EKLAVYA UNIVERSITY
ज्ञान प्राप्तये लक्ष्य संधानम्

School of Basic and Applied Sciences

Class	**M.Sc. (Microbiology)**
Semester/Year	**III Semester**
Subject & Subject Code	**Microbiology - MMBIO20S301**
Paper	**Microbial Genetics and Recombinant DNA Technology – 301**
Max. Marks	**30 (ETE) + 20 (IA) = 50**

Credit			Total Credits
L	T	P	3
3	0	0	

Course Objectives:

The objective of the course is to familiarize the students with the basic concepts in genetic engineering; to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology; and to appraise them about applications genetic engineering.

Course Outcome:

At the end of the course, learners will be able to:

1. Understand use of genetic code table to translate from DNA sequence to protein sequence.
2. Learn the genetic changes due to mutations- Point Mutations, Deletions, Insertions, and Damage, DNA repair and recombination.
3. Get the Knowledge on DNA Structure and its variations, properties and modification of DNA.
4. Get the Overview of DNA packaging; Synthesis and processing of RNA and proteins; Regulation of gene expression.
5. Get the Knowledge on the repetitive DNA sequences and transposable elements; Promoters and methods of isolation; Transcription factors- their classification and role in gene expression.

Student Learning Outcomes (SLO):

Students will:

1. Explain genome organization in higher organisms.
2. Describe kinetic classes of DNA and Gene families.
3. Understand the steps involved in recombinant DNA technology.
4. Explain the construction of DNA & c DNA library and their applications.
5. Understand about the Nucleic acids
6. Know the structure of nucleic acid, types of Nucleic acid and itsForms.
7. Explain genome organization in Prokaryotes and Eukaryotes.

Unit	Syllabus	Periods
UNIT - I	Structure of DNA. Variation from Watson and Crick model. Chromosome structure (eubacteria, eukaryotes, viruses). Modes of DNA replication in bacteriophages (X 174, lambda). Mitochondrial DNA. Selfish DNA, C- DNA paradox. Primary structure determination (denaturing, heteroduplex. RNA sequencing . DNA sequencing). Western, Southern and Northern blotting. Types of plasmids, detection of plasmids. Replication of plasmids. Application of plasmids in genetic engineering. Cosmids and their application. Construction of bacterial strain for industrial purpose.	12

UNIT - II	RNA: Structure of RNA (mRNA, tRNA. rRNA) Prokaryotic and eukaryotic transcription. Regulation of transcription. The genetic code. Protein synthesis (translation in prokaryotes and eukaryotes.	12
UNIT - III	Types of mutagens. Molecular basis of mutation. Types of mutation. Genetic analysis of mutants. Mutations affecting structure and function. Methodology in evaluating mutation. DNA damage and DNA repair system. Site directed mutagenesis. Random mutagenesis- Induction screening and isolation. Site directed mutagenesis.	12
UNIT - IV	Fine structure expression and analysis of gene. Functional allelism and complementation tests. Genetic recombination in bacteria. (transformation, Transduction, Conjugation and transfection). Restriction mapping. Gene therapy.	12
UNIT - V	Enzymes involved in DNA replication. Isolation of DNA. RNA vectors. In vitro manipulation of DNA (random and restriction end nucleases, polynucleotide kinase)	12

REFERENCE BOOKS –

1. Biochemistry of Nuclic acids By Davision. J.N.
2. Gene VII By Lewin, Oxford University Press.
3. Chemical mutagenesis By Vogal and Rohroborn.
4. Genetics of Bacteria and their Viruses (Studies in basis genetics and molecular biology) By W. Haves.
5. Mannual of methods for general bacteriology By Philip G.
6. Biochemistry By Stryer L.WH. Freedom and Company
7. Foundation of genetics By A.C. Pai
8. Molecular Biology of the gene By Watson.
9. Genetics By P.K. Gupta
10. Essential genetics By Russel.
11. Genetics By Gardner.
12. Principles of Biochemistry By Lehninger and cox.
13. Molecular cloning Vol. I,II and III Maniats, Sambrook and fritz.

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School of Basic and Applied Sciences

Class				**M.Sc. (Microbiology)**
Semester/Year				**III Semester**
Subject & Subject Code				**Microbiology - MMBIO20S302**
Paper				**Food and Dairy Microbiology – 302**
Max. Marks				**30 (ETE) + 20 (IA) = 50**
Credit			**Total Credits**	
L	**T**	**P**	**3**	
3	0	0		

Course Objectives:

The aim of the course is to gain knowledge about fermentation techniques used in dairy industry, role of microorganisms in fermentation and to gain skills to control fermentation process.To understand the key concepts in food and dairy microbiology.To gain knowledge on various methods of microbial analysis of food.

Course Outcome:

At the end of the course, learners will be able:

1. To understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in food and dairy.
2. To understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in food and dairy.
3. To Know about food Preservation.
4. To understand the Importance of microorganisms in preparation of dairy products.
5. To understand the Microbial production of single cell protein.

Student Learning Outcomes (SLO):

Students will:

1. To know the spoilage mechanisms in foods and dairy and thus identify methods to control deterioration and spoilage
2. To recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods and dairy.
3. To learn various methods for their isolation, detection and identification of microorganisms in food and dairy and employ in industries
4. To identify ways to control microorganisms in food and dairy and thus know the principles involving various methods of food preservation
5. To understand of the basis of food safety regulations and discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food and dairy.
6. To acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.

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Unit	Syllabus	Periods
UNIT - I	Microorganisms important in food microbiology-fungi, yeast, bacteria- Their general characteristics, classification and importance. Principle of food preservation. Asepsis- removal of microorganisms (anaerobic condition, high temperature, low temperature, drying). Factors influencing microbial growth. Chemical preservation, food additives, canning, treatment parameters.	12
UNIT - II	Food Fermentation, Bread, Vinegar, fermented vegetables. Oriental fermented foods. Spoilage of vegetables, fruits, meat and meat products. Spoilage of fish and sea foods, poultry products. Spoilage of canned foods, detection of spoilage and characterization.	12
UNIT - III	Microbiology of Milk and milk products: Source of microorganisms in milk, their types and classification. Microbiological examination of milk and milk products. Standard plate count, microscopic count, reductase test. Preservation of milk and milk products. Pasteurization, drying of milk.	12
UNIT - IV	Production of milk products: Importance of microorganisms in preparation of dairy products: cheese and butter milk, yogurt. Diseases caused by milk associated bacteria.	12
UNIT - V	Microbial production of single cell protein, mycoprotein, mushroom cultivation. Genetically modified foods.	12

REFERENCE BOOKS –

1 Food microbiology by Frazier and westhoff.

2 Fundamentals of food microbiology by fields, M.L.

3 Food Microbiology By Adams M.R. and Moss M.O. Royal Society of Chemistry Publication. Cambridge.

4 Principles of Fermentation Technology. Stanbury, P.F. Whiteker, A. and Hall, S.J. (1995) 2nd Edition. Pergamon press

5 Basic Food Microbiology By Banwart, G.J. (1989) CBS Publishers and Distributors. Delhi.

6 Food Poisoning and Food Hygiene By Hobbs BC and Roberts D Edward Arnold (A division of Hodder and Stoughton) London.

7 Dairy Microbiology By Robinson R.K. Elsevier Applied Sciences. London.

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School of Basic and Applied Sciences

Class	**M.Sc. (Microbiology)**
Semester/Year	**III Semester**
Subject & Subject Code	**Microbiology - MMBIO20S303**
Paper	**Industrial Biotechnology – 303**
Max. Marks	**30 (ETE) + 20 (IA) = 50**

Credit			Total Credits
L	T	P	3
3	0	0	

Course Objectives:

It examines how Industrial biotechnology enables the use of renewable resources in industry, thereby increasing efficiency, decreasing pollution, and reducing energy usage and waste production during various types of industrial processing.

Course Outcome:

At the end of the course, learners will be able to:
Remember and Understand the design and functioning of different types of Bioreactors and Downstream processing
Evaluate the application of different types of Bioreactors including immobilization reactor system and its kinetics
Comprehend the structure and function of macromolecules such as Proteins and Nucleic Acid and there arrangement in Cell
Understand the concept of genes and enzymes
Skillfully perform basic experiment in Industrial Biotechnology

Student Learning Outcomes (SLO):

Students will:
Develop key practical skills in fermenting biotechnology and better understand operations and commercial opportunities in fermentation-based biotechnology
Increase their understanding that 'industrial biotechnology' is based on using machines to control the growth of microorganisms
Develop knowledge of a variety of fermentation strategies
Analyse potential business opportunities in fermentation-based biotechnology
Explore the biological and technological principles which govern actual and potential bio-business

Unit	Syllabus	Periods
UNIT - I	Historical Development and scope of industrial microbiology. Screening for economically important cultures (Primary and Secondary screening). Detection and assay of fermentation products: physiological and biological assay methods. Stock cultures and their preservation methods. Sterilization methods in fermentation industries.	12

UNIT - II	Fermentation equipments: Design and construction of formenters and other laboratory requirements. Shaking device, aeration device, antifoaming agents, Monitoring of fermentation process.Fermentation : Characteristics of fermentation media, Raw materials (substrates). Solid state and liquid state fermentation. Surface, submerged, batch, continuous and dual or multiple fermentation. Scale up of fermentation processes, Computer application in fermentation technology; Product recovery methods.	12
UNIT - III	Application of biotechnology in pharmaceutics: Production of tetracycline and macrolide antibiotics and peptide.Microbial Enzymes: Amylases, Amyloglucosidases, proteases and cellulases. Immobilized systems and their application; Protein Engineering and its application.	12
UNIT - IV	Microbiological Production of beverages: Production of beer wine and whiskey. Fermentative production of ethanol (Pasteur effect), Glycerol, Butanol and Acetone. Production of organic acids (Acetic acid, citric acid), Amino acid (L-lysine, L-Glutamic acid). Vitamins (B & C), Transformation of steroids.	12
UNIT - V	Microbial fermentation of tea, coffee and retting of jute. Importance of microorganisms of in leather, petroleum and mine industries. Acid mine drainage, bioleaching of metals and use of microorganisms in enhanced recovery of petroleum.	12

REFERENCE BOOKS –

1 Industrial Microbiology by Casida. L.E.
2 Industrial Microbiology by Patel. A.H.
3 Industrial Microbiology by Miller and Litsky.
4 Industrial Microbiology by Prescot and Dunn.
5 Industrial Microbiology by Onions. Allsopp and Eggins.
6 Microbial Enzyme and Biotechnology by forgarty and Kelly
7 Comprehensive Biotechnology by Murrag (Ed.) Vol. I
8 Process development of Antibiotics fermentation by Calam C.t.
9 Economic aspects of Biotechnology by Andrew J. Macking.
10 Biotechnology : A Text Book of Industrial Microbiology By Crueger and Anneliese Cruger.
11 Principles of Fermentation Technology By Stanbury, P.F. ABP, New Delhi.

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School of Basic and Applied Sciences

Class	**M.Sc. (Microbiology)**
Semester/Year	**III Semester**
Subject & Subject Code	**Microbiology - MMBIO20S304**
Paper	**Environmental Biotechnology Course – 304**
Max. Marks	**30 (ETE) + 20 (IA) = 50**

Credit			Total Credits
L	T	P	3
3	0	0	

Course Objectives:

This course comprises of giving students a thorough understanding of basic science behind the salient biological processes related to environmental degradation and protection as well as familiarize them with the possible applications leading to biotechnology for protection of environment.

Course Outcome:

At the end of the course, learners will be able to:

1. Study the environmental biotechnology is to understand the current applications of biotechnology to environmental quality evaluation, monitoring and remediation of contaminated environments.
2. Evaluate the potential of biodegradation of organic pollutants, taking microbial and physical/chemical environments, as well as the chemical structure of the compound itself, into consideration
3. Understand the phenomenon of phytoremediation for the decontamination of soil and water, wetlands as treatment processes, biofilms/biofilters for vapor-phase wastes, and composting
4. learn about the environmental quality evaluation, monitoring, and remediation of contaminated environments
5. Students will learn about the use of biosensors in environmental analysis, environmental engineering.

Student Learning Outcomes (SLO):

Students will:

1. Gain fundamental knowledge in microbial biochemistry. Understand molecular basis of various pathological conditions from perspective of biochemical reactions in micro-organisms.
2. Classify microbes according to energy source and carbon source and evaluate energy outcome of the energy metabolism according to electron acceptor and electron donor usage
3. Apply Monods kinetics and basic chemostat theory to determine microbial growth rates, biomass yield, and substrate concentration and removal rate
4. Carry out an experiment with nitrification in a continuous lab-scale bioreactor for ammonia removal
5. Describe suitable methods for characterizing the activity, function, diversity, and composition of microbial communities
6. Define basic concepts in microbial ecology, such as carrying capacity, succession, r- and K-selection, ecological niches
7. Outline the principles of methods for quantification of organic carbon in wastewater and calculate the theoretical oxygen demand for simple organic compounds

Sharma

Unit	Syllabus	Periods
UNIT - I	Air Microbiology: Air borne microorganisms and their significance in human health and plant disease development. Microorganisms in indoor and outdoor environment. Techniques for analysis of air borne microorganisms – The settling plate technique, slit type sampler, liquid impinge, sieve sampler, Anderson's sampler, cascade sampler; Filtration methods. Control of microorganisms in Air-filtration Laminar flow. Major allergic and hypersensitive reactions caused by air borne microorganisms.	12
UNIT - II	Water Microbiology: Source of water, distribution of microorganisms in water from different sources. Methods of purification of water, Bacterial contaminants in water, The coliform group. Microorganisms other than coliforms. Sewage: Composition and its disposal. Major groups of microorganisms in sewage, BOD, treatment of domestic and municipal sewage.	12
UNIT - III	Soil as environment for microbial growth. Importance of microorganisms in soil. Role of microorganisms in mineral cycling- Nitrogen, Carbon, Phosphorus and Sulphur cycling.	12
UNIT - IV	Microbial interactions : commensalisms, Neutralism, Synergism and antagonism, symbiosis. Soil as source of industrially important microorganisms. Screening of soil microorganisms for bioactive molecules. Enzymes and antibiotics.	12
UNIT - V	Role of microorganisms in Bioremediation. Nature of industrial effluents of leather, food and pharmaceutical industries. Nature of solid waste of agriculture, cattle and poultry farms and hair saloons. Solid waste management using microbes as tool.	12

REFERENCE BOOKS –

1 Sewage treatment in hot climates by Mara, D.

2 Biotechnology and waste water treatment by fields, M.L.

3 Aerobiology by Tilak

4 Brock Biology of Microorganisms. By Medigan, M.T. Martinko, J.M. and Parker, J. Pearson Education Inc. New York

5 Microbial ecology By Alexander, M John Wiley & Sons, Inc. New York

6 Introduction to Soil microbiology By Alexander, M John. Wiley & Sons Inc. New York

7 Bioremediation. By Barker, KH. And Herson, D.S. Mc Craw Hill Inc. New York

8 The Environment of the Deep Sea By W.C. Eeneasst, Vol. II J.g. Morin Rubey.

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School of Basic and Applied Sciences

Class				**M.Sc. (Microbiology)**
Semester/Year				**III Semester**
Subject & Subject Code				**Practical Microbiology - MMBIO20S305**
Paper				**Paper- I and II, Practical- I Sitting**
Max. Marks				**30 (ETE) + 20 (IA) = 50**
Credit			**Total Credits**	
L	**T**	**P**	**2**	
0	0	2		

PRACTICALS

1 Study of transformation in bacteria.

2 Isolation and characterization of mutants.

3 Isolation of mutants using physical and chemical methods.

4 Isolation of DNA, RNA and Protein from Microorganisms.

5 Determination of molecular weight of DNA, RNA and Proteins using agarose gel and PAGE

6 Preparation of standard curve of sugar and protein.

7 Isolation and identification of microorganisms from milk & milk products Grading of milk using phosphatase test/methylene blue reductase test. Identification of toxic metabolites in spoiled milk and milk products.

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School of Basic and Applied Sciences

Class				**M.Sc. (Microbiology)**
Semester/Year				**III Semester**
Subject & Subject Code				**Practical Microbiology - MMBIO20S306**
Paper				**Paper- III and IV, Practical- II Sitting**
Max. Marks				**30 (ETE) + 20 (IA) = 50**
Credit			**Total Credits**	
L	**T**	**P**		
0	0	2	**2**	

PRACTICALS

1 Production of enzyme in submerged and solid state culture.

2 Primary and Secondary screening of microorganisms for industrially important compounds (enzymes, antibiotic, alcohol).

3 Purification of proteins and bioactive molecules.

4 Assay and estimation of fermentation products.

5 Knowledge of basic fermentation equipments used in batch and continuous cultures.

6 Isolation and enumeration of microorganisms from soil, water and air.

7 Study of microbial contaminants from water and waste water.

8 B.O.D. and C.O.D. estimation.

9 Solid waste management.

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School of Basic and Applied Sciences

Class				**M.Sc. (Microbiology)**
Semester/Year				**III Semester**
Subject & Subject Code				**Dissertation Microbiology - MMBIO20S401**
Paper	**English**			**Dissertation Work**
Max. Marks				**300 (Thesis) + 200 (Presentation) = 500**
Credit			**Total Credits**	
L	**T**	**P**	**16**	
0	0	16		

Course Objectives:

Develop the skills of preparing and conducting independent research.
M. Sc. Dissertation is designed in a way to teach and train the students with practical knowledge in the different areas of Microbiology in order to become efficient researchers to start their carrier in research through Ph.D. and R & D programmes.

Course Outcome:

At the end of the Dissertation the students will be trained in:
1. Student is able to conceive a problem based on current published research
2. Student is able to carry out comprehensive survey of literature on the topic of research
3. Student is able to make culture media for various microbes
4. Student is able to isolate microorganism from different environmental/ food sources
5. Student is able to identify the isolated microorganism using biochemical and molecular methods
6. Student is able to assess the microorganism's ability to produce various enzymes.

Student Learning Outcomes (SLO):

Ability to apply the tools and techniques of microbiology in conducting independent research.
1. Student becomes well-versed in different enzymatic assay systems
2. Student learns correct handling and use of instruments
3. Student learns correct handling of reagents and chemicals
4. Student learns how to execute experiments correctly.
5. Student learns the importance of including controls in all experiments
6. Student learns how to plot the results.
7. Student learns how to analyze data, using statistical tools where necessary
8. Student learns how to interpret the results from all possible angles.
9. Student is exposed to the science of thesis writing.

DISSERTATION WORK (Project Work + Technical Writing)

1 Dissertation thesis will be examinde by internal and external at the time of presentation.

2 There will be weekly seminars and continuous internal assessment throghout the course.

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