

JAYPEE INSTITUTE OF INFORMATION
TECHNOLOGY

M.Sc. MICROBIOLOGY
(IV SEMESTER)

2023-2024

Detailed Syllabus

Programme Name: M.Sc. Microbiology

Course Code	19M27BT211	Semester -EVEN	Semester -IV Session: 2023-2024 Month from: Jan - June
Course Name	Dissertation		
Coordinator	Dr. Ankisha Vijay		
Credits	10	Contact Hours	20

COURSE OUTCOMES: Upon completion of this course, students will be able to		COGNITIVE LEVELS
	Define a research problem relevant to health, environment, industry, and society	Understanding Level Level II
C250.2	Interpret and organize the existing literature on the chosen topic to formulate a hypothesis	Applying Level Level III
C250.3	Analyze experimental methodologies for the chosen research problem	Analyze level Level IV
C250.4	Analyze experimental findings	Analyze level Level IV
C250.5	Communicate research findings both orally and in written form	Create Level Level VI

PBL Component: The students will define a research problem relevant to health, environment, industry, and society after literature mining. They will design a methodology for obtaining solution to the defined problem and execute it. The students will develop skills to analyze their findings and communicate them to the scientific community both orally and in written form.

Market Research and Data Analysis
M.Sc (IV Sem)
Detailed Syllabus
Lecture-wise Breakup

Course Code	22M22BT211	Semester Summer	Semester Summer Even Sem Session 2023-24 Month from Jan - July
Course Name	Market Research and Data Analysis		
Credits	3	Contact Hours	42
Faculty (Names)	Coordinator(s)		Dr. Ashwani Mathur
	Teacher(s) (Alphabetically)		Dr. Ashwani Mathur
COURSE OUTCOMES			COGNITIVE LEVELS
CO1	Understand Market Research, its application in entrepreneurial and start-up initiatives		Understand level (C2)
CO2	Interpret Segmentation and market sizing and their role in Market Research design		Apply Level (C3)
CO3	Utilize software and tools for data collection and analysis		Apply Level (C3)
CO4	Analyze market research reports of collected or available segmented data		Analyze level (C4)
Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	Introduction of Market Research, Market Research Industry size and potential, future prospects of Market Research sector	3
2.	Entrepreneurship in Market Research	Understand independent market research strategy, knowledge of market potential	3
3.	Market research – Categorization and strategic approach	Types of Market research based on problem statements (Ambiguous, somewhat defined and well defined problem), Market Research based on data source (Primary and Secondary data), Based on strategic approach (Exploratory and Descriptive Research)	4
4.	Data collection strategy	Identifying and formulating the problem, Methods of Data collection, Nature of Data: primary data, secondary data, big data. Familiarize with data sources and approach to collect data for market sizing, company profiling	5
5.	Company profiling	Knowledge of competitor analysis based on Market Share, Understanding company revenue and market share, demographic analysis of competitor	5

6.	Product analysis	Categorization of products, analysis of market share of biological / therapeutic products based on available databases, data collection and analysis.	4
7.	Customer and Market segmentation	Diffusion of innovation theory, knowledge of Anstoffs matrix for exploring potential market, Knowledge of different attributes of market segmentation.	4
8.	Data collection and analysis	Familiarization with different databases used for collection of data for market research report, data collection through LinkedIn scouting, sample size estimation, Questionnaire designing and familiarizing with classification, open ended and close ended questions	6
9.	Statistical tools and Data analysis softwares	Inferential statistical approaches for data analysis (hypothesis testing using student T-test, F- test) for data collected for the assigned PBL project, Use of MS Excel, SPSS and Tableau software. Understanding of ODK tool for primary survey (data collection).	4
10.	Preparation of Report	Report preparation template, components of Market Research report, Data presentation layout	4
Total number of Lectures			42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Market Research Report preparation /Assignment)
Total	100

Project Based Learning: Students will understand the importance of Market Research in start-up ecosystem and entrepreneurial initiatives. They will learn different strategies of segmentation, data collection databases, primary data collection strategies and prepare a segmented market research report

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.	A concise guide to market research by Marko Sarstedt and Erik Mooi, Springer Publication, 2020
2.	The market research tool box by Edward F McQuarrie, Sage Publication, 2015
3.	Entrepreneurship in Independent Market Research & Strategic Digital Marketing by Mirdul Amin Sarkar, Evincepub Publishing, 2020
4.	Recent Market Research reports (available online)

Detailed Syllabus

Lecture-wise Breakup

Course Code	21M22BT211	Semester: Even (specify Odd/Even)	Semester IV sem Session 23-24 Month from January to June
Course Name	Prebiotic and Probiotic		
Credits	3	Contact Hours	3

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

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain and categorize prebiotics and probiotics	Understand (C2)
CO2	Identify the importance of prebiotics and probiotics in health and disease	Apply (C3)
CO3	Analyze the impact of prebiotics and probiotics on human gut microbiota	Analyze (C4)
CO4	Design prebiotics /probiotics functional foods	Create (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Prebiotics Concepts and Ingredients	Prebiotic: definition, criteria, use of Prebiotics, types and sources of prebiotics : β -Glucan, Galacto- Oligosaccharide, Xylo- Oligosaccharides, Resistant Starch, Inulin-Type Fructans, Oligofructose, Polyphenols as prebiotics.	6
2.	Health benefits of prebiotics	Decrease GI infection, mineral absorption, immune response, cancer prevention, IBD, elderly health and infant health, metabolic disorders prevention, Maintaining healthy gut	4
3.	Probiotics: Foundation and Definition	Introduction and history of Probiotics, Probiotic microorganisms, Commercially important probiotics, Mechanism of probiotics, safety of probiotic microorganisms, legal status of probiotics.	5

4	characteristics of Probiotics for selection	Key features of probiotics, Selection Criteria for isolating and defining probiotic bacteria, Technological criteria for selection of probiotics, Stresses encountered by probiotic bacteria, minimum effective dose, Production of Probiotic Cultures for Foods or Food Supplements, maintenance of probiotic microorganisms.	8
5	Health Benefits of Probiotics	Effect on Gastroenteritis, Coadministration with Antibiotics, Effects on Inflammatory Bowel Disease (IBD), Irritable Bowel Syndrome (IBS), and Other Gastrointestinal Disorders, Antiallergic effects, Anticancer Effects, Effect on <i>Helicobacter pylori</i> , Antihypertensive Effects, Lactose intolerance, Cholesterol lowering effects	6
6	Probiotics and Prebiotics for Promoting Health: Through Gut Microbiota	Human Gut Microbiota: Complexities, Diversities, Functionalities, Gut Microbiota Balance in the Triangle of Nutrition, Health, and Disease, Factors Influencing the Gut Microbiota, Prebiotics and Probiotics effects on Intestinal Microbiota and Environment.	6
7.	Enriched food products containing Health Promoting Molecules (Prebiotics and probiotics)	Functional Dairy products, beverages, snacks and confectionary, fermented food products, Infant food, and their therapeutic applications	5
8.	Product development	Enhancing functionality of prebiotics and probiotics Through product development, Current status of functional food industry.	2
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Class Test-1, PBL/ Presentation / Report)	
Total		100	

Project based learning: Each student will present an idea on Enhancing functionality of prebiotics and probiotics through product development. They will present and discuss in detail about the development of prebiotic and probiotic based products. This will enhance the student's understanding about various application aspects of prebiotics and probiotics. They will get an insight into how prebiotic and probiotic can be employed for Enriched food products containing Health Promoting Molecules (Prebiotics and probiotics).

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.	Glenn R. G. Marcel R. <i>Handbook of Prebiotics</i> , CRC press, 2008.
2.	Lee Y K, Salminen S , <i>Handbook of Probiotics and Prebiotics</i> . A John Willey and Sons Inc. Publication, 2009
3.	Rao V. and Rao L., <i>Probiotics and prebiotics in human nutrition and health</i> , Intech Open, 2016

Detailed
Syllabus

Course Code	19M22BT213	Semester Even (specify Odd/Even)	Semester IV Session 2023-24 Month from: Jan-June
Course Name	Microbiomics		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	1. Dr. Chakresh KumarJain
	Teacher(s) (Alphabetically)	Dr Chakresh Kumar Jain

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Overview of microbiomics	Fundamentals microbiomics and applications, Which functions are expressed in the microbiome - transcriptomics	7
2.	Microbiomic theory of life	human ‘commensal’ microbiota, Human microbiome project, soil or water microbiota, their features and role in living system	5
3.	Microbiome diversity	16s rRNA profiling analysis, Shotgun Metagenomics, and internal Transcribed spacer (ITS), internal Transcribed region analysis, Taxonomic classification, Diversityanalysis	8
4.	Sequencing methods	Extracting whole genomes from the microbiome - genome sequencing through PacBio, Deep sequencing, shot gun sequencing and data analysis using computational tools and pipelines, such as MG-RAST server etc.	10
5.	Human Microbiome	Nexus of Food, Agriculture, Human Nutrition, and Gut Microbiome	7

6	Environment and Microbiome	Environmental influences on bacterial genomes: bacterial epigenome and its analysis	4
7.	Applications and tools	Human microbiota and infectious diseases, liver diseases, gastrointestinal malignancy etc.	5
Total number of Lectures			42
Evaluation Criteria Components Maximum Marks T1 20 T2 20 EndSemester Examination 35 TA 25 (Assignments 1, 2 / MCQ/PBL, Attendance) Total 100			

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Papers, Reports, Websites etc. in the IEEE format)	
1.	Vassilios fanos, “ Metagenomics and microbiomics”, 2016, pp 144, Academic press. ISBN 9780128053058
2.	<u>Pierre Baldi</u> and <u>Søren Brunak</u> “Bioinformatics The Machine Learning Approach” , February 2001, The MIT Press, Cambridge, London
3.	Research papers and online resources

Programme Name: MSc (Microbiology), MSc (Environment)

Course Name & Code: Environmental Microbiology; 19M21BT114

1. Course Outcomes: (Old)

At the completion of the course, students will be able to:

COURSE OUTCOMES		COGNITIVE LEVELS
C121.1	Explain principle associations and role of microbes in ecosystem functioning	Understand Level (C2)
C121.2	Identify contribution of microbes to various environments and demonstrate their application potential	Apply Level (C3)
C121.3	Analyse different aspects of pollution and suggest methods of detoxification for polluted environments	Analysis Level (C4)
C121.4	Take part as productive team members in projects concerning to microbial ecology, soil and environmental microbiology	Analysis Level (C4)
C121.5	Summarize latest advances in microbe based technologies for applications in energy, environment, agriculture and industry	Understand Level (C2)

2. CO-PO and CO-PSO Mapping:

Course	PO1	PO2	PO3	PSO1
C121.1	2	1		
C121.2	2	2		1
C121.3	3	2		2
C121.4	2	2	3	2
C121.5	2	2		2
Avg.	2	2	3	2

Course: Environmental Microbiology

Code: 19M21BT114 (4 credits)

Revised Course Outcomes

Course Outcomes (Cos): Upon completion of the course, students would be able to:

COURSE OUTCOMES: Upon completion of the course, students will be able to		COGNITIVE LEVELS
CO.1	Explain microbial associations and their contribution to various environments	Understand Level (C2)
CO.2	Identify application potential of microbes in different biotechnology sectors	Apply Level (C3)

CO.3	Make use of research advances in microbe-based technologies concerning microbial ecology and environmental balance	Apply Level (C3)
CO.4	Analyse different aspects of polluted environments and suggest methods of detoxification	Analyze Level (C4)

CO-PO MAPPING:

Course	PO1	PO2	PO3	PSO1
CO.1	2	1		1
CO.2	2	2		2
CO.3	3	2	3	2
CO.4	3	2	2	2

Agriculture Biotechnology
Integrated M.Tech, M.Tech, MSc (Microbio), MSc (Environment)
(Elective Course)
Detailed Syllabus

Brief Outline: National Agriculture Policy, Food security, Agriculture and climate change, formulations for Plant Growth Promotion and Combating Phytopathogens, Formulation Technology of Biocontrol Agents, Laws & Regulations governing Bioformulations, Quality control in agriculture and agri-products

Course Code	22M12BT111	Semester:	Semester: II, IV, Session: Even 2024
Course Name	Agriculture Biotechnology		
Credits	3-0-3	Contact Hours	3
COURSE OUTCOMES: Upon completion of the course, students will be able to			COGNITIVE LEVELS
CO.1	Infer applications of agriculture biotechnology for improved quality and productivity.	Understand Level, C2	
CO.2	Relate Physiological & Molecular mechanisms of plant, its genome and extra chromosomal genetic information.	Apply Level, C3	
CO.3	Apply different agricultural & biotechnological methods to meet National food security goals.	Apply Level, C3	
CO.4	Connect advances in agriculture biotechnology to quality control, transgenics, regulations & agriculture policies.	Analyze Level, C4	

Faculty (Names)	Coordinator(s)		
	Teacher(s) (Alphabetically)	1. Prof. Krishna Sundari	
Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Overview of agriculture biotechnology & NAP	Introduction and significance of biotechnology in agriculture, Climate change and its impact on agriculture, National agriculture Policy, food security, SDG & agriculture, quality control in agriculture & GAP	6
2.	Plant growth & Physiology	Fundamentals of Plant growth, Photosynthesis and genes involved, symbiotic and non-symbiotic nitrogen	6

		fixation, Role of lectins, nod genes, nif genes, Structure, function and regulation of nitrogenase, Leg-haemoglobin, Nodulins, Molecular aspects of regulation and enhancement of nitrogen fixation, Synthesis and metabolism of hormones and plant signaling	
3.	Plant Genome & Plant Genetic resources	Genome size and sequence components, Nuclear, cytoplasmic/organelle genomes and significance, conservation of plant genetic resources, seedbanks, germplasm conservation and cryopreservation	4
4.	Agriculture Biotechnology & methods for improved production	Concept of plasticity in plant development, Tissue culture, hybridization, Marker Assisted Breeding, Molecular markers for plant genotyping and germplasm analysis commercial application of plant tissue culture	8
5.	Plant genetic engineering & applications	Agrobacterium-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid, Agrobacterium-mediated gene delivery, Cointegrate and binary vectors and their utility, Chloroplast transformation: advantages, vectors systems of plant genetic engineering, Enhancing crop yield and crop quality improvement through Genetic Engineering for quality improvement: Seed storage proteins; essential amino acids, Vitamins and minerals, heterologous protein production in transgenic plants for agriculture, industry and pharmaceuticals uses, biodegradable plastics	12
6.	Agriculture policies & Regulations for GM and non-GM crops	Provisions on crop genetic resources in Indian Biodiversity Act, CBD and Cartagena protocol, Agricultural biodiversity; International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA), Global efforts for management of crop genetic resources; Strategies on PVFR and Biodiversity Acts; Impact of GE crops on Biodiversity	6
Total number of Lectures			42

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.	Genetics, Agriculture, and Biotechnology, Walter Suza, Iowa State University Donald Lee, Published by University of Nebraska-Lincoln, Copyright Year: 2021
2.	Textbook of Agriculture Biotechnology, Nag Ahindra , Second Edition, PHI publications, 2018
3	Plant Biotechnology and Agriculture-Prospects for the 21st Century, Eds. Arie Altman, Paul Hasegawa, Elsevier publications, 2 nd Edition, 2020.
4.	Research articles from refereed journals.

Detailed Syllabus

Lecture-wise Breakup

Subject Code	20M22BT212	Semester : Even (specify Odd/Even)	Semester : Session : 2023-24 Month from : Jan-June
Subject Name	Bioenergetics in Human Health and disease		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Shalini Mani
	Teacher(s) (Alphabetically)	Dr. Shalini Mani

Course outcomes

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Understand the mitochondrial biology and its significance in cellular viability	Understand (C2)
CO2	Apply the mitochondria quality control pathways in understanding the pathogenesis of mitochondrial diseases	Apply (C3)
CO3	Analyze the techniques for diagnosis and therapy of mitochondrial diseases	Analyze (C4)
CO4	Examine the epidemiology of mitochondrial diseases and their effect on global health	Analyze (C4)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module	COs
1.	Basic principles of mitochondrial biology and bioenergetics	Introduction to mitochondria, structure, mitochondrial biology, mt DNA, peculiarities of mt DNA and its inheritance, Threshold effect and bottleneck effect., Energy transformations in mitochondria. Mesosomes in bacteria as analogous to eukaryotic mitochondria.	4	CO1
2.	Mitochondrial quality control pathways	Biogenesis, autophagy role of TFAM and POLG, trafficking, fission and fusion, mtDNA replication, regulation and maintenance; mutations in mtDNA, Nuclear-mitochondria cross talk.	8	CO2
3	Significance of Mitochondria for cellular viability and function	Respiratory chain and ATP generation, mitochondria as sources and targets of free radicals, The vulnerability of mtDNA and consequences of oxidative damage, calcium signaling: mechanisms and functional consequences, apoptosis, necrosis and PTP.	8	CO2

4	Mitochondrial defects and disease:	Cancer, neurological disorders, Cardiac problems, ageing, Metabolic disorders.	8	CO3
5	Diagnosis and therapy of mitochondrial disorders	Diagnosis: Microscopic techniques, molecular biology bases techniques, Biochemical studies, clinical and radiological studies; Therapy: Vitamin supplementation, mt donation by spindle transfer methods and PMT method, ethical issued associated with mt donation, Mitochondria and future of medicine.	10	CO3
6	Case studies on different mitochondrial diseases and its cure	Global prevalence of mitochondrial disorders and different case studies for their comprehensive studies.	4	CO4
Total number of Lectures			42	

Evaluation Criteria

Components Maximum Marks

T1 20

T2 20

End Semester Examination 35

TA 25 (Class Test, assignment, quiz, PBL)

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.	Mitochondria in Health and in Sickness. Editors: Andrea Urbani, Mohan Babu, 2019, Springer
2.	Diagnosis and Management of Mitochondrial Disorders Editors: Mancuso, Michelangelo, Klopstock, Thomas (Eds.). 2019, Springer
3.	Mitochondrial Medicine: A Primer for Health Care Providers and Translational Researchers. Author: Pankaj Prasun, 2019, Academic Press
4.	Mitochondria and the Future of Medicine: The Key to Understanding Disease, Chronic Illness, Aging, and Life Itself. Lee Know, 2018, Kindle Edition
5.	Research Papers

PBL: The students learn various advanced methods for diagnostics and therapeutics of rare as well some common mitochondrial diseases. Students will be assigned projects to identify the common and overlapping clinical features of mitochondrial disease and how to select the suitable methods and approaches for diagnosis and therapy of the same.