Jaypee Institute of Information Technology

M.Sc. Microbiology

Course Descriptions

SEMESTER 3

FOOD AND DAIRY MICROBIOLOGY

Course Code	**19M21BT211**	**Semester:** ODD	**Semester: III** **Session: 2021-22** July to December
Course Name	**Food and Dairy Microbiology**		
Credits	**4**	**Contact Hours**	**3-1-0**

Faculty (Names)	**Coordinator(s)**	Dr. Smriti Gaur
	Teacher(s) (Alphabetically)	Dr. Smriti Gaur

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the interactions between microorganisms and the food environment, and factors influencing their growth and survival.	**C2**
CO2	Illustrate the role of microorganisms in spoilage of food and dairy products and food borne diseases caused by them.	**C2**
CO3	Analyze the effects of fermentation in food production and how it influences the microbiological quality and status of the fermented dairy and non dairy products.	**C4**
CO4	Examine food preservation methods and quality standards for food safety and control.	**C4**
CO5	Utilize microbes for commercial development of food and dairy products.	**C3**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Food and microorganis**	Food as substrate for microorganism, Microorganisms important in food and dairy microbiology; Mold yeast and	05

	m	bacteria, Factors influencing microbial activity	
2.	**Food Spoilage and Food borne diseases**	Contamination of food, general principles underlying spoilage, Spoilage of various foods and food products; cereals and cereal products, bakery products, dairy products, meat poultry and sea foods, Eggs, vegetables and fruits, sugar and sugar products, Microbiological examination of milk and milk products, source of their contamination and control, Food borne diseases: *Staphylococcal, E.coli, Salmonellosis, Shigellosis, Listerial* infections, Mycotoxins.	10

Project based learning: Each student will opt a topic based on applications of food and dairy microbiology. They will present and discuss in detail about the topic. This will enhance the student's understanding about various application aspects of food and dairy microbiology. They will get an insight into how different microorganisms can be employed for food and dairy based applications.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Food Science & Food Biotechnology, G.F.G Lopez and GVB Canovas CRC Press, Florida(2003)
2.	Bioprocess and Biotechnology for functional foods and Nutraceuticals, J.R Neeser , J.Bruce German Marcel and Dekker , New York (2004)
3.	Food Microbiology, Frazier W C, Westoff DC, Vanitha NM, Mc Graham Hill Education (2013)
4.	Fundamental Food Microbiology, 3rd edition by B. Ray., CRC press, (2006).
5.	Food Microbiology by M.R. Adams, Royal Society of Chemistry, (2008).

RECOMBINANT DNA TECHNOLOGY

Subject Code	**19M21BT212**	**Semester:** Odd	**Semester: III** **Session: 2021-22** July to December
Subject Name	**Recombinant DNA Technology**		
Credits	**3**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	1. Dr. S Krishna Sundari
	Teacher(s) (Alphabetically)	1. Dr. S Krishna Sundari

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Summarize the fundamental concepts of RDT, cloning vectors, prokaryotic vs. eukaryotic hosts and expression systems	**Understanding Level (Level II)** **C2**
CO2	Illustrate different methods of gene transfer, cloning, genomic libraries and molecular tools for microbes, plants and animal cell lines	**Applying level (Level III)** **C3**
CO3	Criticize the significance of tools and techniques employed in RDT and its applications in environment, Medicine and agriculture	**Analysis level (Level IV) C4**
CO4	Identify importance as well as ethical and biosafety issues related to generating transgenic plants, animals and microbes	**Understanding Level (Level II)** **C2**

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the**

			module
1.	Introduction	Basic Concepts of Recombinant DNA technology, origin of RDT, pioneering discoveries and significance of tailoring microbes, model plants and animals in present context	4
2.	Enzymes, Vectors and Hosts for Cloning	Restriction enzymes and other DNA modifying enzymes; Cloning vectors, expression vectors, prokaryotic and eukaryotic expression systems, bacterial, fungal and plant hosts for cloning, methods of gene transfer	6
3.	Recombinant DNA Technology	Basic techniques of gene manipulation, - Gel electrophoresis, DNA transformation techniques, Cloning of PCR products, Construction of Genomic and cDNA libraries, Screening Libraries with Gene Probes, Screening Expression Libraries, Positional Gene Cloning, Subtractive cloning, Functional cloning	6
4.	Molecular tools supporting RDT	PCR, RT-PCR, Blotting techniques, Sequencing methods, NGS, Gene editing, Mutagenesis, Gene expression techniques, Regulation of gene expression, microRNAs, Microarrays	4
5.	Methods & Applications of Plant Genetic engineering	Molecular Biology of DNA transfer in Plant through *Agrobacterium tumefaciens*, methods for artificial gene transfer, Applications in agriculture such as golden rice, BT Cotton, Nif and Nod gene clusters and Nitrogen fixing, etc.	5
6.	RDT for Environmental Biotechnology	Environmental Applications: biodegradation and bioremediation Energy based applications: Biogas, biodiesel and bioethanol production by microorganisms. Biotechnological applications. Biotechnological applications.	5
7.	RDT in Medicine & Therapeutics	Production of recombinant vaccines and antibiotics, phytopharming, microbes as cell factories for production of therapeutic molecules, insulin and other major discoveries, gene therapy	6

8.	Animal cloning & Issues	Transferring gene in animal oocytes, eggs embryos and specific animals tissues, Application of rDNA technology in animal cell lines, tailoring model animals, Controlling the expression of transgene in time and space, case studies exposing risks of animal cloning	4
9.	Ethics & Biosafety in RDT	Ethical issues, Biosafety guidelines and regulations	2
Total number of Lectures			**42**

PBL Component: Team-work based research paper collection on latest advances in RDT and its applications in medicine, agriculture, microbial and industrial biotechnology. preparation of summary report and presentation

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Genes XII: Benjamin Lewin, 2016
2.	Molecular Biology of the Gene, Seventh Edition: James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, 2004Microbial Biotechnology: Progress and Trends, Farshad Darvishi Harzevili, Hongzhang Chen, First edition CRC Press/Taylor & Francis Group, 2017
3	Molecular biotechnology: principles and applications of recombinant DNA / Bernard R. Glick and Jack J. Pasternak, Cheryl L. Patten. ASM Press
4.	Gene Cloning and DNA Analysis: An Introduction, Seventh Edition-T. A. Brown, John Wiley & Sons Ltd. 2016
5.	Microbial Biotechnology: Progress and Trends, Farshad Darvishi Harzevili, Hongzhang Chen, First edition CRC Press/Taylor & Francis Group, 2014

BIOINFORMATICS AND OMICS

Course Code	**19M21BT213**	**Semester:** Odd	**Semester: III** **Session: 2021-22 July to December**
Course Name	**Bioinformatics and Omics**		
Credits	3	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	Dr. Shazia Haider
	Teacher(s)(Al phabetically)	Dr. Shazia Haider

COURSE OUTCOMES Upon completion of the course, students will be able to		**COGNITIV E LEVELS**
CO1	Overview of the bioinformatics methods and resources	Understandin g Level LevelC2
CO2	Explain about the Sequence analysis and high output methodologies	Understandin g Level LevelC2
CO3	Apply Genome annotation and proteome analysis in solving biological problems.	Apply Level LevelC3
CO4	Analyzing the use of Phylogenetic analysis in Microbial System annotation	Analyse Level Level C4

Module No.	Title of the Module	Topics in the module	No. of lecture for the module
1.	Overview of bioinformatics and Microbial Informatics	Introduction to Bioinformatics, Information flow, Scope of bioinformatics, computers and microbes, basics of internet, Network-based services (Cloud & Grid Computing), microbial informatics, environment and diversity	5
2.	Biological databases, microbial genomes Projects	Basics of Database designing and modeling, Designing policies, File formats (FASTA, PIR, Genbank), data storage, retrieval, *Microbial* Genomes, Genbank, Pfam, KEGG, Brenda, MBGD,	5
		biodiversity databases	
3.	Sequence analysis (Sequence, retrieval, methods, substitution matrices, submission andanalysis)	String comparison (substring, subsequence), Hamming and Levenshtein distance, Sequence alignment (pairwise, multiple) Dot plot method, Dynamic programming, *Needleman–Wunsch* and *Smith–Waterman* algorithm, BLAST algorithm, FASTA algorithm comparison, PSI blast, Gap penalty, e-value, statistical importance, PAM and BLOSUM matrices, log odd score, Sequence submission tools (Banklt, Sequin)	8
4.	High throughput data generation and analytics (NGS and Microarray)	Genome sequencing projects, NGS generation, Computational tool and pipelines, microarray technology, data analysis methods and tools	5

5.	Genome annotation procedures and analysis tools	Gene structure, Gene finding strategies Glimmer, Genscan, promoter region identification, promoter signals, genome annotation tools, Gene ontology, biological networks	4
6.	Protein Structure prediction and proteome analysis	Protein sequence and structures (primary, secondary and tertiary) and prediction, protparam, Chou–Fasmana lgorithm, GOR method, Concepts of structural modeling and tools (Comparative homology modeling, Threading), PHD, ANOLEA, Transmembrane protein prediction tools, Mass spectrometry data and analysis	6
7.	Phylogeneti c analysis	Phylogeny, Phylogenetic reconstruction distance matrix, types of trees, Rooted un-rooted, distance based methods (UPGMA, FM, NJ Methods), Character based methods (Parsimony method, Maximum likelihood method), tree evaluation, (bootstrapping, Jackknifing), functional inferences. Phylogenetic profiles.	5
8.	Microbial System biology, Environment, and Metagenomics	System biology, microbial diseases. Metagenomics, Environmental *Informatics and health*	4

Total number of Lectures	**42**
Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Assignment 1, MCQ, Presentations/PBL, Viva)
Total	**100**

PBL: Students will choose any protein prediction and proteome analysis tools to solve the biological problem linked to a particular disease. How is it commercially used as a therapeutic molecule or as a target to manage the disease? An understanding of proteins is required for Biotechnology companies including patent firms

Recommended Reading material:
Author(s),Title,Edition,Publisher,YearofPublicationetc.(Textbooks,ReferenceBooks,Journals,Report s,Websites etc. in the IEEE format)

1.	AttwoodT.K.&SmithParry.,"IntroductiontoBioinformatics",BenjaminCummings,2001
2.	Baxevanis A., D & Ouellette "Bioinformatics A practical guide to analysis of genes and protein", Wiley-Interscience,1998.
3.	David Mount "Bioinformatics: Sequence and Genome analysis", Cold Spring Harbor Laboratory Press,2001.

BIOSENSORS

Subject Code	**17M12BT111**	**Semester: Odd (specify Odd/Even)**	**Semester: III** **Session: 2021-22 July to Dec.**
Subject Name	Biosensors		
Credits	**3**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	1. Dr. Sudha Srivastava
	Teacher(s) (Alphabetically)	1. Dr. Sudha Srivastava
COs	**Cos description**	**Level**
CO111.1	Understand biosensor, its performance characteristics and types of biosensors and advancement thereof	Understand Level 2
CO111.2	Analyze different immobilization methods and their effect on biosensor performance	Analyze level 3
CO111.3	Evaluate performance of a given biosensor, for disease diagnosis, drug screening, pathogen and pollutant detection	Evaluate level 5
CO111.4	Design methods to improve sensitivity of the biosensor	Create Level 6

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures**
1.	**Introduction:**	Sensors and biosensors, definitions, types of sensors, markets, target analytes, glucose and other medical sensors	2
2.	**Biosensor Advancements and nanotechnology**	First-, second-, third generation biosensors, Nanotechnology and present day biosensors	3
3.	**Basic Design Consideration**	Calibration, dynamic Range, signal to noise, sensitivity, selectivity, interference.	3

	s		
4.	**The biological component**	Whole cell sensors, enzymes – sensing substrates or inhibitors, antibodies (Mab, Fab). And other binding proteins, oligonucleotides and aptamers.	3
5.	**Types of biosensors**	Optical biosensors, Electrochemical biosensors, Piezoelectric biosensor, Calorimetric biosensors	8
6.	**Immobilization method**	Non-covalent immobilization - entrapment and multipoint electrostatic attachment. Covalent attachment via thiol, amino and hydroxyl groups. Affinity interactions - avidin/biotin, complementary oligonucleotides.	4
7.	**Techniques for sensing: Physical and chemical**	Absorbance, fluorescence, chemi/bioluminescence and phosphorescence, Surface Plasmon Resonance (SPR), quartz crystal microbalance, cyclic voltammetry	8
8.	**Sensor stabilization**	Storage and operational stability. Polyols, polymers and low Mw compounds as stabilizing agents for drying and long term storage. Stabilization mechanisms.	3
9.	**Applications**	Pharmaceutical**,** agricultural, food safety, biomedical applications, food processing: state of the field, market potential, unique design criteria and needs, current sensors in use.	8
Total number of Lectures			**42**

PBL: Students form group or as individual and present a report on biosensor designing and performance for various applications like agriculture, environment and healthcare

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Ligler, F.S. and Rowe Taitt, C.A. 2002. Optical Biosensors: Present & Future. Elsevier, The Netherlands. ISBN: 0-444-50974-7.
2.	Yang, V.C. and T.T. Ngo. 2000. Biosensors and Their Applications. Kluwer Academic/Plenum Publishers, New York, NY. ISBN: 0-306-46087-4.
3.	Recent research articles

PRODUCT DEVELOPMENT IN BIOTECHNOLOGY

Course Code	**17M12BT118**	**Semeste r Odd**	**Semester: III** **Session: 2021-22** July – Dec
Course Name	**Product Development in Biotechnology**		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Manisha Singh
	Teacher(s) (Alphabetically)	Dr. Neeraj Wadhwa

COURSE OUTCOMES		**COGNITIV E LEVELS**
CO1	Outline various processes relevant for Biobusiness	**Understand Level (C2)**
CO2	Compare marketing techniques and related ethics	**Apply Level (C2)**
CO3	Select appropriate technology for the production of Biological products	**Understand Level (C3)**
CO4	Explain financial, regulatory, health policy aspects for biobased industries	**Understand Level (C2)**

Modul e No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Biotechnolog y Industries overview**	Biotech industries in India and abroad, Biotechnology as a function of science and business ,Company structures versus other non-biotech companies , Functional units Company structure and functions Emerging technology and technical convergences issues	**5**

2.	**Business in the context of biotechnology** **Entrepreneurs hip-**	Science/development, the idea and its development , Plant tissue culture lab-equipment- glasswares chemical requirements-- construction, techniques in culturing and export abroad, Vermitechnology, Mushroom cultivation, single cell protein, Biofertilizer technology-production, Textile processing, leather treatment, leather industry set up a etergent industry, bakery, diary, Technology product development Other biotech product development, such as biofuels, bioengineered foods,	**14**
		etc.- commercialization of Bakery and dairy products relevant case studies	
3.	**Product development**	a. Production of commercially important primary metabolites like organic acids, amino acids and alcohol & Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids. b.Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers, Pulp and Paper , SINGLE CELL PROTEIN & Mushroom culture, Bioremediation. Bioprocess strategies in Plant Cell organ culture and Animal Cell culture.	**12**
4.	**Biobusiness plans**	Concerns and oppurtunities, Environmental clearances requirement from government, Quality checks and validation certificates, Branding, Marketing and Packaging concerns Bank loan and finance strategy, Budget planning, Policy and regulatory concerns,	**6**
5.	**Bioremediation Bioethics and legal issues**	Business Development public perception in product development, Sustainability, Environmental concerns of product and their waste as well of genetically modified products and organism-	**5**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment)

Total	**100**

Project Based Learning (PBL): Students will be skilled, prepared and oriented towards understanding the insight of various bio based business development ideas. They will be made aware of various planning and policy systems existing in the global market to start and run a business. Students will also be trained to develop entrepreneurial skills.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2.	Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
3.	Balasubramanian, D. etal., "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.
4.	Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge University Press, 2001
5.	Faber K , Biotransformations in Organic Chemistry, IV edition , Springer
6.	Dubey, R.C. "A Textbook of Biotechnology" S.Chand & Co. Ltd., 2006. Trevor Palmer , Enzymes II ed Horwood Publishing Ltd
7.	Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000
8.	Moo-Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
9.	Richard Oliver "The coming Biotech Age ; the business of Biomaterials" Mc Graw Hill Publication , New York USA2000
10.	Karthikeyan,S and Arthur Ruf." Biobusiness"MJP Publication Chennai India 2009
11.	Cynthia Robins," The business of Biotechnology". UK Harper Collins 2001

DIAGNOSTIC MICROBIOLOGY

Subject Code	**19M22BT211**	**Semester: Odd**	**Semester: III** **Session: 2021-22** July to December
Subject Name	**Diagnostic Microbiology**		
Credits	**3**	**Contact Hours**	**3 + 1**
Faculty	**Coordinator/Teacher**	Dr. Sonam Chawla	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C250.1	Interpret the fundamental concepts, tools and methods of microbial diagnostics in relation to various human diseases/disorders	**Applying level (Level III)** **C3**
C250.2	Apply principles of Molecular diagnostics to genetic counselling, communicable, non-communicable and lifestyle diseases/disorders	**Applying level (Level III)** **C3**
C250.3	Correlate different advances in microbial diagnostics to human microbiome, their significance in disease management and therapy	**Analysis level (Level IV) C4**
C250.4	Identify importance as well as ethical and biosafety issues related to the field of diagnostics	**Understanding Level (Level II)** **C2**

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction	Fundamentals of Microbial diagnostics and its significance in post genomic era in health care industry	03

2.	Microbiological diagnostic tools for bacterial pathogen detection	Microscopy and other culture based tests, Blood and other body fluids based biochemical methods for pathogen detection, strategies for antimicrobial sensitivity testing, Urea Breath Tests for *Helicobacter pylori*	08
3.	*Advanced Techniques in Diagnostic*	Principles and characteristics of techniques ranging from rapid antigen testing, to advanced antibody detection, *in vitro* nucleic acid amplification	10
	Microbiology	techniques, Gene and signal amplification techniques, non-PCR mediated target amplification, RT-PCR and microarray based Identification, probe technologies, FISH, RFLP, RNA inhibition analysis, OLA, DNA finger printing	
4.	Diagnostics for assessing viral infections	Methods in basic virology, Human Immunodeficiency Virus (HIV), Hepatitis C, B & A Virus, Covid and emerging microorganism detection and genotyping	04
5.	Diagnostic tools for Genetic counseling and Cytogenetics	Genetic analysis for inherited disorders, mutation detection, detection of allelic diversity (SSCP/DGGE/ DHPLC, PTT tests), Heterozygote Testing, Presymptomatic Testing, Prenatal Testing, and Newborn Screening	05
6.	Lifestyle diseases/disorders, Human microbiome	Human microbiome and Cancer, sequence-based gut microbial identification and applications in disease management and therapy	06
7.	Applications in Health care & Forensics	Diagnostic tools applicable in Hemoglobinopathies, Plasmapheresis, Blood Banking, blood and blood product screening forensics & Quarantine	04
8.	Regulatory, Ethical and biosafety issues in diagnostics	Laboratory safety and specimen management, regulatory controls, case studies related to ethics in diagnostics	02
Total number of Lectures			**42**

Project Based Learning (PBL): Students will present recent advancement in diagnostics in class presentations, followed by a discussion on comparison of advancement with previous technologies and the benefit of the said advancement in terms of ASSURED criteria.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	**Tang**, Yi-Wei, **Stratton**, Charles W. (Eds.), "Advanced techniques in Diagnostic microbiology", 2018, Springer publication
2.	Bailey & Scott's Diagnostic Microbiology, 14th Edition, **by Patricia Tille, 2017, Elsevier Evolve**
3.	Jean-Louis Serre, "Diagnostic techniques in Genetics", 2006, John Wiley & Sons publication
4.	Trent R J, "Molecular Medicine : An Introductory text", Churchill Livingston publication
5.	Refereed papers from scientific journals for case studies

Microbiology Lab III

Course Code	19M25BT211	**Semester** Odd	**Semester** III **Session** 2021-22 Month from **July to December**
Course Name	Microbiology Lab-III		
Credits	4	**Contact Hours**	8

COURSE OUTCOMES Students will be able to		**COGNITIVE LEVELS**
CO1	Apply concepts of food microbiology	Level III (Apply)
CO2	Analyze bacterial transformation techniques	Level IV (Analyze)
CO3	Evaluate cloning techniques	Level V (Evaluate)
CO4	Apply bioinformatics tools for microbial genome analysis	Level III (Apply)

Module No.	**Title of the Module**	**List of Experiments**
1.	**Food microbiology**	Enumeration of yeasts and moulds in food; microscopic examination of moulds; microbial standards for different foods and drinking water; food adulteration: methods of detection of common adulterants in food, heat preservation of food; food fermentations
2.	**Bacterial Transformation**	Competent cells preparation and transformation of plasmid DNA, calculation of transformation efficiency
3.	**Cloning and screening of recombinants**	Restriction digestion of vector and insert; ligation of gene of interest in vectors; transformation; Screening of recombinants
4.	**Bioinformatics**	Bioinformatics tools (BLAST, genome analysis & phylogenetic analyses tools) and resources (NCBI); proteome and transcriptome analyses; network studies
Scheme of Evaluation: Mid Term Examination: 20 marks End Term Examination: 20 marks Day to Day Evaluation: 60 marks		
PBL component: The students will be acquainted with the techniques used in food microbiology and microbial genomics.		