TECHNO INDIA UNIVERSITY
WEST BENGAL

SEMESTER 8

FOR B.SC (HONS IN MICROBIOLOGY WITH RESEARCH)

ECOLOGY AND BIODIVERSITY (Theory)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: ECOLOGY AND BIODIVERSITY (Theory)	**Subject Code:** TIU-UMB-MJ-T42401
Contact Hours/Week: 2–1–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understanding Ecological Concepts
2. Analyzing Environmental Challenges
3. Applying Ecological Knowledge

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Describe fundamental ecological concepts	K1
CO-2:	Differentiate ecological interactions and succession	K2
CO-3:	Analyze ecosystem structure and energy flow	K4
CO-4:	Evaluate biodiversity conservation methods	K5
CO-5:	Apply ecological tools for environmental assessment	K3
CO-6:	Develop solutions for environmental sustainability	K6

COURSE CONTENT :

MODULE 1:	**THE ENVIRONMENT**	**7 Hours**
Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population Ecology: Characteristics of a population; population growth curves; population regulation.		
MODULE 2:	**COMMUNITY ECOLOGY**	**8 Hours**
Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.		

MODULE 3:	**ECOSYSTEM ECOLOGY**	**10 Hours**
Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); Food Chain, Food web, Trophic level, Ecological pyramids, primary production and decomposition; structure and function of some ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography: Major terrestrial biomes; biogeographical zones of India		
MODULE 4:	**BIODIVERSITY**	**10 Hours**
levels of biodiversity, alpha, beta and gamma diversity, hotspots of biodiversity, Threat to species diversity, Extinction vortex, Causes of extinction; RedData Book, Biodiversity conservation approaches: Local, National and International, In situ and ex situ conservation, Concept of protected area network, Selecting protected areas, criteria for measuring conservation value of areas, Sanctuary, National Park and Biosphere reserves; Design and management of protected areas; Threats to wildlife conservation and wildlife trade; Tools for wildlife research, Wildlife threat, Use of Radiotelemetry and Remote sensing in wildlife research, Indian case studies on conservation/management strategy (Project Tiger)		
MODULE 5:	**APPLIED ECOLOGY**	**10 Hours**
Environmental pollution; Microorganisms and environmental pollutants, Overall process of biodegradation, Environmental biomonitoring and indicator microorganisms, biodegradation of organic pollutants.		
TOTAL LECTURES		**45 Hours****

Books:

1. Odum, E.P. (1971). Fundamentals of Ecology. W.B. Sounders Natraj publication (Indian edition).
2. Sharma, P.D.(2017) Ecology and environment, 13th edition, Rastogi Publication.
3. Kormandy E. J. (1996) Concepts of ecology, Prentice Hall of India Pvt. Ltd.
4. Chapman J.L. and Reiss M.J. (2000) Ecology : Principles and applications 2 nd edition, Cambridge : University Press.Microbiology, 9 th edition, McGraw Hill Higher Education

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	3	2	3	-	2	-	-	1	2	3	2	3	3
CO-2	3	2	2	2	3	-	-	-	-	2	2	3	2	3	3
CO-3	3	2	3	-	2	3	-	-	-	2	2	3	2	2	3
CO-4	3		2	-	-	-	1	-	-	3	2	2	-	2	2

CO-5	3	2	3	-	2	-	-	3	3	3	2	3	2	3	3
CO-6	3		2	-	-	-	3	-	-	3	3	3	-	2	2

ECOLOGY AND BIODIVERSITY (Tutorial)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: ECOLOGY AND BIODIVERSITY (Tutorial)	**Subject Code:** TIU-UMB-MJ-L42401
Contact Hours/Week: 0–0–1 (L–T–P)	**Credit:** 1

COURSE OBJECTIVE :

Enable the student to:

1. Identify and describe the ex-situ conservation strategies and practices employed at the visited site, demonstrating an understanding of their purpose and significance.
2. Analyze the challenges and successes of the ex-situ conservation efforts observed and critically evaluate their effectiveness in preserving biodiversity.
3. Produce a comprehensive and well-organized field report that accurately documents the observations and findings from the site visit, adhering to scientific reporting standards.
4. Articulate and defend the findings and conclusions of the field report during a viva voce examination, demonstrating a thorough understanding of the subject matter.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Describe the principles and importance of ex-situ conservation and its role in biodiversity preservation.	K1
CO-2:	Explain different conservation strategies implemented at the visited site, such as botanical gardens, seed banks, zoos, or gene banks.	K2
CO-3:	Demonstrate field observation and data collection skills by documenting conservation practices and species maintained in ex-situ conditions	K3
CO-4:	Analyze the effectiveness of ex-situ conservation methods in comparison to in-situ conservation approaches.	K4
CO-5:	Evaluate the challenges and benefits of ex-situ conservation efforts based on the field visit observations and literature review	K5
CO-6:	Compile and Present a well-structured field report summarizing findings, personal reflections, and recommendations, followed by a viva voce discussion.	K6

COURSE CONTENT :

MODULE 1:	DEVELOPMENT OF MICROBIAL CULTURE AND OBSERVATION	15 Hours
Students will have to make a field visit to any ex-situ conservation site and submit a field report. Evaluation will be based on the viva voce and examination of the field report by an external examiner.		
TOTAL LECTURES		**15 Hours****

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3		2	-		3	2	-	-	2	-	2	2	-	3
CO-2	3	2	2	-	2	3	2	-	-	-	2	3	3	2	3
CO-3	3	2	3	-	3	2	2	2	2	2	2	3	3	3	3
CO-4	3	3	3	2	3	3	-	-	-	-	2	3	3	2	3
CO-5	3	3	3	2	3	3	-	-	-	-	3	3	3	2	3
CO-6	3	2	3	2	2	2	2	3	3	3	3	3	2	2	3

FUNGAL, ALGAL AND PROTOZOAL PATHOGENESIS (Theory)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: FUNGAL, ALGAL AND PROTOZOAL PATHOGENESIS (Theory)	**Subject Code:** TIU-UMB-MJ-T42402
Contact Hours/Week: 2–1–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Define and differentiate key concepts related to host-pathogen interactions, including pathogenicity, virulence, and modes of transmission, and explain the pathophysiological effects of bacterial endotoxins.
2. Describe the etiology, symptoms, transmission, prophylaxis, and control of major viral, protozoal, and fungal diseases affecting various organ systems, with a focus on specific examples like polio, malaria, and candidiasis.

3. Analyze the mechanisms of action of various antimicrobial agents, including antifungal, antiviral, and anti-protozoal drugs, and understand their applications in disease treatment.
4. Compare and contrast the characteristics and transmission routes of different infectious agents, and evaluate the effectiveness of various preventive and therapeutic strategies.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Define key concepts related to host-pathogen interactions, including infection, virulence, toxigenicity, and nosocomial infections.	K1
CO-2:	Explain the symptoms, modes of transmission, prevention, and control measures for major viral, protozoal, and fungal diseases.	K2
CO-3:	Classify various infectious diseases based on their causative agents and organ systems affected.	K3
CO-4:	Analyze the mechanisms of action of different antimicrobial agents, including antifungal, antiviral, and antiparasitic drugs.	K4
CO-5:	Evaluate the impact of microbial infections on public health and the effectiveness of different prophylactic and therapeutic strategies.	K5
CO-6:	Develop a comparative study on different microbial diseases and propose effective control strategies based on current advancements in antimicrobial treatments.	K6

COURSE CONTENT :

MODULE 1:	**HOST PATHOGEN INTERACTION**	**10 Hours**
Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS		
MODULE 2:	**VIRAL DISEASES**	**8 Hours**
List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis, Covid.		
MODULE 3:	**PROTOZOAL DISEASES**	**7 Hours**
List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar		

MODULE 4:	**FUNGAL DISEASES**	**10 Hours**
Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tineapedis (Athlete's foot) Systemic mycoses: Histoplasmosis, opportunistic mycoses: Candidiasis		
MODULE 5:	**ANTIMICROBIAL AGENTS**	**10 Hours**
General characteristics and mode of action Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine. Anti Protozoal medicine: Chloroquine phosphate, Liposomal amphotericin B, Metronidazole		
TOTAL LECTURES		**45 Hours****

Books:

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology, 4 th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology, 9 th edition, McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition, Pearson International Edition Freeman
6. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
7. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	-	2	-	-	3	2	-	-	2		2	3	-	3
CO-2	3	2	2	-	2	3	2	-	-		2	3	3	3	3
CO-3	3	2	3	-	2	2	2	2	2	2	2	3	3	3	3
CO-4	3	3	3	2	3	3	-	-	-	-	2	3	3	3	3
CO-5	3	3	3	2	3	3	2	-	-	3	3	3	3	3	3

CO-6	3	3	3	3	3	3	2	3	3	3	3	3	3	3

FUNGAL, ALGAL AND PROTOZOAL PATHOGENESIS (Practical)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 2nd Sem
Course Title: FUNGAL, ALGAL AND PROTOZOAL PATHOGENESIS (Practical)	**Subject Code:**TIU-UMB-MJ-L42402
Contact Hours/Week: 0–0–1 (L–T–P)	**Credit:** 1

COURSE OBJECTIVE :

Enable the student to:

1. Apply and interpret various microscopic techniques (including brightfield, phase contrast, and staining methods) to examine and identify microorganisms in diverse samples
2. Employ aseptic culturing techniques to isolate, cultivate, and characterize microorganisms from environmental and clinical samples, using appropriate media and growth conditions.
3. Perform and interpret biochemical assays and antimicrobial susceptibility tests to determine the physiological characteristics and antibiotic resistance profiles of bacterial isolates.
4. Understand the principles of molecular diagnostic techniques (e.g., PCR, ELISA) and apply field sampling methods to collect and process samples for microbiological analysis.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Describe the fundamental principles and techniques of microscopic examination, culturing, biochemical assays, molecular diagnostics, and antimicrobial susceptibility testing.	K1
CO-2:	Demonstrate proper laboratory techniques for culturing microorganisms, performing biochemical assays, and conducting antimicrobial susceptibility tests.	K2
CO-3:	Apply molecular diagnostic techniques for detecting and identifying microbial pathogens.	K3

CO-4:	Analyze the results of microscopic, biochemical, and molecular diagnostic tests to identify microorganisms and assess their characteristics.	K5
CO-5:	Evaluate antimicrobial susceptibility testing results to determine the resistance profile of pathogens and recommend appropriate treatment strategies.	K4
CO-6:	Design a structured field sampling protocol for the collection, transport, and processing of microbial specimens for diagnostic and research purposes.	K6

COURSE CONTENT :

MODULE 1:	**STUDY OF MICROBIOLOGICAL CULTURE AND SUSCEPTIBILITY TESTING**	**15 Hours**
1. Microscopic Examination 2. Culturing Techniques 3. Biochemical Assays 4. Molecular Diagnostics 5. Antimicrobial Susceptibility Testing 6. Field Sampling		
TOTAL LECTURES		**15 Hours****

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	-	2		2	3	-	-	-	-	-	2	3	3	3
CO-2	3	2	2	-	3	-	-	-	2	2	2	3	3	3	3
CO-3	3	2	3	2	3	-	-	-	-	-	2	3	3	3	3
CO-4	3	3	3	-	3	-	-	-	2	2	2	3	3	3	3
CO-5	3	3	3	2	3	3	-	-	2	3	2	3	3	3	3
CO-6	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

PLANT PATHOLOGY (Theory)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: PLANT PATHOLOGY (Theory)	**Subject Code:** TIU-UMB-MJ-T42403

Contact Hours/Week: 2–1–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Describe the fundamental concepts of plant diseases, including disease cycles, pathogenicity, and virulence, and analyze the historical contributions of key scientists to the field of plant pathology.
2. Explain the stages of disease development, including inoculation, penetration, infection, and dissemination, and analyze the principles of plant disease epidemiology, including disease forecasting and the disease triangle.
3. Analyze the mechanisms of host-pathogen interactions, including microbial pathogenicity, plant disease genetics, and plant defense mechanisms, and evaluate the effectiveness of different plant disease control strategies.
4. Identify and describe the symptoms, etiology, epidemiology, and control measures for specific plant diseases caused by fungi, bacteria, phytoplasmas, and viruses, with a focus on economically important examples.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Understand the fundamental concepts of plant pathology, including the history, scope, and importance of plant diseases in agriculture.	K1
CO-2:	Explain the mechanisms of plant disease development, including pathogen invasion, colonization, and disease progression.	K2
CO-3:	Analyze the disease cycle, epidemiology, and factors influencing disease outbreaks in different crops.	K3
CO-4:	Evaluate chemical, biological, cultural, and integrated disease management strategies for sustainable crop protection.	K4
CO-5:	Examine the role of biotechnological tools, including transgenic plants and molecular markers, in plant disease control.	K5
CO-6:	Explore emerging trends in plant pathology, including climate change impacts, precision agriculture, and advanced disease forecasting models.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION AND HISTORY OF PLANT PATHOLOGY**	**8 Hours**
Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates.		

MODULE 2:	STAGES IN DEVELOPMENT OF A DISEASE	7 Hours
Inoculation, pre-penetration, penetration, infection, invasion, colonization, dissemination, overwintering/oversummering of pathogens.		
MODULE 3:	**PLANT DISEASE EPIDEMIOLOGY**	**7 Hours**
Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.		
MODULE 4:	**HOST PATHOGEN INTERACTION**	**8 Hours**
A. Microbial Pathogenicity Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction). B. Genetics of Plant Diseases Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types ofplant resistance: true resistance– horizontal & vertical, apparent resistance. C. Defense Mechanisms in Plants Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological-cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].		
MODULE 5:	**CONTROL OF PLANT DISEASES**	**7 Hours**
Principles & practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical -protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals. biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes		
MODULE 6:	**SPECIFIC PLANT DISEASES**	**8 Hours**

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control A. Important diseases caused by fungi Late blight of potato - Phytophthora infestans, Powdery mildew of wheat - Erysiphe graminis Ergot of rye - Claviceps purpurea, Black stem rust of wheat - Puccinia graminis tritici, Loose smut of wheat - Ustilago nuda, Red rot of sugarcane - Colletotrichum falcatum, Early blight of potato - Alternaria solani B. Important diseases caused by phytopathogenic bacteria: crown galls, bacterial cankers of citrus C. Important diseases caused by phytoplasmas: Aster yellow D. Important diseases caused by viruses: Rice tungro, Tobacco mosaic
TOTAL LECTURES **45 Hours****

Books:

1. Agrios GN. (2006). Plant Pathology. 5 th edition. Academic press, San Diego,
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3 rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of IndiaPvt. Ltd., New Delhi.
5. Singh RS. (1998). Plant Diseases Management. 7 th edition. Oxford & IBH, New Delhi

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	-	-	-	-	-	2	-	-	2	-	2	3	2	3
CO-2	3	2	2	-	-	-	-	-	-	-	-	2	3	2	3
CO-3	3	3	3	-	2	3	-	-	-	-	2	2	3	3	3
CO-4	3	3	3	2	3	3	-	-	-	2	2	3	3	3	3
CO-5	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
CO-6	3	3	3	2	2	3	2	-	-	2	2	3	3	3	3

PLANT PATHOLOGY (Practical)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: PLANT PATHOLOGY (Practical)	**Subject Code:** TIU-UMB-MJ-L42403

Contact Hours/Week: 0–0–1 (L–T–P)	**Credit:** 1

COURSE OBJECTIVE :

Enable the student to:

1. Apply Koch's postulates to demonstrate the causal relationship between specific fungal, bacterial, and viral plant pathogens and their associated diseases.
2. Prepare and examine microscopic sections of infected plant material to identify and characterize the symptoms and signs of plant diseases caused by Albugo, Puccinia, Ustilago, Fusarium, and Colletotrichum.
3. Correlate the observed symptoms and signs in infected plant material with the known characteristics of the respective fungal pathogens.
4. Properly document and report the findings from microscopic examinations and Koch's postulates demonstrations, adhering to scientific reporting standards

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Demonstrate aseptic techniques for handling plant pathogens in the laboratory.	K2
CO-2:	Isolate and identify fungal, bacterial, and viral pathogens using staining, culture methods, and microscopy.	K2
CO-3:	Perform Koch’s postulates to establish the pathogenicity of plant pathogens.	K4
CO-4:	Analyze disease symptoms and diagnose plant diseases through field and laboratory techniques.	K3
CO-5:	Apply molecular and serological techniques for pathogen detection and identification.	K4
CO-6:	Evaluate the effectiveness of chemical, biological, and cultural disease management strategies.	K3

COURSE CONTENT :

MODULE 1:	**PATHOGEN IDENTIFICATION AND DISEASE DIAGNOSIS IN CROP PLANTS**	**15 Hours**
1. Demonstration of Koch’s postulates in fungal, bacterial and viral plant pathogens. 2. Study of important diseases of crop plants by cutting sections of infected plant material - Albugo,Puccinia,Ustilago, Fusarium, Colletotrichum.		
TOTAL LECTURES		**15 Hours****

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	2	-	-	-	-	-	2	2	2	2	3	3	2
CO-2	3	2	2	-	-	-	-	-	-	-	-	2	3	3	3
CO-3	3	3	3	-	3	-	-	-	-	-	2	2	3	3	3
CO-4	3	3	3	-	2	2	-	-	-	-	2	2	3	3	3
CO-5	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
CO-6	3	3	3	2	3	3	-	-	-	2	2	3	3	3	3

DISSERTATION/ RESEARCH WORK-I

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 7th Sem
Course Title: DISSERTATION/ RESEARCH WORK-I	**Subject Code:** TIU-UMB-SEC-D4201
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 4**

COURSE OBJECTIVE :

Enable the student to:

1. To develop research aptitude by identifying a relevant research problem and formulating clear research objectives.

2. To enhance critical thinking and analytical skills by conducting a thorough literature review and understanding existing scientific knowledge.

3. To familiarize students with research methodologies including experimental design, data collection, and appropriate analytical techniques.

4. To cultivate scientific writing and documentation skills by preparing a structured research proposal and maintaining accurate records of research findings.

5. To build effective communication and presentation skills for discussing research progress through oral presentations, reports, and scientific discussions.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Identify and define a research problem based on a thorough review of relevant literature.	K1
CO-2:	Analyze scientific literature to develop a research hypothesis and justify the significance of the study.	K3
CO-3:	Design an appropriate research methodology, including experimental setup, data collection, and analysis techniques.	K4
CO-4:	Demonstrate technical proficiency in laboratory or computational techniques relevant to the chosen research area.	K6
CO-5:	Compile and document research progress in the form of structured reports and scientific documentation.	K5
CO-6:	Present research findings effectively through oral presentations, discussions, and written reports.	K1

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	3	-	3	-	-	-	-	2	3	3	3	3	3
CO-2	3	3	3	2	3	-	-	-	-	2	3	3	3	3	3
CO-3	3	3	3	3	3	-	-	-	-	-	3	3	3	3	3
CO-4	3	3	3	2	3	-	-	-	2	2	3	3	3	3	3
CO-5	3	2	3	-	3	-	-	2	-	3	3	3	3	3	3
CO-6	3	2	2	-	-	-	-	3	3	3	3	3	3	3	3

DISSERTATION/ RESEARCH WORK-II

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 7th Sem

Course Title: DISSERTATION/ RESEARCH WORK-II	**Subject Code:** TIU-UMB-SEC-D4202
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit: 4**

COURSE OBJECTIVE :

Enable the student to:

1. To develop advanced research skills by identifying, formulating, and refining a research problem within a specialized domain.

2. To enhance critical thinking and analytical abilities by conducting a comprehensive review of literature and identifying research gaps.

3. To design and implement innovative research methodologies with appropriate experimental, computational, or theoretical approaches.

4. To cultivate scientific writing and communication skills through structured documentation, technical reports, and research publications.

5. To foster independent and ethical research practices by adhering to scientific integrity, data authenticity, and responsible conduct in research.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Identify and formulate a research problem by critically analyzing existing literature and research gaps.	K1
CO-2:	Apply advanced research methodologies to design experiments, collect data, and implement theoretical frameworks.	K3
CO-3:	Evaluate research findings through statistical, qualitative, or computational analysis to derive meaningful conclusions	K4
CO-4:	Develop structured scientific documentation by organizing research work into a dissertation, technical report, or research article.	K6
CO-5:	Present and defend research outcomes effectively through oral and written communication in seminars, conferences, or peer discussions.	K5
CO-6:	Demonstrate ethical research conduct by adhering to academic integrity, data authenticity, and responsible scientific practices	K1

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	2	-	-	-	-	-	2	2	2	2	3	3	2
CO-2	3	2	2	-	-	-	-	-	-	-	-	2	3	3	3
CO-3	3	3	3	-	3	-	-	-	-	-	2	2	3	3	3
CO-4	3	3	3	-	2	2	-	-	-	-	2	2	3	3	3
CO-5	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
CO-6	3	3	3	2	3	3	-	-	-	2	2	3	3	3	3

FOR B.SC (HONS IN MICROBIOLOGY WITHOUT RESEARCH)

ADVANCES IN MICROBIOLOGY (Theory)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: ADVANCES IN MICROBIOLOGY (Theory)	**Subject Code:** TIU-UMB-MJ-T42404
Contact Hours/Week: 2–1–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Describe the fundamental concepts of plant diseases, including disease cycles, pathogenicity, and virulence, and analyze the historical contributions of key scientists to the field of plant pathology.
2. Explain the stages of disease development, including inoculation, penetration, infection, and dissemination, and analyze the principles of plant disease epidemiology, including disease forecasting and the disease triangle.

3. Analyze the mechanisms of host-pathogen interactions, including microbial pathogenicity, plant disease genetics, and plant defense mechanisms, and evaluate the effectiveness of different plant disease control strategies.
4. Identify and describe the symptoms, etiology, epidemiology, and control measures for specific plant diseases caused by fungi, bacteria, phytoplasmas, and viruses, with a focus on economically important examples.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Recall fundamental concepts of microbial systematics, taxonomy, and evolutionary relationships.	K1
CO-2:	Describe sequencing technologies for nucleic acids and proteins, explaining their principles and applications.	K2
CO-3:	Analyze microbial genome organization, horizontal gene transfer, and its impact on microbial virulence.	K3
CO-4:	Evaluate chemical, biological, cultural, and integrated disease management strategies for sustainable crop protection.	K4
CO-5:	Evaluate the role of metagenomics in understanding microbial diversity and identifying genes of biotechnological significance.	K5
CO-6:	Design research-based strategies to study host-microbe interactions and mechanisms of microbial pathogenesis.	K6

COURSE CONTENT :

MODULE 1:	**SYSTEMATICS, TAXONOMY**	**8 Hours**
Concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers		
MODULE 2:	**SEQUENCING OF NUCLEIC ACIDS AND PROTEINS**	**7 Hours**
Nucleic acid sequencing technologies: Maxam Gilbert sequencing, Sanger's dideoxy sequencing, Pyrosequencing, Next-Generation Sequencing, Protein sequencing technologies: Edman degradation, Sanger's method, Trypsin and Cyanogen Bromide fragmentation, Dansyl and Dabsyl chloride derivatisation		
MODULE 3:	**EVOLUTION OF MICROBIAL GENOMES**	**7 Hours**
Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Horizontal gene transfer (HGT), Evolution of bacterial virulence - Genomic islands, Pathogenicity islands (PAI) and their characteristics		

MODULE 4:	**METAGENOMICS**	**8 Hours**
Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using metagenomics Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics		
MODULE 5:	**MOLECULAR BASIS OF HOST-MICROBE INTERACTIONS**	**7 Hours**
Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, virulence and antimicrobial resistance		
TOTAL LECTURES		**45 Hours****

Books:

1. Biochemistry, Donald Voet and Judith G. Voet, 4th Edition, John Wiley and Sons, 2011.
2. DNA Sequencing Protocols, 2nd edition, by Graham, Humana Press Inc.2001
3. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press
4. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
5. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press
6. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition, Pearson-Bejamin Cummings
7. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011) Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press,
8. Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	-	-	-	-	-	2	-	-	2	-	2	3	2	3
CO-2	3	2	2	-	-	-	-	-	-	-	-	2	3	2	3
CO-3	3	3	3	-	2	3	-	-	-	-	2	2	3	3	3
CO-4	3	3	3	2	3	3	-	-	-	2	2	3	3	3	3
CO-5	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
CO-6	3	3	3	2	2	3	2	-	-	2	2	3	3	3	3

ADVANCES IN MICROBIOLOGY (Practical)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: ADVANCES IN MICROBIOLOGY (Practical)	**Subject Code:** TIU-UMB-MJ-L42404
Contact Hours/Week: 0–0–1 (L–T–P)	**Credit:** 1

COURSE OBJECTIVE :

Enable the student to:

1. Compare and contrast conventional and molecular approaches in bacterial taxonomy, including the use of evolutionary chronometers
2. Describe and evaluate the principles and applications of nucleic acid and protein sequencing technologies, including Sanger sequencing, next-generation sequencing, and Edman degradation.
3. Analyze the evolution of microbial genomes, including the concepts of core and flexible genomes, horizontal gene transfer, and the role of genomic and pathogenicity islands in bacterial virulence.
4. Explain the principles of metagenomics and its applications in understanding microbial diversity and prospecting for biotechnologically important genes

On completion of the course, the student will be able to:

CO-1:	Recall the principles and techniques involved in the extraction of metagenomic DNA from soil.	K1
CO-2:	Explain the challenges and impediments associated with soil metagenomic DNA extraction.	K2
CO-3:	Perform PCR amplification of metagenomic DNA using universal 16S ribosomal gene primers.	K3
CO-4:	Analyze sequencing gel patterns to accurately read and interpret DNA sequences	K4
CO-5:	Apply molecular and serological techniques for pathogen detection and identification.	K5
CO-6:	Develop an optimized workflow for soil metagenomic DNA extraction, PCR amplification, and sequence analysis.	K6

COURSE CONTENT :

MODULE 1:	**PATHOGEN IDENTIFICATION AND DISEASE DIAGNOSIS IN CROP PLANTS**	**15 Hours**

1. Extraction of metagenomic DNA from soil 2. Understand the impediments in extracting metagenomic DNA from soil 3. PCR amplification of metagenomic DNA using universal 16S ribosomal gene primers 4. Reading a DNA sequence from a sequencing gel
TOTAL LECTURES **15 Hours****

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	2	-	-	-	-	-	2	2	2	2	3	3	2
CO-2	3	2	2	-	-	-	-	-	-	-	-	2	3	3	3
CO-3	3	3	3	-	3	-	-	-	-	-	2	2	3	3	3
CO-4	3	3	3	-	2	2	-	-	-	-	2	2	3	3	3
CO-5	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
CO-6	3	3	3	2	3	3	-	-	-	2	2	3	3	3	3

GENETICS AND GENOMICS (Theory)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: GENETICS AND GENOMICS (Theory)	**Subject Code:** TIU-UMB-MJ-T42405
Contact Hours/Week: 2–1–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Explain and apply Mendelian principles of inheritance, including extensions of Mendelian genetics, and analyze the chromosome theory of inheritance
2. Describe the mechanisms of linkage, crossing over, and extra-chromosomal inheritance, and analyze their impact on genetic variation and inheritance patterns
3. Analyze the structural organization and variations of chromosomes, including normal and abnormal karyotypes, and explain the genetic basis of chromosomal disorders.
4. Describe the principles and applications of genomics, including genetic and physical mapping, genome sequencing, and comparative genomics, and analyze the impact of genome data in forensics, disease diagnosis, and genetic counseling.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Recount Mendelian genetics	K1
CO-2:	Decode linkage, crossing over and mapping	K2
CO-3:	Analyse different extrachromosomal inheritance in different organisms	K3
CO-4:	Analyse different special chromosomal structures	K4
CO-5:	Explain genomics, mapping processes, genome annotation	K5
CO-6:	Apply different knowledge of genomics	K3

COURSE CONTENT :

MODULE 1:	**MENDELIAN PRINCIPLES**	**10 Hours**
Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, incomplete dominance and co-dominance, multiple alleles, epistasis, penetrance and expressivity, epigenetic controls		
MODULE 2:	**LINKAGE AND CROSSING OVER**	**10 Hours**
Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at fourstrand stage, Molecular mechanism of crossing over, mapping		
MODULE 3:	**EXTRA-CHROMOSOMAL INHERITANCE**	**7 Hours**
Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in Chlamydomonas, mitochondrial, mutations in Saccharomyces, Maternal effects – Shell coiling in Limnaea peregra Infectious heredity - Kappa particles in Paramecium		
MODULE 4:	**CHARACTERISTICS OF CHROMOSOMES**	**8 Hours**

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome		
MODULE 5:	**GENOMICS**	**10 Hours**
Introduction to genomics; Mapping genomes: Genetic mapping -molecular markers- RFLP, SSLP, SNPs, basis to genetic mapping; Physical mapping- : Restriction mapping and optical mapping, FISH, RH and STS Mapping, Genome sequencing, assembly and annotation; Human genome project; Brief Overview of Structural, functional and comparative genomics; Application of genome data in forensics, disease diagnosis and genetic counselling		
TOTAL LECTURES		**45 Hours****

Books:

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. WileyIndia
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics.10th Ed. Benjamin Cummings
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed. W.H.Freeman and Co., New York
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers
7. Russell PJ. (2009). i Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings
8. Brown TA (2018) Genomes 4th Ed., Garland Science
9. Primrose SB and Twyman RM (2006) Principles of Gene Manipulation and Genomics, 7th Ed., Blackwell Publishing

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	2	-	-	-	-	-	2	2	2	2	3	3	2
CO-2	3	2	2	-	-	-	-	-	-	-	-	2	3	3	3

CO-3	3	3	3	-	3	-	-	-	-	-	2	2	3	3	3
CO-4	3	3	3	-	2	2	-	-	-	-	2	2	3	3	3
CO-5	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
CO-6	3	3	3	2	3	3	-	-	-	2	2	3	3	3	3

GENETICS AND GENOMICS (Practical)

Program: B. Sc. in Microbiology	**Year, Semester:** 4th Yr., 8th Sem
Course Title: GENETICS AND GENOMICS (Practical)	**Subject Code:** TIU-UMB-MJ-L42405
Contact Hours/Week: 0–0–1 (L–T–P)	**Credit:** 1

COURSE OBJECTIVE :

Enable the student to:

1. Analyze and interpret deviations from Mendelian inheritance in dihybrid crosses, demonstrating an understanding of non-Mendelian genetic phenomena.
2. Prepare and examine temporary mounts of human cheek cells to identify and understand the significance of Barr bodies in sex chromosome determination
3. Utilize online genome resources to extract and interpret information about a specific gene, demonstrating proficiency in bioinformatics tools and data analysis.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Analyse Mendelian genetics	K2
CO-2:	Explain different deviations from dihybrid cross	K2
CO-3:	Master of mounting different cells	K4
CO-4:	Analyse Bar Body structure	K3
CO-5:	Explain gene structure	K4
CO-6:	Predict genes from gene sequences information	K3

COURSE CONTENT :

MODULE 1:	**PATHOGEN IDENTIFICATION AND DISEASE DIAGNOSIS IN CROP PLANTS**	**15 Hours**
1. Mendelian deviations in dihybrid crosses 2. Studying Barr Body with the temporary mount of human cheek cells 3. Extraction of information of any gene from available genome resources		
TOTAL LECTURES		**15 Hours****

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	3	2	3	-	2	-	-	1	2	3	2	3	3
CO-2	3	2	2	2	3	-	-	-	-	2	2	3	2	3	3
CO-3	3	2	3	-	2	3	-	-	-	2	2	3	2	2	3
CO-4	3		2	-	-	-	1	-	-	3	2	2	-	2	2
CO-5	3	2	3	-	2	-	-	3	3	3	2	3	2	3	3
CO-6	3		2	-	-	-	3	-	-	3	3	3	-	2	2