies representative of key areas of environmental Biotechnology;
- Undertake a range of practical approaches relevant to environmental microbiology and biotechnology and be able to record, report and discuss data

Unit I **12 lectures**

Ecology & Environment:

Ecosystem structure and functions, abiotic and biotic component.
Energy flow, food chain, food web.
Ecological Pyramids-types.
Biogeochemical cycles.
Ecological succession, Ecads and ecotypes.
Ecology and its relevance to man, natural resources.
Threats to Environment - Global and regional threats to the environment.
Sustainable management and conservation of environment.
Agro ecology; cropping pattern as indicators of environments.

Unit II **11 lectures**

Environmental Pollution:

Classification of pollutants.

Air pollution and their properties, Gaseous pollutants.
Water pollutants and their properties.
Environmental pollution and associated hazards to crops, animals and humans.
Green house effect and global warming.
Climate change - International conventions and global initiatives.
Environmental Laws and Policies

Unit III **12 lectures**

Biotechnological processes:

Waste water treatment plant-
Physical, Chemical and Biological unit operations/processes-overview, Activated Sludge Process, Trickling Filters, Oxidation ponds, anaerobic biological treatment process.

Biotechnology in Remediation:

Introduction to bioremediation, Advantages, limitations and applications
Types of Bioremediation and Factors affecting: Natural, Engineered, Ex-situ and in-situ Phytoremediation, Bioaugmentation, Biostimulation. Bioconversion, Bioaccumulation, Bioconcentration, Biomagnification, Biodegradation.

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

Unit IV **10 lectures**

Advancement in environmental technology:

Remote sensing and GIS- Principal, terminologies and objectives.
Energy sources for remote sensing, Types of remote sensing.
Applications- Agricultural, Forestry, Water Resource, Urban Planning, Wildlife Ecology, Disaster Assessment.
Ecological modeling.
Environmental Impact Assessment: Introduction, Objectives, Classification, Guidelines, Case Study.

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2. Environmental Biotechnology by Prof.Jogdand, Himalayan publication
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6. Environmental Biotechnology by A.K. Chatterjee
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8. Environmental pollution control engineering. C. S. Rao. New Age International Publis hers.
9. Environmental Biotechnology theory and application by Gareth Evans and Judith Furlong. John Wiley and Sons Ltd.
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M.Sc. Biotechnology (Semester Pattern)

IV Semester

Course Title: Lab Course XIV (Based on P-FOB-434 and P-ENB-435)

Course Code: P-LAC-437

Marks 50 **Hours 45** **Credit: 02**

Course Outcome:-

- Students are able to develop skills in detection of nutritional value in food
- Students are able to detect type of spoilage in Food sample.
- Students are able to learn Preservation Techniques.
- Students are able to determine Acidity, Alkalinity, Salinity, COD , BOD etc.
- Students are able to estimate Nitrogen of soil (Kjeldals method) and metal content of soil

Practicals

1. Isolation and Characterization of food fermenting organism from idli,butter.
2. Estimation of ascorbic acid from given food sample by titrimetric method.
3. Analysis of mycotoxin (Aflatoxin) in fungus contaminated food material.
4. Microscopic examination of Food/Milk by breed method.
5. Estimation of lactose from milk.
6. Quality characterization of pasteurized milk by MBRT method.
7. To judge efficiency of pasteurization of milk by Phosphatase test.
8. Detection of microbial count in Milk by SPC method.
9. Isolation and biochemical testing of probiotic cultures (Lactobacilli) from food samples (curd, intestine, sauerkraut, dosa, etc)
10. Check the potential of bacterial culture as probiotic culture by testing bile i) salt toleranceii) acid tolerance iii) heat tolerance
11. Isolation and characterization of heavy metal resistant microbes
12. Plate assays for determination of MIC of heavy metals
13. Bioaccumulation of heavy metals
14. Biosorption of heavy metals
15. Isolation and characterization of microbes degrading xenobiotics
16. Isolation and characterization of microbes degrading PAH
17. Synthesis of nanoparticles using microbes
18. Waste water analysis - pH, COD, BOD, Hardness, halides, Total solids, alkalinity and chloride