

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

Nationally Accredited with 'A' Grade by NAAC

ISO 9001:2015 Certified

TIRUCHIRAPPALLI

PG AND RESEARCH DEPARTMENT OF MICROBIOLOGY



M.Sc., MICROBIOLOGY

SYLLABUS

2022 -2023 and Onwards



CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)
PG AND RESEARCH DEPARTMENT OF MICROBIOLOGY

VISION

Our vision is to encourage eminent research work through the conception of an attractive and vibrant environment to achieve goals of our department.

MISSION

- To impart relevant, ultimate, principle-oriented education and practical expertise in the field of Microbiology.
- To strive to provide quality education conjugated with innovative technology so as to be able to gain technical and educational expertise locally, nationally, internationally.
- Our prime focus is to enrich the ambitions of our students, staff and steer with constructive collaboration towards excellence.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

PEOs	Statements
PEO1	LEARNING ENVIRONMENT To facilitate value-based holistic and comprehensive learning by integrating innovative learning practices to match the highest quality standards and train the students to be effective leaders in their chosen fields.
PEO2	ACADEMIC EXCELLENCE To provide a conducive environment to unleash their hidden talents and to nurture the spirit of critical thinking and encourage them to achieve their goal.
PEO3	EMPLOYABILITY To equip students with the required skills in order to adapt to the changing global scenario and gain access to versatile career opportunities in multidisciplinary domains.
PEO4	PROFESSIONAL ETHICS AND SOCIAL RESPONSIBILITY To develop a sense of social responsibility by formulating ethics and equity to transform students into committed professionals with a strong attitude towards the development of the nation.
PEO5	GREEN SUSTAINABILITY To understand the impact of professional solutions in societal and environmental contexts and demonstrate the knowledge for an overall sustainable development.

PROGRAMME OUTCOMES FOR M.Sc., Microbiology PROGRAMME

PO NO	On completion of M.Sc., Microbiology, the students will be able to
PO1	Scientific Management and Career Opportunities: Master the scientific and applied aspects of the subject for employment opportunities.
PO2	Explore Creativity and Intelligence: Employ novel ideas with conceptual thinking to secure self-discipline and independence to foster scientific attitude by exploration of Science.
PO3	Team Building and Scientific Temperament: Inculcate training, internships and team spirit with leadership skills through academic projects and transmit complex scientific and technical information and contribute to the scientific community.
PO4	Innovative Learning and Technological Advancement: Perceive research in the specialized areas and to engage in life-long learning to keep pace with emerging trends in academics, research and technology.
PO5	Personality Development with Social Responsibility: Achieve ethical, social and holistic values with social responsibility to develop a healthy life.

PROGRAMME SPECIFIC OUTCOMES FOR M.Sc., MICROBIOLOGY

PSO NO.	Students of M.Sc., Microbiology will be able to	POs Addressed
PSO 1	Understand the applied sciences to engage them life long learning to foster their successful carrier and educational goals.	PO1 PO5
PSO 2	Focus perceptive in the subject of Microbiology to apply its principles and its applications by adding broad range of scientific knowledge.	PO2 PO3
PSO 3	Acquire contextual knowledge on basis and modern concepts in current areas with contemporary technologies and multidisciplinary domains	PO3 PO4
PSO 4	Instill to work independently identify appropriate resources; enable individual, institutional and national values to understand the impact of innovation and applications.	PO4 PO1
PSO 5	Ability to imbibe moral and ethical values to formulate effective research grants and experimental designs	PO5 PO2

Cauvery College for Women (Autonomous), Trichy-18

PG & Research Department of Microbiology

M.Sc., Microbiology

Learning Outcome Based Curriculum Framework (CBCS-LOCF)

(For the Candidates admitted from the Academic year 2022-2023 onwards)

Semester	Course	Title	Course Code	Inst./ Hrs/Wee	Credit	Hrs	Marks		Total
							Int.	Ext.	
I	Core Course– I (CC)	Essentials of Microbiology	22PMB1CC1	6	5	3	25	75	100
	Core Course– II (CC)	Biological Macromolecules	22PMB1CC2	6	5	3	25	75	100
	Core Course – III (CC)	Clinical Virology	22PMB1CC3	6	5	3	25	75	100
	Core Practical–I (CP)	Essentials of Microbiology, Biological Macromolecules and Clinical Virology (P)	22PMB1CC1P	6	5	3	40	60	100
	Discipline Specific Elective Course – I(DSE)	A. Biological Techniques	22PMB1DSE1A	6	3	3	25	75	100
		B. Organic Farming	22PMB1DSE1B						
		C. Microbial Cytology	22PMB1DSE1C						
TOTAL				30	23	-	-	-	500
15 Days INTERNSHIP during Semester Holidays									
II	Core Course- IV (CC)	Bacteriology and Mycology	22PMB2CC4	6	5	3	25	75	100
	Core Course – V(CC)	Immunology and Immunotechnology	22PMB2CC5	6	5	3	25	75	100
	Core Choice Course – I (CCC)	A. Microbial Metabolism	22PMB2CCC1A	6	4	3	25	75	100
		B. Environmental and Agricultural Microbiology	22PMB2CCC1B						
		C. Microbial Ecology	22PMB2CCC1C						
	Core Practical–II (CP)	Bacteriology ,Mycology,Immunology and Immuno technology (P)	22PMB2CC2P	6	5	3	40	60	100
	Discipline Specific Elective Course – II (DSE)	A. Biofertilizer Technology	22PMB2DSE2A	6	3	3	25	75	100
		B. Public Health Microbiology	22PMB2DSE2B						
		C. Marine Microbiology	22PMB2DSE2C						

	Internship	Internship	22PMB2INT	-	2	-	-	100	100
	Extra Credits Course	SWAYAM	As Per UGC Recommendation						
	TOTAL			30	24	-	-	-	600
III	Core Course-VI (CC)	Molecular Biology and Microbial Genetics	22PMB3CC6	6	5	3	25	75	100
	Core Course-VII(CC)	Food and Dairy Microbiology	22PMB3CC7	6	5	3	25	75	100
	Chore Choice Course- II(CCC)	A. Cyber security	22PGCS3CCC2A	5	4	3	25	75	100
		B. Microbial Gene Technology	22PMB3CCC2B						
		C. Biosafety and Intellectual Property Rights	22PMB3CCC2C						
	Core Practical-III (CP)	Molecular Biology and Microbial Genetics, Food and Dairy Microbiology (P)	22PMB3CC3P	6	5	3	40	60	100
	Discipline Specific Elective Course – III (DSE)	A. Microbiology for Competitive Examinations	22PMB3DSE3A	4	3	2	-	100	100
		B. Food Adulteration	22PMB3DSE3B			3	25	75	
		C. Biomedical Laboratory Technology	22PMB3DSE3C						
	Generic Elective Course - I (GEC)	Food Quality Testing	22PMB3GEC1	3	2	3	25	75	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	TOTAL			30	24	-	-	-	600
IV	Core Course – VIII (CC)	Bioprocess Technology	22PMB4CC8	6	5	3	25	75	100
	Core Choice Course– III (CCC)	A. Bioinformatics and Biostatistics	22PMB4CCC3A	6	4	3	25	75	100
		B. Computational Biology	22PMB4CCC3B						
		C. Microbial Nanotechnology	22PMB4CCC3C						
	Core Practical-IV (CP)	Bioprocess Technology (P)	22PMB4CC4P	6	5	3	40	60	100
	Generic Elective Course -II (GEC)	Entrepreneurial Microbiology	22PMB4GEC2	3	2	3	25	75	100
	Project	Project Work	22PMB4PW	9	5	-	-	100	100
	TOTAL			30	21	-	-	-	500
GRAND TOTAL				120	92	-	-	-	2200

Courses & Credits for PG Science Programmes

Sl. No	Courses	No of Courses	No of Credits	Marks
1.	Core Course – (CC)	08	40	800
2.	Core Choice Course– (CCC)	3	12	300
3.	Core Practical-(CP)	4	20	400
4.	Discipline Specific Elective- (DSE)	3	9	300
5.	Generic Elective Course - (GEC)	2	4	200
6.	Project	1	5	100
7.	Internship	1	2	100
	Total	22	92	2200

The internal and external marks for theory and practical papers are as follows:

Subject	Internal Marks	External Marks
Theory	25	75
Practical	40	60

Separate passing minimum is prescribed for Internal and External

For Theory:

- a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)
- b) The passing minimum for End Semester Examinations shall be 40% out of 75marks (i.e. 30 mark
- c) The passing minimum not less than 50% in the aggregate.

For Practical:

- a) The passing minimum for CIA shall be 40% out of 40 marks (i.e. 16 marks)
- b) The passing minimum for End Semester Examinations shall be 40% out of 60marks (i.e. 24 mark
- c) The passing minimum not less than 50% in the aggregate.

For PROJECT:

Marks for Dissertation: 80 Marks

Marks for Viva Voce: 20 Marks

Total Marks: 100 Marks

Semester : I	Internal Marks: 25		External Marks : 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	CREDITS
22PMB1CC1	ESSENTIALS OF MICROBIOLOGY	CORE COURSE	6	5

Course Objective

To enable the students to understand the basic knowledge in Microbiology.

Prerequisites

Basic knowledge and concepts of microbiology.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Remember and understand the scope, history and basics of microbiology	K1,K2
CO2	Analyze the principles of Microscopy and able to understand the characteristics of different microbes	K1,K2,K3
CO3	Locate and classify and bacteria, fungi, algae and virus	K2,K4
CO4	Explain Microbial growth and recall methods of reproduction	K1,K5
CO5	Construct and revise cultivation and preservation methods of microbes	K5,K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	1	3	2	3	3	2
CO2	2	2	2	2	2	3	2	3	2	2
CO3	2	3	1	2	3	3	2	3	2	2
CO4	3	2	3	2	2	3	2	3	2	1
CO5	3	3	3	3	2	3	2	3	3	2

1- Slight (Low) correlation

2- Moderate(Medium) correlation

3- Substantial (High) correlation

“-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	History and Scope of Microbiology, Classification systems– Phenetic, phylogenetic and numerical. Domain and	18	CO1, CO2, CO3	K1, K2, K3,

	kingdom concept - Haeckel's three kingdom concept, Whittaker's five kingdom concept, Carl Woese three domain system, Cavalier-Smith eight kingdom concept. Bacterial classification(outline)according to Bergey's manual of systemic Bacteriology.			K4
II	Principles of microscopy. Compound microscope (Monocular and Binocular microscopes) – construction and function of parts, ray diagram of path of light, objectives, oculars, condensers, sources of illumination and uses. Dark field, Phase contrast and Fluorescence microscopes, Confocal microscopes, Atomic Force Microscope - principle, construction, ray diagram and applications - Electron microscopy – TEM and SEM – principle, construction, ray diagram and uses.	18	CO1, CO2	K1, K2, K3
III	Study of bacteria: Size, shape and arrangement of bacterial cells. Structures external to cell wall – capsule, slime layer, flagella, pili, fimbriae, stalks, prosthecae. Cell wall – gram positive and gram negative. Structures internal to cell wall – cell membrane, cytoplasm, cytoplasmic inclusions, genome, spores and cysts. Reproduction in bacteria: a) Binary fission <i>E. coli</i> , <i>Bacillus</i> and <i>Streptococcus</i> b) Other methods – Budding, Fragmentation, Prostheca, Multiple fission.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
IV	General characteristics, Classification, Structure and Reproduction of Algae: <i>Chlorophyta</i> (Green algae), <i>Diatoms</i> , <i>Rhodophyta</i> (Red algae), Fungi: Cell wall – chemical composition and functions, membranes and their functions, nutritional strategies of fungi. Structure and life cycle of fungi <i>Ascomycetes</i> (<i>Aspergillus</i>), <i>Zygomycetes</i> (<i>Mucor</i>), <i>Basidiomycetes</i> (<i>Agaricus</i>). Discovery, distinctive properties, morphology and ultra-structure of Virus, Classification of virus.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
V	Microbial growth - culture media - isolation of pure culture. Growth curve: Diauxy - continuous culture – chemostat – turbidostat - synchronized growth. Measurement of microbial growth – Total cell count method - viable cell count method and biomass determination - dry weight – wet weight – protein – Kjeldhal nitrogen – chlorophyll. Growth phases – kinetics – asynchronous – synchronous - batch – continuous culture.	18	CO1, CO4, CO5	K1, K2, K4, K5

	Factors affecting growth (pH, salinity, temperature, light, etc). Microbial growth control - Physical and chemical methods – sterilization and disinfection. Maintenance and preservation of microorganism			
VI	Self Study for Enrichment (Not included for End Semester Examinations) Nomenclature and modern methods of Bacterial taxonomy, Micrometry, Gaint bacteria, Cultivation of virus and Protozoa, Bacterial nutrition.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Dave Wessner , Christine Dupont , Trevor Charles , Josh Neufeld.(2020).Microbiology.Wiley.
2. BhagwanRekadwad. (2020).Microbial Systematics: Taxonomy, Microbial Ecology, Diversity. CRC Press.
3. Joan L. Slonczewski , John W. Foster , Erik R. Zinser.(2020).Microbiology: An Evolving Science. W. W. Norton & Company.
4. Michael J. LeBoffe, Burton E. Pierce. (2019).Microbiology: Laboratory Theory & Application, 1st Edition. Morton Publishing Company.
5. Gerard Tortora , Berdell Funke , Christine Case. (2018).Microbiology: An Introduction, 4th Edition,Pearson.

Reference Books

1. Gerard Tortora , Berdell Funke , Christine Case, Derek Weber, Warner Bair . (2020).Microbiology: An Introduction, 12th Edition.Pearson.
2. Barry Chess.(2020).Talaro's Foundations in Microbiology: Basic Principles, 7th Edition.McGraw Hill.
3. Lourdes Norman-McKay .(2018).Microbiology: Basic and Clinical Principle, 1st Edition .Pearson.
4. Kathleen Park Talaro , Barry Chess. (2017).Foundations in Microbiology, 7th Edition. McGraw Hill.
5. PrescottL.M,Harley,J.P.andHelin,D.A. (2017).Microbiology, 5th Edition. McGraw Hill.

Web References

1. <https://microbenotes.com/category/basic-microbiology/>
2. <https://microbiologyinfo.com/>
3. [https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_\(Kaiser\)/Unit_1%3A_Introduction_to_Microbiology_and_Prokaryotic_Cell_Anatomy/1%3A_Fundamentals_of_Microbiology](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Kaiser)/Unit_1%3A_Introduction_to_Microbiology_and_Prokaryotic_Cell_Anatomy/1%3A_Fundamentals_of_Microbiology)
4. <https://www.biologydiscussion.com/notes/microbiology-notes/notes-microbiology-biology/34235>
5. <https://www.britannica.com/science/microbiology>

Pedagogy

Chalk and talk, Quiz, Assignments, Group Discussion, Demo and PPT

Course Designer

Dr.P.F.Steffi

Semester: I	Internal Marks:25	External Marks:75		
COURSE CODE	COURSE TITLE	CATEGORY	Hrs/ Week	CREDITS
22PMB1CC2	BIOLOGICAL MACROMOLECULES	CORE COURSE	6	4

Course objective

- To provide knowledge about cell, it's structure and function
- To understand the metabolic pathways of various macromolecules.
- To know about the basic concepts of thermodynamics, chemical reactions and buffers
- To illustrate the structure, function, kinetics and inhibition of enzymes

Prerequisite

Basic understanding of cell and its functions, biological macromolecules.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Remember and understand the basic structure of cell and it's various components	K1,K2
CO2	Analyze and understand the basic concepts of enzyme and it's catalysis	K2,K3
CO3	Categorize the Various types of Macro molecules examine their structure, properties & Function	K3,K4
CO4	Explain the basic concepts of thermodynamics and list out the various types of transport mechanisms	K4,K5
CO5	Discuss the various metabolic pathways and interpret the ATP Production and regulation	K5,K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2	3	3	3	2	3
CO2	3	2	3	3	2	2	3	2	3	3
CO3	3	2	2	3	3	3	2	3	3	2
CO4	2	3	3	2	3	3	3	2	3	2
CO5	3	3	2	3	2	3	3	3	2	2

"1" – Slight (Low) Correlation

"3" – Substantial (High) Correlation

"2" – Moderate (Medium) Correlation

"-" indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Cell and its function-Structural organization and function of bacterial, animal and plant cell-Nucleus, Cytoplasm, Mitochondria, Golgi apparatus, Lysosomes, Ribosomes Endoplasmic reticulum. Various specialized components of microorganisms-Pili,Fimbriae,Cilia,Flagella, S-layer,Magnetosomes-their structure and function. Cell division-Mitosis,Meiosis	18	CO1, CO2, CO3	K1, K2, K3
II	Enzymes-Definition –Classification –specificity-active site-Emil fisher and koshland Model for the mechanism of enzyme action, Enzyme kinetics:Michaelis–Menton equation for simple enzymes-Factors affecting enzyme activity. Enzyme inhibition- Competitive, Non competitive and Uncompetitive. Isozymes-coenzymes- Biological significance of enzymes	18	CO1,CO2	K1, K2, K3, K4
III	Macromolecules. Nucleic acid - properties,biosynthesis of purines and pyrimidines - Structure of DNA and RNA.Types of RNA. Proteins -classification - primary-secondary-tertiary - quaternary and three dimensional structure of proteins.Synthesis of proteins.Aminoacids-Essential and Non Essential-Carbohydrates-mono,di,oligo and polysaccharides. Lipids and biomolecules: Fatty acids, properties, -oxidation	18	CO1,CO2, CO3, CO4	K1, K2, K3, K4, K5
IV	Bioenergetics –Laws of thermodynamics,strategy of energy production in the cell. Oxidation -reduction reactions,coupled reactions and group transfer. Biological energy transducers-structural features of biomembranes, transport, free energy and spontaneity of reaction,G,G°,G'and equilibrium.Basic concepts of acids,bases,pH and buffer	18	CO1, CO3, CO4	K1, K2, K3, K4, K5
V	Basic concepts of metabolism - catabolic principles and break down of carbohydrates-Glycolysis-EMP and Entnerdoudroff pathway,TCA cycle and HMP shunt. Lipids-Types of oxidation-proteins- Deamination,Transamination,Decarboxylation and Transmethylation- Nucleicacids – Purine and pyrimidine catabolism-significance	18	CO1, CO3, CO5	K1, K2, K3 ,K5
VI	Self study for Enrichment (Not included for End Semester Examinations) Cell cycle, Allosteric enzymes, Biosynthesis of cholesterol, Biological buffer system –Types and functions, ATP production	-	CO1, CO2, CO3, CO4	K2, K3, K4, K5

Text Books

1. Amit Kumar Nayak, Amal Kumar Dhara, Dilipkumar Pal (2021) *Biological Macromolecules Bioactivity and Biomedical Applications*. 1st Edition.Elsevier Inc.
2. Rene Creste Kratz , (2020) *Molecular & Cell Biology* 2nd edition dummies
3. Jeremy M Berg, John L Tymoczko and Lubert Stryer., (2002) *Biochemistry* 5th edition W.H. Freeman and company, New York
4. Freifelder D (2004) *Molecular Biology*, 4th Edition Narosa Publishing House, New Delhi

Reference Books

1. David. E. Metzler and Carol. M. Metzler (2001) *Biochemistry - The chemical reactions of living cells - Volume 2*. 2nd edition Harcourt/Academic press, New York
2. Lehninger, Albert L, David L Nelson and Michael M Cox. (2021) *Lehninger Principles of Biochemistry*. New York: 8th Edition Worth Publishers.
3. Stryer L, Berg J M and Tymoczko J L (2002) *Biochemistry* 5th edition. New York W.H. Freeman.
4. Thomas M Devlin. A. (2002) *Textbook of Biochemistry with clinical correlations*, 5th edition. John Wiley and sons, Inc., publication, New York
5. Rafi MD (2014) *Textbook of Biochemistry for medical students*, 2nd edition Universities Press, (India) Pvt. Ltd, Hyderabad, India

Web References

1. [https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_\(Boundless\)/03%3A_](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/03%3A_)
2. <https://www.youtube.com/watch?v=h-z9-9OOWC4>
3. <https://www.youtube.com/watch?v=-FQmAnmLZtE>
4. <https://www.youtube.com/watch?v=ok9esggzN18>
5. <https://www.youtube.com/watch?v=PYH63o10iTE>
6. <https://www.youtube.com/watch?v=VigpwmH7E3M>
7. https://www.youtube.com/watch?v=_zm_DyD6FJ0
8. <https://www.youtube.com/watch?v=VGHD9e3yRIU>
9. https://www.youtube.com/watch?v=2Jgb_DpaQhM
10. <https://www.youtube.com/watch?v=NNASRkIU5Fw>
11. <https://www.youtube.com/watch?v=qVAvmieRM1E>
12. <https://www.youtube.com/watch?v=Gh2P5CmCC0M>

Pedagogy

Chalk and talk, Quiz, Assignments, Group Discussion, Demo and PPT

Course Designer

Dr. N. Pushpa

Semester: I	InternalMarks:25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB1CC3	CLINICAL VIROLOGY	CORE COURSE	6	5

Course Objective

- To impart and explain the students with the advanced knowledge of the characteristics of Clinically important viruses with the focus on the General characters, Cultivation, Pathogenesis, Lab diagnosis, Prophylaxis, and Treatment of the disease.

Prerequisites

Basic Understanding of Etiology and Diagnostic Management of Animal Viruses.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Describe General Characters and Classification of viruses	K1,K2,K3
CO2	Aware different Diagnostic methods adopted for viruses	K2,K3,K4
CO3	Understand the replicative cycles of Viruses	K2,K3, K4,K5
CO4	Analyze the pathogenesis and symptoms of Viruses	K3,K4, K5,K6
CO5	Examine and Categorize different types of preventive measures Of Viruses	K3,K4, K5,K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	1	3	3	3	3
CO3	3	3	2	3	3	3	2	3	3	3
CO4	2	3	1	3	3	3	1	3	3	2
CO5	3	3	3	1	3	3	3	3	1	3

“1”–Slight(Low) Correlation “2” – Moderate (Medium) correlation

“3”–Substantial(High) Correlation “-“indicates there is no correlation

Syllabus

UNIT	CONTENTS	HOURS	COs	COGNITIVE LEVEL
I	General Virology- Introduction and Historical perspective of clinical virology. Nomenclature, General Properties and Ultrastructure of viruses. viral replication, classification of Viruses – Baltimore and ICTV methods. Sample collection, Transport and examination of viral Specimens. Incomplete viruses- Prions, Satellite Viruses, Viroids and Virusoids.	15	CO1, CO2, CO3	K1, K2, K3
II	General Methods of Diagnosis and Serology- Cultivation of clinically important viruses in embryonated eggs, experimental animals, cell cultures, cell lines and transgenic systems. Serological methods – Haem agglutination & HAI; complement fixation, Immuno fluorescence methods, PCR, ELISA and Radio immuno assays, Immuno blotting- Western Blot. Assay of viruses – physical, chemical and Infective assay. Antiviral agents and viral vaccines.	15	CO1, CO2, CO5	K1, K2, K3, K4
III	Air borne Viruses- Clinical Course, Disease burden, risk factor, Epidemiology, Prevention and Treatment of following Air borne viruses- Rhinovirus, Influenza Virus (A, B and H1N1), Varicella virus- Chicken pox, Mumps virus, Measles virus, MERS-Co V and SARS-Cov-2.	15	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
IV	Food borne Viruses- Causative agent, Pathogenesis, Lab Diagnosis, Treatment and Prophylaxis of following Food borne Viruses- Adenovirus, Rotavirus, Hepatitis virus, Enteroviruses- Poliomyelitis, Calcivirus, Polio virus and Cocksackie viruses.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

V	<p>Vector borne Viruses- Morphology of Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following Vector borne viral diseases-Chikungunya, Dengue, Yellow fever, Rabies and Ebola Viruses.</p> <p>Oncogenic Viruses - Pathogenesis, Diagnosis and Prevention of Oncogenic viruses- Human Papiloma virus, HIV, HTLV, Herpes and Epstein Barr Virus.</p>	15	CO1, CO2,CO3, CO4,CO5	K1, K2,K3, K4K5, K6
VI	<p>Self Study Enrichment(Not included for End Semester Examinations)</p> <p>Cultural Characters of Viruses, Qualitative and Quantitative estimation of Viruses, Structure and life cycle of viruses, Etiology and Classification of viruses and Viral Prophylaxis.</p>	-	CO1, CO2,CO3, CO4,CO5	K1, K2,K3, K4K5, K6

Text Books

1. Ananthanarayan and Jayaram Paniker(2020).*Text book of Microbiology*.11th Edition,London:OxfordUniversity press.
2. GeoBrooks,Karen Carroll,JanetButlandStephenMorse(2020).*MedicalMicrobiology*.26th Edition, McGraw Hill Publication.
3. Jawetz,MelnickandAdelberg's(2019).*MedicalMicrobiology*.24th Edition,HillMedicalPublication division.
4. KennethJRyan,NafeesAhmadandAndrewAlspaughJ(2018).*SherrisMedicalMicrobiology*.7th Edition, McGraw Hill Education.
5. Mishra B(2018).*Text BookofMedicalVirology*.1st Edition, CBS Publishers.
6. GreenwoodD,SlackRC,BarerMRandIrvingWL(2018).*MedicalMicrobiology:AGuide to Medical Infections*.19th Edition,Churchill Livingstone Publishers.

Reference book

1. AejaIqbalandZafarNowshad(2020).Medicalmicrobiology:MillenniumEdition. Notion Press.
2. AlanJ.Cann(2015).PrinciplesofMolecularVirology.4th Edition,California:AcademicPress.
3. DimmockNJandPrimeroseSB(2016).Introductiontomodernvirology.4th Edition,London:OxfordBlackwell scientific publication.
4. SinghR.P(2015).ImmunologyandMedicalMicrobiology.1st Edition,NewDelhi:KalaniPublishers.

Web References

1. https://www.youtube.com/watch?v=SAbYEEYs-_ak
2. <https://www.youtube.com/watch?v=6RDofkmG1yo>
3. <https://www.youtube.com/watch?v=dGKeq7DH91c>
4. <https://www.youtube.com/watch?v=xEp-Sdgl9AU>
5. <https://www.youtube.com/watch?v=Kweu6hjWV9w>

Pedagogy

Chalk and talk, Quiz, Assignments, Group Discussion, Demo and PPT

Course Designer

Dr.S.Jeyabharathi

Semester : I	Internal Marks: 40		External Marks : 60	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	CREDITS
22PMB1CC1P	ESSENTIALS OF MICROBIOLOGY, BIOLOGICAL MACROMOLECULES AND CLINICAL VIROLOGY PRACTICAL	CORE PRACTICAL	6	4

Course objective

To impart knowledge about bacterial morphology, phage identification and estimation of nucleic acids

Prerequisites

Imparting practical skills of microbiology

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Learn and recall basic microbiological methods	K1
CO2	Understand fundamental techniques involving staining, Micrometry, sterilization, disinfection, culturing etc.	K2
CO3	Demonstrate various methods to study viruses and bacteria	K3
CO4	Evaluate and quantify the biological macromolecules	K5
CO5	Create and apply various standard operating procedures for handling microbes	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	3	3	2	2
CO2	3	2	2	3	3	3	2	2	3	2
CO3	3	3	3	3	3	3	2	2	2	2
CO4	3	2	3	2	3	3	2	3	3	2
CO5	3	3	3	2	2	3	2	3	3	2

“1”-Slight (Low) correlation

“3”- Substantial (High) correlation

“2”- Moderate(Medium) correlation

“-” indicates there is no correlation

Syllabus

S.NO	CONTENT	HOURS	COS	COGNITIVE LEVEL
1.	I. Essentials of Microbiology <ol style="list-style-type: none"> 1. Safety measures to be followed in the laboratory 2. Study of compound microscope: use of monocular, binocular microscopes, use of oil immersion lens 3. Micrometry – measurement of cell dimensions 4. Study of instruments – autoclave, hot air oven, inoculation chamber (LAFU), Incubator, pH meter 5. Cleaning and sterilization of glassware and preparation of cleaning solutions 6. Enumeration of bacteria from environmental sample – Spread and Pour plate 7. Purification of bacteria by different streaking methods 8. Study of microbial behavior – motility of bacteria by hanging drop technique 9. Staining of bacteria - Monochrome staining, Preparation of Gram staining solutions, Gram staining, Negative staining, Structural staining – endospore, cell wall, capsule staining 10. Fungal slide culture 	45	CO1, CO2, CO3, CO5	K1, K2, K3, K6
2.	II. Biological Macromolecules <ol style="list-style-type: none"> 1. Preparation of buffer (Tris, Phosphate, Acetate buffer) 2. Determination of (H⁺) ion concentration 3. Verification of Beer-Lambert's law using coloured solution 4. Preparation of standard graph for the following and estimating the concentration in a microbial sample <ol style="list-style-type: none"> i) Glucose-Anthrone method, ii) Bovine serum albumin (Lowry's method) and iii) Nucleic acid -DNA (diphenyl amine method), RNA (Orcinol method). 5. Separation of amino acids by paper chromatography and identification of amino acid. 6. Separation of proteins by PAGE, SDS-PAGE-Demonstration. 	30	CO2, CO4	K2, K5

3.	III. Clinical Virology 1. Animal tissue culture - Demo 2. Embryonated egg inoculation 3. Cell lines studies - Demo	15	CO1, CO2, CO3, CO5	K1, K2, K3, K6
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Reference Books

1. Saha R. (2022). *Microbiology Practical Manual*, 2nd edition. CBS Publishers & Distributors.
2. Apurba S Sastry , Sandhya Bhat.(2021).*Essentials of Practical Microbiology*, 1st edition. Jaypee Brothers Medical Publishers.
3. Baveja C. P, BavejaV. (2021).*Text and Practical Microbiology for MLT*, 3rd edition. Arya Publications.
4. Das S.(2020).*Microbiology Practical Manual*, 1st edition CBS Publishers.
5. Bharti Arora, AroraD.R. (2020).*Practical Microbiology*, 2nd edition. CBS Publishers & Distributors.
6. Sinha K P.(2020).*Manual of Practical Biochemistry*, 1st edition. Scientific Book Company.
7. Rafi Mohammed.(2020).*Manual of Practical Biochemistry*, 3rd edition. Orient Blackswan Pvt Ltd.
8. SoundravallyRajendiran , Pooja Dhiman.(2019).*Biochemistry Practical Manual*, 1st edition.Elsevier.
9. Amita Jain , Jyotsna Agarwal , Vimala Venkatesh.(2018).*Microbiology Practical Manual*, 1st edition Elsevier.
10. Gunasekaran P.(2018). *Laboratory Manual In Microbiology*, 2nd editionNewAge International Pvt. Ltd. Publisher.

Web References

1. <https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf>
2. <https://ttk.elte.hu/dstore/document/893/book.pdf>
3. https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC103J-lab-manual.pdf
4. https://profiles.uonbi.ac.ke/jamesmuthomi/files/acp101_microbiology_practical_exercises.pdf
5. <https://www.slideshare.net/PatriciaCosta17/practical-handbook-of-microbiology>

Pedagogy

Chalk and talk, Quiz, Assignments, Group Discussions, Demo and PPT

Course Designer

Dr.P.F.Steffi

Semester : I	Internal Marks :25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB1DSE1A	BIOLOGICAL TECHNIQUES	DISCIPLINE SPECIFIC ELECTIVE	6	4

Course Objective

To educate the students with the basic principles of microbial techniques so as to develop their research aptitude and career prospects.

Prerequisite

Basic understanding of experimental protocols on biological research.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO 1	Describe and compare various instrumentation protocols.	K1,K2
CO 2	Illustrate the working principles of biological techniques	K3
CO 3	Analyze the results of biological techniques.	K4
CO 4	Summarize the advantages of assorted techniques	K6
CO 5	Formulate the applications of instrumentation biology.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2	3	3	2	3	1
CO2	3	3	3	2	2	3	2	3	2	2
CO3	3	3	2	2	3	3	2	3	2	2
CO4	3	2	3	2	2	3	2	3	2	1
CO5	3	3	3	3	2	3	2	3	3	2

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Microscopic Techniques-Basic principles, mechanisms and application of Bright Field, Dark field, Phase contrast, Polarization, Confocal laser scanning microscope, Fluorescence, Scanning Electron microscope & Transmission Electron Microscope (SEM & TEM) and Radio- frequency scanning tunneling microscopy, Atomic force	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K6

	microscopy. Preparation of microbial, animal and plant samples for microscopy.			
II	Spectroscopy & Spectrometry- Basic concepts and applications of Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD), Fluorescence spectroscopy, UV/Visible spectrophotometry, Infrared spectroscopy, Fourier-transform infrared spectroscopy (FTIR), Nuclear Magnetic Resonance spectroscopy (NMR).	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K6
III	Chromatographic Techniques-Basic Principles and application of Thin-layer chromatography, Paper chromatography, Gel filtration chromatography, Ion- exchange chromatography, Affinity chromatography, Gas chromatography and High Performance Liquid chromatography.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K6
IV	Centrifugation & Electrophoresis- Basic principles and applications of Centrifuges - Preparative, analytical, high speed, low speed, ultracentrifuge, differential and density gradient. Basic concepts and applications of Gel Electrophoresis- Agarose and acrylamide (native, denaturing and gradient), Isoelectric focusing, 2D Electrophoresis, Immuno-electrophoresis and Pulse field Electrophoresis.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K6
V	Radiography & Molecular Techniques- Basic principles and application of Autoradiography. Liquid scintillation counting, phosphor imaging, Imatinib Resistance Mutation Analysis. Types of PCR- Real time PCR, Reverse Transcriptase PCR, Multiplex PCR, Nested PCR and In-situ PCR. Blotting (Southern, Western, Northern) Techniques, DNA Finger printing, RFLP, RAPD and AFLP application.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K6

VI	Self Study for Enrichment(Not included for End Semester Examination) Differentiate the functions of Microscope, Interpret the results of FTIR, Separation of the compounds using chromatography and centrifugation, Working principles of DNA Amplification.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K6
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Text Books

1. Rao, D. M. (2020). *Instrumental Methods of Analysis*. 1st Edition. CBS publishers and distributors pvt ltd.
2. Gurdeep R. Chatwal. (2019). *Instrumental Methods of Chemical Analysis*. 3rd Edition. Himalaya publishing house.
3. Bhawana Pandey M.H. Fulekar. (2019). *Bioinstrumentation*. 5th Edition. Dream tech Press.
4. Gilbert H Mitchell. (2017). *Gel Electrophoresis: Types, Applications & Research*. 1st Edition. Nova Science Publishers.
5. Jessica carol. (2016). *Textbook of Analytical Biochemistry*. 1st Edition. Syrawood Publishing House.

Reference Books

1. Ankita Jain, Haresh Kalasariya, Varsha Tailor, Nikunj Patel. (2020). *Bioinstrumentation techniques-Basics and applications*. 1st Edition. Notion Press.
2. Gakhar, Monika Miglani, Ashwani Kumar. (2019). *Molecular Biology: A Laboratory Manual*. 1st Edition. Dreamtech Press.
3. Almroth E., Wright. (2018). *Principles of Microscopy: Being a Handbook to the Microscope*. 1st Edition. Forgotten Books.
4. Andreas Hofmann and Samuel Clokie. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology*. 8th Edition. Cambridge University Press.
5. Sanjay B Bari. (2017). *Theory and Practice of Chromatographic Techniques*. 1st Edition. Pharma Med Press.

Web References

1. http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf
2. <https://research.ipmu.jp/seminar/sysimg/seminar/574.pdf>

3. <http://www-keeler.ch.cam.ac.uk/lectures/Irvine/>
4. https://www.ccamp.res.in/sites/default/files/Basics%20of%20Chromatography_KR_C-CAMP.pdf
5. http://www.bdu.ac.in/schools/biotechnology-and-genetic-engineering/biomedical-science/docs/course_materials/Biotechniques/Electrophoresis.pdf
6. https://ehs.psu.edu/sites/ehs/files/lsc_theory_of_operation_part_1.pdf
7. <https://www.youtube.com/watch?v=kOCcmJ3nVQ4>

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity.

Course Designer

Dr.N.Sathammai Priya

Semester : I	Internal Marks:25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	CREDITS
22PMB1DSE1B	ORGANIC FARMING	DISCIPLINE SPECIFIC ELECTIVE	6	4

Course Objective

- This course aims at sensitizing the need and generating knowledge and skills on various organic farming practices, so as to equip the learners carrying out organic agricultural production and management.

Prerequisites

Basic knowledge and concepts of organic farming

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand the origin and importance of organic farming	K1, K2
CO2	Analyze and apply the methods in Organic Crop Production	K3, K4
CO3	Determine and Explain the methodology practiced in organic farming	K3, K4
CO4	Evaluate and categorize various organic farming system and crop protection practices	K4, K5
CO5	Criticize and manage the commercialization of organic products	K5, K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	3	2	3	2	2	1
CO2	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	2	2	3	2	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3

“1” – Slight (Low) Correlation

“3” – Substantial (High) Correlation

“2” – Moderate (Medium) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Introduction - Different concepts of organic farming – Natural farming, Biodynamic farming, and Zero Budget Farming. Principles of organic farming- Conventional farming v/s Organic farming. Benefits and Need for organic farming.	15	CO1, CO2, CO3,	K1, K2, K3, K4,
II	Development and Scope of organic farming; Requirements for organic farming-Soil fertility, Crop Nutrition & Nutrients inputs. Organic Crop Production Systems. Benefits of Integrated organic farming system.	15	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
III	Green manuring- Composting- principles, stages, types and factors, Composting methods –Vermicomposting- and Preparation of Vermi wash, Organic amendments and sludges. Biofertilizers and their types- methods of application- advantages and disadvantages. Seed Propagation-planting materials and seed treatments, Water management -drip irrigation -rain water harvesting.	15	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	Plant protection- Integrated Pest Management- bio pesticides and Herbal pesticides- production at household/ farm level, Agniastra, Neemastra - mode of application-advantages. Biocontrol agents. Weed management- preventive practices, biological control of weeds, mechanical control, Standards for organic inputs, crop rotation-intercropping- Mulching-Pruning.	15	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,
V	Seed conservation- techniques- seed bank. Farm inspection and Process of Certification. Quality analysis of organic foods-Standards of organic foods- Organic Trademark-Marketing of Organic products. Economics of Organic Farming and Government schemes related to organic farming.	15	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,
VI	Self Study for Enrichment (Not included for End Semester Examinations) Farming components and preparation of organic nutrients. Preparation of Bio	-	CO1, CO2, CO3, CO4,	K1, K2, K3, K4,

	fertilizers - Bio pesticides and formulations. Study on crop rotation and mixed cropping techniques.		CO5,	K5, K6,
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Text Books

1. Joanne M Willey, Kathleen M Sandman and Dorothy H Wood. (2019). *Prescotts Microbiology*, McGraw-Hill, 11th Edition.
2. Unni M Rand Sabu Thomas. (2018). *Organic Farming Global Perspectives and Methods*. 1st Edition. Wood head Publishing.
3. Amitava Rakshit and H B Singh. (2018). *ABC of Organic Farming*. 1st Edition. Jain Brothers.
4. Maliwal P.L. (2019). *Principles of Organic Farming*. 1st Edition. Scientific Publishers.
5. Govind Mishra Munish Kumar Verma, Ajeet Singh. (2019). *Organic farming*. 1st Edition. Sankalp Publication.

Reference Books

1. Bansal M. (2020). *Basics of Organic Farming*. 1st Edition. CBS publishers and Distributors Pvt. Ltd.
2. Janet Wilson. (2020). *Composting: Sustainable and Low- Cost Techniques for Beginners*. 1st Edition, Drip Digital Publisher.
3. Debabrata Biswas, Shirley A. Micallef. (2019). *Safety and Practice for Organic Food*. 1st Edition. Academic press Elsevier Science.
4. Vinaya Kumar Sethi. (2018). *Organic farming and bio-fertilizers*. 1st Edition. Discovery Publishing House Pvt. Ltd.

Web References

1. <https://www.24mantra.com/blogs/organic-farming-vs-conventional-farming-which-method-is-better/>
2. <https://www.onlinebiologynotes.com/biofertilizer-advantages-types-methods-of-application-and-disadvantages/>
3. <https://www.britannica.com/topic/seed-propagation>
4. <https://content.ces.ncsu.edu/extension-gardener-handbook/8-integrated-pest-management-ipm>
5. <https://www.agric.wa.gov.au/small-landholders-western-australia/marketing-organic-produce>
6. <https://youmatter.world/en/definition/organic-farming-definition-standards-benefits/>
7. <https://vikaspedia.in/agriculture/national-schemes-for-farmers/schemes-for-organic-farming>

Pedagogy

Chalk and Talk, Assignment, Seminar and Group Discussion.

Course Designer

Dr. S. Jenny

Semester: I	Internal Marks:25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB1DSE1C	MICROBIAL CYTOLOGY	DISCIPLINE SPECIFIC ELECTIVE	6	4

Course Objective

To introduce basics in prokaryotic and eukaryotic cell structures and its functions

Prerequisites

Microscopic and submicroscopic details of microorganisms.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Remember and analyze the main principles of cells theory	K1 K4
CO2	Outline view of cells	K2
CO3	Identify the Structural and functions of cells	K3
CO4	Analyze and compare the cell division and its functions	K4, K5
CO5	Discuss about the Microbial cell Communication	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2	3	3	2	2	1
CO2	3	2	2	2	3	3	2	2	2	2
CO3	2	3	2	3	2	2	3	2	3	2
CO4	3	2	3	3	2	3	3	2	2	2
CO5	2	3	3	2	3	2	3	3	2	2

“1” – Slight (Low) Correlation

“3” – Substantial (High) Correlation

“2” – Moderate (Medium) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	History of microbial cytology, Cell-definition and general concepts, Main principles of the cell theory, cell as basic unit of life, broad classification of cell types-Prokaryotic and eukaryotic cells and their similarities and differences.	15	CO1, CO2, CO3	K1, K2, K3, K4
II	Structure and function of prokaryotic cell-outer flagella, surface layers, cell wall, cytosol and other organelles, chromosome and extra chromosomal DNA.	15	CO1, CO2, CO3, CO4,	K1, K2, K3, K4
III	Structure and function of eukaryotic cell-cytosol,nucleus,chloroplast,organelles of Vesicular trafficking system, endoplasmic reticulum(rough and smooth), golgibodies, lysosomes and microbodies.	15	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5, K6.
IV	Role of cell cycle and control of cell cycle, cell division- Mitosis and Meiosis.	15	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5
V	Overview- types of cell signaling- signal molecules – signal amplification – receptor types-quorum sensing.	15	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5, K6
VI	Self study for Enrichment(Not included for End Semester Examination) State the cell theory of organisms, Difference between prokaryotic and eukaryotic cell, Cell cycle control mechanism, Role of signal transduction.	-	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5

Text Books

1. Verma P.S. and Agarwal V.K. (2016) *Cell Biology (Cytology, Biomolecules, Molecular Biology)*, Paperback.S.Chand and Company Ltd.
2. Kumar P. and Mina U. (2018) *Life Sciences: Fundamentals and Practice, Part-I, 6th Edition*.Pathfinder Publication.
3. Hardin J. and Bertoni G. (2017) *Becker's World of the Cell. 9th Edition (Global Edition)*. Pearson Education Ltd.
4. Karp G., Iwasa J. and Masall W. (2015) *Karp's Cell and Molecular Biology – Concepts and Experiments. 8th Edition*. John Wiley and Sons.

5. Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) *Campbell Biology in Focus*. Pearson Education.

Reference Books

1. Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. (2018) *Essential Cell Biology 5th Edition*. W.W. Norton & Company.
2. Cooper G.M. and Hausman R.E. (2016) *The Cell – A Molecular Approach, 7th Edition*. Sinauer Associates Inc.
3. Mason K.A., Losos J.B. and Singer S.R. (2011) *Raven and Johnson's Biology, 9th Edition*. Mc Graw Hill publications.
4. Alberts B., Johnson B., Lewis J., Morgan D., Raff M., Roberts K. and Walter P. (2015) *Molecular biology of cell, 6th Edition*. Garland Science, Taylor and Francis.
5. Challoner J. (2015) *The Cell: A visual tour of the building block of life*. The University of Chicago Press and Ivy Press Ltd.

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1. <https://repository.embuni.ac.ke/bitstream/handle/123456789/1246/CYTOLOGY%20CHAPTER%201.pdf?sequence=1&isAllowed=y>
2. <https://biologydictionary.net/prokaryotic-cell/>
3. <https://opentextbc.ca/biology2eopenstax/chapter/eukaryotic-cells/#:~:text=Like%20a%20prokaryotic%20cell%2C%20a,that%20allow%20for%20compartmentalizing%20functions.>
4. <https://ncert.nic.in/textbook/pdf/kebo110.pdf>
5. <https://www.mdpi.com/2079-6382/9/11/779/pdf>

Pedagogy

Chalk and talk Quiz, Assignments, Group Discussions, Demo and PPT

Course Designer

Dr.E.Priya

Semester: II	Internal Marks: 25	External Marks: 75		
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB2CC4	BACTERIOLOGY AND MYCOLOGY	CORE COURSE	6	5

Course Objectives

The course aims to impart the knowledge of structural, physiological, genetic, and growth characteristics of bacteria and fungi.

Prerequisites

Salient Cognizance on Bacteria and Fungi.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Understand the principles of microbial growth kinetics and methods to measure growth	K2
CO2	Analyze the archaeobacterial domain on the basis of cell content and phylogeny	K3
CO3	Categorize the cell wall composition for the classification of bacteria	K4
CO4	Determine Fungal Classification and culture media preparation	K5
CO5	Assess the criteria used for classification of fungi	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2	3	2	2	3	2

CO2	3	3	2	2	2	3	3	2	3	3
CO3	3	3	3	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	2

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Microbial Growth and Reproduction in bacteria: Prokaryotic cell cycle, chromosome replication and partitioning, growth cycle and mathematics of growth, phases of growth, calculation of generation time, measurement of microbial growth, measurement of cell mass, influence of environmental factors on growth, cultivation of anaerobic bacteria and accessing non-culturable.	18	CO1, CO2, CO3 CO4	K2, K3, K4, K5
II	Archaeobacteria : General characteristics and phylogenetic overview, genera belonging to Nanoarchaeota (Nanoarchaeum, Crenarchaeota (Sulfolobus, Thermoproteus), Korarchaeota, Euryarchaeota-Methanogens, Thermophiles, Halophiles and rhodopsin based phototrophy.	18	CO1, CO2, CO3, CO4	K2, K3, K4, K5
III	Classification of Eubacteria : morphology, metabolism, ecological significance and	18	CO1, CO2,	K2, K3,

	economic importance of eubacterial groups, Gram negative non proteobacteria, Gram negative Alpha proteobacteria, Beta proteobacteria, Gamma proteobacteria, Delta proteobacteria, Epsilon proteobacteria.		CO3, CO4	K4, K5
IV	General features of fungi- Various systems of classification of fungi. a. Ainsworth (1973) and b. Webster (1980). Micrometry : Study of micrometry and its significance in fungal taxonomy. Culture: Types of culture media and their preparation, special culture media.	18	CO1, CO4, CO5	K2, K5, K6
V	Criteria used in the classification of fungi: a. Morphology: External and Internal, b. Vegetative and Reproductive, c. Cytological and Genetics, d. Serological and Nutritional. e. Physiological and Biochemical, f. Host specificity, g. Ultrastructural and cultural.	18	CO1, CO4 , CO5	K2, K5, K6
VI	Self Study for Enrichment (Not included for End Semester Examinations) Classification of Eubacteria II : Gram positive: low G+ C (Firmicutes): general characteristics with suitable examples, Gram positive: high G+C (Actinobacteria), Cyanobacteria: an Introduction	-	CO1, CO2, CO3,	K2, K3, K4

Text Books

1. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley And David A. Stahl, Pearson. (2015). Brock Biology Of Microorganisms, Fourteenth Edition, Pearson, Boston.
2. Joanne, M. Willey, Linda, M. Sherwood, Christopher, J. Woolverton And Chris

Woolverton, Mc Graw Hill. (2011). Prescott, Harley, And Klein's Microbiology, Eighth edition.

3. De Vos P.(2012). Bergey's Manual of Systematic Bacteriology: Volume 3: The Firmicutes, Springer, Second Edition, Newdelhi
4. Alexopoulos,C.J, Mims, C.W, Blackwell, M.(2007).Introductory Mycology, Fourth Edition, Wiley & Sons.
5. Aneja, K.R and Mehrotra, R.S.(2018). An Introduction to Mycology, New Age International (P) Ltd., Publishers.

Reference Books

1. Griffiths, A. B.(2019). A Manual of Bacteriology, Forgotten Books.
2. Edgar M Crookshank,(2018). Manual of Bacteriology, Forgotten Books.
3. Arora and Brij Bala Arora. (2019).Medical Mycology, Second Edition, CBS.
4. Hait.(2017). A Textbook of Mycology, New Central Book Agency (NCBA); 1st edition, India.

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1. http://www.rvskvv.net/images/General-Bacteriology_23.04.2020.pdf
2. <https://www.eolss.net/sample-chapters/C03/E5-25-48.pdf>
3. <https://www.vnmueu.edu.ua/downloads/microbiology/20131218-135731.pdf>
4. https://www.uobabylon.edu.iq/eprints/publication_1_13183_803.pdf
5. <https://www.microrao.com/micronotes/mycology.pdf>

Pedagogy

Chalk and Talk, Assignment, Seminar and Group Discussion and Quiz.

Course Designer

Dr.N.Sathammai Priya

Semester : II	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB2CC5	IMMUNOLOGY AND IMMUNOTECHNOLOGY	CORE COURSE	6	4

Course Objective

The students will acquire the competency to serve as future teachers, trainers and researchers in the field.

Prerequisites

Understand and critically analyze the literature in the field of Immunology and its technical aspects in the field of Immunology.

Course Outcome and Cognitive Level Mapping.

CO Number	CO Statement	Cognitive Level
CO1	Explain the basics of immunology	K2
CO2	Illustrate the hypersensitivity reaction	K3
CO3	Categorize auto immunity and auto immune disease	K4
CO4	Intrepret transplantation and tumor immunology	K5
CO5	Discuss molecular immunology and immune diagnosis	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	3	2	3	3	3	3	3	3	3
CO3	3	2	3	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	2	3	3	2	3	3	3

1- Slight (Low) correlation 2- Moderate (Medium) correlation

3- Substantial (High) correlation “-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Basic Immunology: History of Immunology, Types of Immunity, Cells and organs involved in immune system (T-cells, B-cells, lymphoid organ, spleen and bone marrow), immune responses – cell mediated and humoral, Antigens, Cytokine, Haptens, adjuvants, Antibodies: their structure and functions, Complement system, Antigen processing cells, Classes of Immunoglobulin (IgA, IgG, IgD, IgM and IgE).	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	Hypersensitivity reaction: IgE-mediated (type-I), Ab-mediated cytotoxic (type-II), Immune complex mediated (type-III) and Delayed type hypersensitivity (type-IV).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Auto immunity and auto immune disease: (a) Organs specific autoimmune disease – Hashimoto's thyroiditis, Good pastures syndrome, Insulin dependent diabetes mellitus, Grave's disease, Myasthenia gravis. (b) Systemic autoimmune disease – systemic lupus erythematosus (SLE), Multiple sclerosis, Rheumatoid arthritis.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Transplantation and Tumor immunology: Transplantation and its classification, Immunologic basis of graft rejection and its	18	CO1, CO2, CO3,	K1, K2, K3,

	mechanism, Transplantation antigens, tissue typing role of MHC molecules in allograft rejection and immune suppressive therapy. Tumors of the immune system, tumor antigens and immune response to tumors, detection of tumor markers and tumor immunotherapy.		CO4, CO5	K4, K5, K6
V	Molecular Immunology and Immuno diagnosis Antigen antibody interaction – Precipitation reactions, Agglutination reactions, ABO Blood typing principles. Principles and applications of ELISA, Radio Immuno Assay, western blot analysis, immune electrophoresis, Immunofluorescence and chemiluminescence assay.	18	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6
VI	UNIT VI – Self study for Enrichment (Not included for End Semester Examination) Immunological memory, Non-allergic hypersensitivity, Nutrition and autoimmunity, Advances in tumor immunology and fluorescence activated cell sorting (FACS) analysis.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books

1. Coico R. and Geoffrey S. (2015) *Immunology: A Short Course. 7th Edition*. Wiley-Blackwell.
2. Singh R.P. (2015) *Immunology and Medical Microbiology. 2nd Edition*. Kalyani Publishers, New Delhi.
3. Talwar C.P. and Gupta S. K. (2017) *Hand Book of Practical and Clinical Immunology*. CBS Publishers & Distributors.
4. Shyamasree G. (2021) *Immunology and Immunotechnology. 2nd Edition*. Books & Allied Pvt.Ltd.
5. Gupta. S. K. and Goswani. B. (2021) *Immunology for MBBS*. APC Books.
6. Misbah S.A., Spickett G.P. and Dalm V.A.S.H. (2022) *Chapel and Haeney's Essentials of Clinical Immunology. 7th Edition*. Wiley-Blackwell.

Reference Books

1. Sudha G. and Shubhangi S. (2013) *Textbook of Basic and Clinical Immunology*. Universities Press (India) Pvt. Ltd.
2. Rich R., Fleisher T., Shearer W., Schroeder H., Frew A. and Weyand C. (2018) *Clinical Immunology: Principles and Practice*. Elsevier.
3. Abbas A.K., Lichtman A.H. and Pillai S. (2019) *Basic Immunology (Functions and Disorders of the Immune System)*. 6th Edition. Elsevier.
4. Punt J. (2019) *Kuby Immunology*. 8th Edition. Macmillan Learning.
5. Ian C Clift. (2020) *Clinical Immunodiagnostics: Laboratory Principles and Practices*. Jones & Bartlett Publishers.
6. Chakravarty A.K. (2021) *Immunology and Immunotechnology*. Oxford University Press.

Web References

1. <https://www.medicosrepublic.com/kuby-immunology-8th-edition-pdf-free-download/>
2. <https://muhammad1988adeel.files.wordpress.com/2011/04/kuby-immunology-6th-edition.pdf>
3. https://med-mu.com/wp-content/uploads/2018/06/Essentials-of-Clinical-Immunology-6E-Chapel-Haeney-Misbah_-Snowden.pdf
4. <https://www.wiley.com/en-us/Essentials+of+Clinical+Immunology%2C+Includes+Wiley+E+Text%2C+6th+Edition-p-9781118472958>
5. <https://www.flipkart.com/essential-clinical-immunology/p/itmcczzkduhtrf52d>

Pedagogy

Chalk and talk, Power Point Presentation, Quiz, Assignments, Group Discussions, Seminar, Assignment.

Course Designer

Dr. N. Jeenathunisa

Semester: II	Internal Marks: 25	External Marks: 75		
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB2CCC1A	MICROBIAL METABOLISM	CORE CHOICE COURSE	6	4

Course Objectives

This course deals with how to make microbes differentiate based on the metabolism and describe how microbes do catabolism to get energy and metabolism to build structure.

Prerequisites

Basic knowledge on Physiological processes of Microbes.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand the basic concepts of metabolism	K1,K2
CO2	Explain and analyze about the growth phases of Microbial populations	K3, K4
CO3	Analyze about Microbial respiration	K3, K4
CO4	Criticize about bacterial photosynthesis	K5, K6
CO5	Assess about microbial biosynthesis	K5, K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2	2	3	3	2	2
CO2	3	2	3	2	3	3	3	3	3	2
CO3	3	2	2	2	3	3	2	2	2	2
CO4	2	2	2	3	2	3	2	2	2	2

CO5	2	3	2	2	3	3	3	3	3	2
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“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-“indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Metabolism-Definition - specific functions and types- Anabolism versus Catabolism. Metabolic pathways – Linear, irreversible and branched metabolic pathways. Mechanisms of enzyme reaction – the role of ATP, reducing power and precursor metabolites in metabolism. Biochemical mechanisms of generating ATP. Components of electron transport chains - NAD, NADP, FAD, FMN, Coenzyme-Q, Cytochromes..	18	CO1, CO2, CO3	K1, K2, K3, K4,
II	Microbial Growth- Phases of growth, Growth kinetics - batch culture, continuous culture and synchronous culture - induction of synchrony. Factors affecting growth - nutrition, aeration, temperature and pH. Physiological adaptation to extreme environmental conditions. Nutritional types and metabolic diversity - types based on carbon, energy and electron sources. Measurement of cell numbers, cell mass and metabolic activity.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	Respiration- Aerobic respiration: glycolysis, Pentose Phosphate pathway, TCA cycle. Glyoxylate cycle. Respiratory electron	18	CO1, CO2, CO3, CO4	K1, K2, K3,

	transport in mitochondria and bacteria. Anaerobic respirations: sulfate, nitrate, carbonate respirations and their ecological significance. Intracellular location and reactions, Amphibolic reactions.			K4, K5
IV	Bacterial Photosynthesis - Brief account of photosynthesis – oxygenic and anoxygenic photosynthesis. fixation of CO ₂ - Calvin cycle - C ₃ -C ₄ pathway. Chemolithotrophic oxidations - Sulfur, Iron, Hydrogen and Nitrogen oxidations. Methanogenesis, Basic aspects of bioenergetics – entropy, enthalpy, equilibrium constant, electron carriers, artificial electron donors, inhibitors, uncouplers, energy bond, phosphorylation.	18	CO ₁ , CO ₂ , CO ₃ , CO ₄ , CO ₅	K1, K2, K3, K4, K5, K6
V	Microbial Biosynthesis-Biosynthesis of Peptidoglycan, Biopolymers, Amino acids, Fatty acids, Vitamins and their regulations. Assimilation of Nitrogen, Sulfur, Phosphorus.	18	CO ₁ , CO ₂ , CO ₃ , CO ₄ , CO ₅	K1, K2, K3, K4, K5,K6
VI	Self Study for Enrichment (Not included for End Semester Examinations) Bioluminescence: Bioluminescent bacteria and its importance. Biochemistry of Luciferin- Luciferase along with the lux operon (genes).	-	CO ₁ , CO ₂ , CO ₃ , CO ₄ , CO ₅	K1, K2, K3, K4, K5,K6

Text Books

- 1.Satyanarayana, U. and Chakrapani, U. (2013) Biochemistry, Fourth Edition. Book and Allied Pvt, Kolkata.
- 2.Stryer L. (2010) Biochemistry Seventh Edition. W.H. Freeman and Company, New York.
3. Monika Rustugi (2016).Bacterial Metabolism . Meditech.

4. Anadhi, D. (2014). Introduction to Biochemistry and Metabolism. Pearson Education India

Reference Books

1. Tyrrell Conway, Paul S. Cohen. (2015) Metabolism and Bacterial Pathogenesis. ASM Press.
2. Rabus, R. (Oldenburg) Saier Jr., M.H. (La Jolla, CA. (2022). Microbial Physiology. Karger Publication.
3. Walid El Sharoud. (2011). Bacterial Physiology: A Molecular Approach. Springer.
4. G.N.Cohen.(2011). Microbial Biochemistry.Springer.

Web References

1. <https://download.e-bookshelf.de/download/0000/5838/44/L-G-0000583844-0002360696.pdf>
2. <https://www.perlego.com/book/2771785/microbial-physiology-pdf>
3. <https://www.slideshare.net/cavoyc/physiology-of-microorganism-1>
4. <https://byjus.com/biology/metabolism/>
5. <https://www.britannica.com/science/metabolism>

Pedagogy

Chalk and Talk, Assignment, Seminar and Group Discussion, Quiz.

Course Designer

Ms.S.Sathya

Semester : II	Internal Marks:25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB2CCC1B	ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	CORE CHOICE COURSE	6	4

Course Objective

To enable the students to get exposure on relationship between microbes and nature, its roles and its utilization for the creation of sustainable environment and their concepts, Biofertilizer role, Biogeochemical cycles and Plant diseases.

Prerequisites

Basic knowledge about Environment and Agricultural systems.

Course Outcomes and Cognitive Level Mapping

COs	CO Statement	Cognitive level
CO1	Define the basic view of air Microorganisms	K1
CO2	Explain the Microbial association in water	K2
CO3	Discuss about water pollution and water quality	K6
CO4	Understand the production of Biofertilizer	K4
CO5	Discuss about Plant diseases & Control measures	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	2	3	3	3	3	3	3	2	3
CO3	2	3	3	3	3	3	3	2	3	3
CO4	3	3	2	3	3	3	3	3	3	2
CO5	3	3	3	3	2	3	2	3	3	3

“1”- Slight (Low) correlation “2”- Moderate (Medium) correlation

“3”- Substantial (High) correlation “-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Air microbiology: Significance of air microflora-Microbial air pollution-sources, biological indicators and effects on plants and human beings. Enumeration of bacteria from air. Air borne diseases. Role of microbes in biogeochemical cycles – carbon, nitrogen, phosphorus, sulphur.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	Microbes in marine and fresh water environment – eutrophication – Biodegradation and bioaccumulation – bioremediation concepts, microbial and phytoremediation – composting – solid waste treatment – saccarification and pyrolysis.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4
III	Water pollution – sources and nature of pollutants in water – sewage – treatment of liquid waste – primary, secondary and tertiary treatment – water borne diseases – Assessment of water quality – BOD and COD determinations.	18	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5, K6.
IV	Microbial association – beneficial – nitrogen fixing organism – symbiosis, asymbiosis, associate symbiosis – bacteria, Actinomycetes, cyanobacteria – mycorrhiza – ecto, endo and ectendo mycorrhiza – phosphate solubilizers – application of biofertilizers in agriculture. Biology of nitrogen fixation – genes and regulations in Rhizobium.	18	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5

V	Plant pathogens – bacterial – viral – fungal pathogens. Morphological, physiological changes with reference to disease establishment in plants – plant protection – phenolics – phytoalexins and related compounds. Bioinsecticides – viral, bacterial and fungal.	18	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5, K6
VI	Self Study for Enrichment (Not included for End Semester Examination) Soil microbes and fertility of soil. Bioaugmentation, Xenobiotics degradation. Plant growth promoting rhizobacteria (PGPR). Role of biofertilizer in integrated nutrient management.	-	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5

Text Books

1. Bibhuti Bhusan Mishra, Suraja Kumar Nayak, Swati Mohapatra, Deviprasad Samantaray (2021). *Environmental and Agricultural Microbiology: Applications for Sustainability*. Wiley-Scrivener; 1st edition.
2. Robert L.Tate (2020). *Soil Microbiology*. John Wiley & Sons 3rd edition.
3. Subba Rao (2020) *Soil Microbiology*. Oxford Publishing.
4. Mangesh Y Dudhe (2020). *Agriculture- Microbiology*. New Vishal Publications.
5. Krishnendu Acharya, Surjit Sen and Manjula Rai (2019) *Biofertilizers and Biopesticides*. Techno World.
6. Aneja (2017) *Fundamental- Agricultural Microbiology*. New Age International (P) Ltd Publishers.

Reference Books

1. Pareek and Navneet Pareek (2019). *Agricultural Microbiology*. Scientific Publishers.
2. Paul (2015). *Soil Microbiology, Ecology and Biochemistry*. Academic Press.
3. Trivedi (2015). *Agriculture Microbiology and Microbial Applications*. Pointer Publishers.
4. Gupta, S.K.(2014) *Approaches and trends in plant disease management*. Scientific publishers.
5. Jamaluddin (2013) *Microbes and sustainable plant productivity*. Scientific Publishers.

Web References

1. <https://www.tandfonline.com/doi/abs/10.1080/10643387409381619?journalCode=best18>
2. <https://forages.oregonstate.edu/nfgc/eo/onlineforagecurriculum/instructormaterials/availabletopics/nitrogenfixation/definition>
3. <https://cropwatch.unl.edu/soybean-management/plant-disease>
4. <https://www.biologydiscussion.com/biotechnology/biodegradation/biodegradation-and-bioremediation-with-diagram/11043>
5. <https://thebiologynotes.com/biopesticides/>

Pedagogy

Chalk and talk, Power point presentation, Group Discussion, Seminar, Quiz, Assignment.

Course Designer

Ms.K.Sangeetha

Semester: II	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs/WEEK	CREDITS
22PMB2CCC1C	MICROBIAL ECOLOGY	CORE CHOICE COURSE	6	4

Course Objective

To create awareness on evolutionary relationship of ecosystem and its interactions. To understand the concepts of community ecology and strategies for biodiversity conservation.

Prerequisite

Basic Knowledge of Ecological concepts

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Examine basic concept of ecosystem	K4
CO2	Determine the microorganisms and their natural habitats	K4
CO3	Evaluate the environmental pollution	K5
CO4	Diagnose waste management system	K5
CO5	Extend the biodiversity and its conservation	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	2	3
CO2	3	3	2	3	2	3	3	2	3	2
CO3	3	2	3	3	2	2	3	3	3	2
CO4	2	3	2	3	3	3	3	3	2	3
CO5	2	3	3	2	3	3	2	3	3	2

“ 1”- Slight (Low) correlation “2”- Moderate (Medium) correlation

“ 3”- Substantial (High) correlation “-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	History, significance, principle, scope and development of microbial ecology. Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation. Biological Interactions: Microbe–Microbe Interactions, Microbe–Plant Interactions, Microbe–Animal Interactions. Ecological succession: mechanisms; concept of climax.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	Ecosystem – structure and functions. Abiotic and biotic components. Energy flow, food chain, food web, ecological pyramids and types. Terrestrial Environment: Soil characteristics, Soil profile, Soil formation, Soil as a natural habitat of microbes, Soil microflora. Aquatic Environment: Stratification & Microflora of Freshwater & Marine habitats. Atmosphere: Stratification of the Atmosphere.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4
III	Environmental pollution-Air pollution: Sources and classification of major air pollutants; Noise pollution- concept and effects. Soil pollution: sources and types of soil and water pollutants; effect of pollutants on soil health and productivity; Radioactive pollutants, their lifetime and disposal; Water pollution: major sources and types of water pollutants; pollution in fresh and sea water bodies. Efficient	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6.

	microbes in Pollution control. Climate change: Global warming and green house effects.			
IV	Waste management- Solid and liquid wastes. Physical, chemical and biological properties of wastes; Effluent treatment- sewage and other agro-industrial wastes; Biomagnification and its impact on loss of biodiversity. Biodegradation and Bioconversion of organic wastes; Microbiological and public health aspects of waste disposal; heavy metal contamination of environments. Source and sinks of heavy metals	18	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5
V	Biodiversity- concepts, levels and types; strategies for biodiversity conservation. Biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Principles of conservation- <i>in-situ</i> and <i>ex-situ</i> . Major approaches to management. Miyawaki forest.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	Self study for Enrichment (Not included for End Semester Examination) Ecological succession-types, Aero microflora, dispersal of microbes. Sources and sinks of greenhouse gases, Acid rain. E-waste management. Biodiversity hot spots in India and world.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Books

1. Joseph C Daniel(1999). *Environment Aspects of Microbiology 1st Edition*. Bright sun Publications, Chennai.
2. Vaun Mc Arthur (2009). *Microbial Ecology – An Evolutionary approach*. Elsevierpublications, Academic press.
3. Saha, T.K (2010). *Ecology and Environmental Biology*. Books and Allied Pvt. Ltd.

Kolkata.

4. Edward J Kormandy (2017). *Concepts of Ecology*. Pearson India
5. P.D.Sharma (2018). *Fundamentals of Ecology*. Rastogi Publications.
6. Vaishali Anand (2020). *Environment and Ecology*. Mc Graw Hill.

Reference Books

1. Atlas, R.A and Bartha, R (2000). *Microbial Ecology, Fundamentals and Application*. Benjamin Cummings, New York.
2. Nduka Okafor. (2011). *Environmental Microbiology of Aquatic and Waste Systems*. Springer Dordrecht Heidelberg London New York
3. Ian Pepper Charles Gerba Terry Gentry (2014). *Environmental Microbiology 3rd Edition*. Academic press. USA.
4. Prescott, L.M., Harley, J.P. and Helin D.A. (2017). *Microbiology 10th Edition*. McGraw Hill, New York.

Web References

1. <https://study.com/learn/lesson/metapopulation-concept-model.html>
2. <https://study.com/academy/lesson/what-is-a-terrestrial-ecosystem-definition-examples-types.html>
3. <https://microbiologysociety.org/blog/bioremediation-the-pollution-solution.html#:~:text=Currently%2C%20microbes%20are%20used%20to,processes%20known%20as%20'bioremediation'.&text=Bioremediation%20uses%20micro%2Dorganism%20to,pollutants%20into%20non%2Dtoxic%20substances.>
4. <https://www.biologydiscussion.com/biodiversity/biodiversity-concept-types-and-other-details-with-diagram/7132>
5. <https://www.intechopen.com/chapters/45093>

Pedagogy

Chalk and talk, Power point presentation, Group Discussion, Seminar, Quiz, Assignment.

Course Designer

Ms.K.Sangeetha

Semester: II	Internal Marks: 40	External Marks: 60		
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	CREDITS
22PMB2CC2P	BACTERIOLOGY, MYCOLOGY, IMMUNOLOGY AND IMMUNOTECHNOLOGY PRACTICAL	CORE PRACTICAL	6	4

Course Objective

To impart knowledge about pure culture, staining & immuno techniques.

Prerequisites

Basic knowledge and concepts of bacteriological, mycological and immunological techniques.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Analyze the Growth nature of organisms	K4
CO2	Assess the staining techniques	K5
CO3	Evaluate on bacterial motility	K5
CO4	Determine ABO blood grouping	K5
CO5	Compiled view of immune techniques	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	2	3	3	2	2	3	2	3	3
CO3	3	2	2	3	3	3	2	3	3	2
CO4	2	3	3	2	3	3	3	2	3	2
CO5	3	3	2	3	2	3	3	3	2	2

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

Syllabus

S. No	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	BACTERIOLOGY	45	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,
1.	Preparation of culture media for cultivation of bacteria from air, water & soil			
2.	Pure culture techniques – dilution-plating, Streak-plate, Spread-plate, Pour-Plate			
3.	Staining Techniques –Simple and Differential (Gram Staining and Spore Staining)			
4.	Hanging drop method			
II	MYCOLOGY			
5.	Preparation of culture media for cultivation of fungi			
6.	Isolation and identification of major classes of fungi			
7.	KOH Mount, LCB Mount			
III	IMMUNOLOGY & IMMUNOTECHNOLOGY	45	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,
8.	ABO blood grouping.			
9.	Perform Total Leukocyte Count of the given blood sample.			
10.	Perform Differential Leukocyte Count of the given blood sample.			
11.	Separation of serum from the blood sample.			
12.	Perform immunodiffusion by Ouchterlony method.			
13.	Perform single radient immunodiffusion			
14.	Perform DOT ELISA.			
15.	Perform immuno electrophoresis			

Reference Books

1. Arora. D. R and Brij Bala Arora. (2019). Medical Mycology. Second Edition. CBS Publisher.
2. Punt J. (2019) *Kuby Immunology. 8th Edition*. Macmillan Learning.

3. Ian C Clift. (2020) *Clinical Immunodiagnostics: Laboratory Principles and Practices*. Jones & Bartlett Publishers
4. Elsa Cooper, (2018). *Microbial Physiology: A Practical Approach*. Callisto Reference.
5. Gerhard Gottschalk, (2020). *Bacterial Metabolism*. Springer.

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1. <https://fccljohnson.files.wordpress.com/2012/10/kim-and-gadd-bacterial-physiology-and-metabolism-b-h-kim-g-m-gadd-cambridge-university-press-2008.pdf>
2. <https://medicine.yale.edu/labmed/sections/immunology/>
3. <https://aacijournal.biomedcentral.com/articles/supplements/volume-14-supplement-2>
4. <https://vlab.amrita.edu/?sub=3&brch=73&sim=1105&cnt=6>

Pedagogy

Chalk and Talk, demo and hands-on.

Course Designer

Dr. R. Nithyatharani

“1” – Slight (Low) Correlation
 “3” – Substantial (High) Correlation

“2” – Moderate (Medium) Correlation
 “-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Biofertilizers–characteristics-types- Bacterial, Fungal, Algal and Actinorhizal, Plant Growth Promoting Rhizobacteria (PGPR). Advantages and limitations of biofertilizers.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5,K6
II	Bacterial biofertilizer-production and application of <i>Rhizobium</i> , <i>Azospirillum</i> , <i>Azotobacter</i> and <i>Glucano acetobacter</i> . <i>Rhizobium</i> nodule formation- Mechanism-biochemistry of Nitrogen fixation. Phosphate solubilizing bacteria- phosphate solubilizers, phosphate mobilizers-mechanism of phosphate solubilization.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5, K6
III	Fungal biofertilizer - Mycorrhizae- AM and VAM fungi and its types- production. Actinorhizal biofertilizer- Frankia- <i>Casuarina</i> symbiosis- Frankia characters and their importance.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5, K6
IV	Algal biofertilizer -Blue green algae- characteristics, production and application. Azolla –cultivation and application.	18	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5,K6,
V	Biocontrol agents- characteristics - <i>Pseudomonas</i> , <i>Trichoderma</i> . Bioinsecticides- <i>Bacillus thuringiensis</i> , <i>Verticillium</i> , <i>Beauveria</i> , <i>Metarhizium</i> . Biopesticides.	18	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5,K6,
VI	Self Study for Enrichment (Not included for End Semester Examinations) Liquid biofertilizer production- application methods. Field visits	-	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,

Text Books

1. ReetaKoshla, (2017). Biofertilizers and biocontrol agents for organic farming. Kojo Press.
2. Hyma. P, (2017). Biofertilizers: Commercial production Technology and Quality Control. Random Publications.
3. Bikas. R. Pati, (2016). Recent Trends in Bio-fertilizers. I.K. International.
4. Dr. K. Kumar, K. Govindarajan, S.Kumarkannaiyan (2010) Biofertilizer Technology Scientific Publisher (India).

Reference Books

1. Dinesh K Maheswari, (2012). Bacteria in agrobiolgy. Springer Heildelberg, New York.
2. Mahendra K Rai, (2015). The Handbook Microbial Biofertilizers 9th edition. Haworth Press, Inc. New York.
3. BoopanderGiri, Ram Prasad, Qiang-Sheng Wu, Ajit Varma, (2019). Bio-fertilizers of sustainable agriculture and environment. Springer.
4. AmitavaRakshit, Vijay Meena, Manoj Parihar, H.B. Singh, A.K.Singh, (2021). Bio-fertilizers. Elsevier

Web References

- 1..https://www.researchgate.net/publication/323185331_Role_of_Biofertilizers_in_Agriculture
- 2..https://www.researchgate.net/publication/225980699_Bacterial_Biofertilizers
- 3..<https://www.fungaldiversity.org/fdp/sfdp/FD38-2.pdf>
- 4..<https://annamalaiuniversity.ac.in/studport/download/VAC%20Syllabus/VAAG%20011.pdf>
- 5..<https://www.apsnet.org/edcenter/disimpactmngmnt/topc/Documents/PHI-BiologicalControl.pdf>6..[https://www.fehd.gov.hk/english/pestcontrol/images/Pestnews_45e\(text\).pdf](https://www.fehd.gov.hk/english/pestcontrol/images/Pestnews_45e(text).pdf)

Pedagogy

Chalk and Talk, Assignment, Seminar and Group Discussion.

Course Designer

Dr. R. Nithyatharani

Semester : II	Internal Marks: 25	External Marks: 75		
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB2DSE2B	PUBLIC HEALTH MICROBIOLOGY	DISCIPLINE SPECIFIC ELECTIVE COURSE	6	4

Course Objectives

This course deals with the microbes related to public health and to gain knowledge about the medically important human microbial pathogens with focus on the diseases caused by them, disease pathogenesis, lab diagnosis, prophylaxis, control measures.

Prerequisites

Basic knowledge about diagnosis and treatment methods for various microbial infections.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and examine the basic ideas about microbial association	K1,K4
CO2	Diagnose and analyze various airborne disease	K3,K4
CO3	Determine the water borne diseases and its control	K1,K4
CO4	Evaluate and discuss about the role of microorganisms in food	K3,K5
CO5	Extend the diagnosis hospital acquired Infections	K2,K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3	3	3	3	2	3
CO2	2	3	2	3	3	3	2	3	3	3
CO3	3	2	3	3	3	3	2	3	2	3
CO4	3	2	2	2	2	3	2	2	2	3
CO5	3	2	3	3	2	2	3	3	3	3

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Introduction to public health: Definition, scope, concept and importance of public health microbiology – roles of microbiologist in public health – microbial association of water, air and soil. Basic concept on pollution and its types.	18	CO1, CO2, CO3	K1, K3, K4
II	Air borne infections: Air and its composition – indoor air and outdoor air. Air borne diseases- (bacterial, fungal and viral), Sources of infection. Methods of enumeration of microorganisms in air – air sanitation.	18	CO1, CO2, CO3, CO4	K1, K3, K4, K5
III	Water borne infections: Kinds of water – water borne diseases (viral, bacterial, protozoan) – methods of enumeration of microorganisms in water – indicator organisms – water treatment control of water borne diseases.	18	CO1, CO2, CO3, CO4	K1, K3, K4, K5
IV	Food borne diseases: Definition and importance of food hygiene – types (spoilage of meat and its products, milk and dairy products, fish and fish products and eggs) – Role of microorganisms in food spoilage and poisoning – food borne diseases – types of food borne diseases – food poisoning – food borne infection. Principles of Food microbiological analysis.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Nosocomial infection: Introduction and its types, pathogenicity of nosocomial infection, prevention and control of nosocomial infections. Prophylactic immunization – disposal of infective hospital and laboratory materials – monitoring of sanitation in the community – techniques used	18	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5, K6

	for the diagnosis of hospital acquired infection.			
VI	Self Study for Enrichment (Not included for End Semester Examinations) Classification of Medically important Microbes.	-	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5, K6

Text Books

1. Patrick R. Murray, Ken S. Rosenthal, and. Michael A. Pfaller.(2012).Medical Microbiology. Elsevier Health Sciences.
2. Keith Struthers.J.(2017).Clinical Microbiology. Taylor& Francis Group.
3. Sastry Apurba.S.(2021).Essentials of Microbiology. Jaypee Brothers Medical Publishers
4. Gerard Tortora (Author), Berdell Funke (Author), Christine Case.(2022).Microbiology An Introduction. Pearson Mastering.

Reference Books

1. Joanne Willey, Christopher J. Woolverton, Linda Sherwood (2011).Prescott's Microbiology. McGraw Hill
2. Park.K.(2017).Parks Text Book of Preventive and Social Medicine.
3. Goering, Hazel Dockrell, Mark Zuckerman, Peter Chiodini.(2018).Mim's Medical Microbiology and Immunology
4. Engelkirk.P.K. and Duben-Engelkirk.J.(2015).Burton's Microbiology for the Health Sciences,10th Edn.Wolters Kluwer Health.

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1. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/env_occupational_health_students/medicalbacteriology.pdf
2. <https://ysmubooks.am/uploads/Microbiology.pdf>
3. <https://www.slideshare.net/MMASSY/intro-to-medical-microbiology-lecture-notes>
4. http://samples.jbpub.com/9781284032314/9781284032314_ch01_001_016.pdf

Pedagogy

Chalk and Talk, Assignment, Seminar and Group Discussion, Quiz.

Course Designer

Ms.S.Sathya

Semester: II	Internal Marks:25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WE EK	CREDITS
22PMB2DSE2C	MARINE MICROBIOLOGY	DISCIPLINE SPECIFIC ELECTIVE	6	4

Course Objective

This course deals with the study of microorganisms in sea environment including their biodiversity, ecology and biogeochemistry, so as to equip the learners to understand the microbial diversity in marine environment.

Prerequisites

Basic knowledge and concepts of Marine microbial diversity.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand the marine microbes and kingdom concepts	K1, K2
CO2	Analyze and apply the role of microbes in seawater habitats	K3, K4
CO3	Determine and Explain the Biogeo chemical processes in marine systems	K3, K4
CO4	Evaluate and categorize various application of marine microbial products	K4, K5
CO5	Criticize and manage the Biodegradation methods for marine pollutants	K5, K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	3	2	3	2	2	1
CO2	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	2	2	3	2	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Marine Microbes- Classification- Haeckel's three kingdom, Whittaker's five kingdom, Carl Woese three domain concepts. Marine bacteria and Archaea, Marine fungi, and Marine viruses.	18	CO1, CO2, CO3,	K1, K2, K3, K4,
II	Marine Habitats- Role of microbes in sea water habitats- coastal, intertidal, estuaries, shores, salt marsh, mangrove, lagoon, coral reef, deepsea, hydrothermal vents. Sea weeds, Sea grasses, Kelp forest and uses. Marine Microbial food web.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
III	Marine Biogeochemistry- Chemical and physical factors in the marine environment- Properties of seawater. Biogeochemical processes in marine systems- carbon, nitrogen, oxygen, sulfur and phosphorous cycle.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	Marine Microbial Products- Marine microbes of Biotechnological importance; Marine hydrocolloids (Agar, Agarose, Carrageenan and Alginate), Marine drugs- bioactive compounds, Marine Nutraceutical- functional foods.	18	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,
V	Marine Pollution- Sources- domestic, industrial and agricultural discharges- oil pollution- thermal and radioactive pollution. Biodegradation and bioremediation of marine pollutants. Biofouling- biofilm formation- related microbes- control & prevention methods.	18	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,
VI	Self Study for Enrichment (Not included for End Semester Examinations) Extremophiles- biotechnological applications. Marine flora & fauna. Composition of sea water and brackish water. Antifouling coating- production.	-	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,

TextBooks

1. Verma Divya, (2022). Marine Microbiology Ecology and Application. 1st Edition. Bio-Green Publishers
2. Colin B. Munn. (2019). Marine Microbiology. 3rd Edition. CRC PressPublishers.
3. Steffi P. F. Rajeswari Anburtaj. (2020) A Textbook on Marine Microbiology. 1st Edition. Ryan Publishers.
4. Se-Kwon Kim. (2013). Marine Microbiology Bioactive Compounds and Biotechnological Applications. 1st Edition. John Wiley Publishers.

ReferenceBooks

1. Anjana K. Vala, Bharti P. Dave, Dushyant R. Dudhagara. (2021).Marine Microbial Bioremediation. 1st Edition. CRC PressPublishers.
2. Lucas J. Stal, Mariana Silvia Cretoiu. (2022). The Marine Microbiome. 1st Edition. Springer Nature.
3. Aparna Gunjal, Sonali Shinde. (2021). Microbial Diversity and Ecology in Hotspots.1st Edition. Elsevier Science.
4. Milton Fingerman.(2020). Recent Advances in Marine Biotechnology. 1st Edition. CRC Press Publishers.

Web References

1. <https://ocean.si.edu/ocean-life/microbes/marine-microbes>
2. <https://www.slideshare.net/LeiramSejram/marine-habitats>
3. <https://byjus.com/biology/biogeochemical-cycles/>
4. <https://www.slideshare.net/SudheerKandibanda/marine-drugs-56601492>
5. <https://www.slideshare.net/ShaiikhMuzahim/marine-nutraceuticals>
6. <https://byjus.com/free-ias-prep/marine-pollution/>
7. http://www.marinebiotech.eu/wiki/Bioremediation_of_marine_ecosystems

Pedagogy

Chalk and Talk, Assignment, Seminar and Group Discussion.

Course Designer

Dr. S. Jenny

Semester: III	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	Credits
22PMB3CC6	MOLECULAR BIOLOGY AND MICROBIAL GENETICS	CORE	6	5

Course Objectives:

This course deals with the knowledge on the genetic material of microorganisms and its replication process and to impart conceptual idea about the molecular biology concepts, central dogma, gene expression and its regulations.

Prerequisites

Basic knowledge and concepts of Molecular biology and Microbial Genetics

Course Outcome and Cognitive Level Mapping

Cos	CO Statement	Cognitive level
CO1	Define and Understand the basics of molecular biology	K1, K2
CO2	Analyze and apply central dogma of molecular biology	K3, K4
CO3	Determine and Explain the nucleotide sequence change and repair mechanism	K3, K4
CO4	Evaluate and categorize the significance of vectors and bacterial genetics	K4, K5
CO5	Criticize and manage gene expression and transposons	K5, K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	3	2	3	2	2	1
CO2	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	2	2	3	2	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3

“1” – Slight (Low) Correlation

“3” – Substantial (High) Correlation

“2” – Moderate (Medium) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Nucleic acid Composition & Replication Introduction to molecular biology- central dogma of molecular biology. Nucleic acids as genetic information carriers: experimental evidence. DNA- Structure, Properties, Types, Forms, Functions. DNA replication: general principles and Enzymology, various modes of replication. Inhibitors of DNA replication. Structure of RNA - replication -types of RNA: tRNA, mRNA, rRNA and siRNA. Introduction to PNA (Peptide Nucleic Acid).	18	CO1, CO2, CO3	K1, K2, K3, K4
II	Transcription and Translation Transcription steps - initiation, elongation and termination, Transcriptional factors, types of RNA polymerases, Inhibitors of transcription - Polycistronic and monocistronic RNAs. Post – transcriptional modifications. Translation - Basic features of genetic code, Protein synthesis - initiation, elongation and termination, inhibitors of protein synthesis. Post translation modifications- Wobble hypothesis.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	DNA Mutation, Damage & Repair Mutation & its types, Mutagens: Types - physical, chemical, biological agents. DNA damages: Deamination, methylation, alkylation, UV damage. DNA repair pathways: mismatch, Nucleotide and Base excision, recombinational and SOS repair.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	Microbial Genetics Gene transfer mechanisms- Bacterial transformation: detection, development of competence, mechanism, transfection. Conjugation: mechanism, F-factor, high frequency recombination (Hfr); Transduction: generalized, abortive, specialized transduction. Sexduction.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6,
V	Regulation of Gene Expression Regulation of gene expression: Operon concept, lac, trp, arabinose operons, promoters and repressors. Organization of Genes in Prokaryotes and Eukaryotes. Transposons: structure, types and mechanism of transposable elements.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	Self Study for Enrichment (Not included for End Semester Examinations) Gene cloning in bacteria, Construction of genomic and cDNA libraries, Gene silencing – Gene knockouts and gene therapies.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Krishnaiah G.R. Microbial Genetics & Molecular Biology (1st edition), Blue Rose Publisher, 2019.
2. David P. Clark, Nanette J. Pazdernik, Michelle R. McGehee. Molecular Biology (3rd edition), Academic Cell, 2019.
3. Lizabeth A. Allison. Fundamental Molecular Biology (3rd Edition). Wiley-Blackwell, 2021.
4. Bruce Alberts, Rebecca Heald, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter, John Wilson, Tim Hunt. Molecular Biology of the Cell (7th edition) W. W. Norton & Company, 2022.
5. Rupal Sengar. Textbook of Microbial Genetics (1st edition), LAP LAMBERT Academic Publishing, 2021.
6. Pradeep D. Devkate, Samina R. Khan, Dipak G. Puri, Sachin S. Shinde. A Textbook of Microbial Genetics (1st edition), Booksclinic Publishing, 2023.

Reference Books

1. Hartl, Daniel L. Genetics: Analysis of genes and genomes. (9th Edition), Jones & Bartlett Learning, 2019
2. Arumugam N. Cell Biology and Molecular Biology (9th Edition), Saras Publication, 2019.
3. Poonam Agrawal, Lippincott Illustrated Reviews: Cell and Molecular Biology (SAE- 2nd edition), Wolters Kluwer India Pvt Ltd, 2022.
4. Jordanka Zlatanova. Molecular Biology: Structure and Dynamics of Genomes and Proteomes (2nd Edition), Garland Science, 2023.
5. Joanne Willey, Kathleen Sandman, Dorothy Wood. Prescott's Microbiology (12th edition), Mc Graw Hill, 2022.
6. Bernard R. Glick, Cheryl L. Patten. Molecular Biotechnology: Principles and Applications of Recombinant DNA (ASM Books) (6th Edition). ASM Press, 2022.

Web References

1. <http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html>
2. http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html
3. <https://www.nature.com/scitable/ebooks/>
4. http://www.digitalbookindex.org/_search/search010biolmolecularcellbiologya.asp
5. <https://microbenotes.com/dna-structure-properties-types-and-functions/#types-of-dna>
6. <https://www.biologydiscussion.com/dna/dna-damage-types-and-repair-mechanisms-with-diagram/16332>
7. <https://www.biologydiscussion.com/gene/transposons-or-jumping-genes-types-structure-mechanism-and-functions/16499>

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity.

Course Designer

Dr. S. Jenny

Semester: III	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	Credits
22PMB3CC7	FOOD AND DAIRY MICROBIOLOGY	CORE	6	5

Course Objectives:

This course deals with the knowledge on the food and dairy products and disease-causing microorganism and their toxins which may contaminate the food and its quality control.

Prerequisites

Basic knowledge and concepts of food and dairy Microbiology

Course Outcome and Cognitive Level Mapping

Cos	CO Statement	Cognitive level
CO1	Define and Understand the basics of food microbiology	K1, K2
CO2	Analyze the food borne diseases	K3, K4
CO3	Determine and Explain the food contamination and preservation	K3, K4
CO4	Evaluate and categorize the microbial products	K4, K5
CO5	Criticize and manage quality control and assurance of products	K5, K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	3	2	3	2	2	1
CO2	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	2	2	3	2	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Introduction to Food Microbiology General Introduction of Foods and Related Microorganisms. Intrinsic Factors- Nutrient Content, pH and Buffering Capacity, Redox Potential, Antimicrobial Barriers and Constituents and Water Activity. Extrinsic Factors- Relative Humidity, Temperature and Gaseous Atmosphere.	18	CO1, CO2, CO3	K1, K2, K3, K4
II	Food Borne Diseases Definition of food poisoning, food infections and toxications. Causative agents, foods involved, symptoms and preventive measures. Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Escherichia coli, Shigella, Listeria monocytogenes.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	Food Contamination and Methods of Food Preservation Contamination and Spoilage of Cereals, Cereal Products, Fruits, Vegetables, Meats, Meat Products, Fish, Sea Foods, Eggs, Poultry and Canned Foods. General Principles, physical methods of food preservation: temperature, Pasteurization, types (canning, drying); High pressure and Irradiation; chemical methods of food preservation: salt, sugar, organic acids, SO ₂ and antibiotics.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	Dairy Microbiology, Microbial Products Dairy Microbiology- Normal Flora of Milk and Milk Products, Spoilage of Milk and Milk Products. Fermented Milk Products- Acidophilus Milk, Bifidus Milk, Yoghurt Manufacture of Cheese and Evolution of Quality Milk. Microbial Food Fermentation- Fermentation in Food Processing, Role of Microorganisms in Food Fermentation. Microbial Products of Food; SCP, Mushrooms, Oriental Foods Fermented Beverages (Fruit and Cereal Based).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6,
V	Microbial Enzymes, Quality Control And Quality Assurance Industrial Production of Enzymes- Cellulases, Amylases, Proteases, Phytases, Pectinases, Lipases and Glucose Isomerases. Food Sanitation – Microbiology of Food Plant Sanitation, Water and Milk Testing. Food Laws and Quality Control – HACCP, Codex Alimentarius, PFA, FPO, MFPO, BIS and AGMARK.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	Self Study for Enrichment (Not included for End Semester Examinations)	-	CO1, CO2,	K1, K2,

	Food Borne Disease Outbreaks - Objectives of Investigation, Field Investigation, Lab Testing and Preventive Measures.		CO3, CO4, CO5	K3, K4, K5, K6
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Text Books

1. Adams MR and Moss MO. (2012). Food Microbiology, The Royal Society of Chemistry, Cambridge.
2. Biotechnology by R.C. Dubey. (2014). A Textbook of Biotechnology. S. Chand publishers.
3. Frazier WC and West off DC. (2017) Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi.

Reference Books

1. Bibek Ray, Arun Bhunia. (2013). Fundamental Food Microbiology. CRC Press.
2. Foster W M. (2015). Food Microbiology. CBS Publication.
3. Karl R. Mathews. (2017). Food Microbiology an Introduction. ASM Press.
4. Charlene Wolf Hall. (2017). Microbial Food Safety A Food Systems Approach.

Microbial Food Safety A Food Systems Approach.

5. Dongyou Liu. (2018). Handbook of food borne diseases. CRC Press.

Web References

1. https://asutoshcollege.in/new-web/Study_Material/SM_16062020.pdf
2. https://www.who.int/health-topics/food-safety#tab=tab_1
3. <https://www.sciencedirect.com/topics/food-science/food-borne-disease>
4. <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/dairy-microbiology>
5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5956270/>

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignments.

Course Designer

Dr. R. Nithyatharani

Semester : III	Internal Marks:25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PGCS3CCC2A	CYBER SECURITY	CORE CHOICE	3(T) + 2(P)	4

Course Objective

- To develop skills in students that can help them plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.
- To expose students to governance, regulatory, legal, economic, environmental, social, and ethical contexts of cyber security.
- To expose students to the responsible use of online social media networks.
- To systematically educate the necessity to understand the impact of cyber-crimes and threats with solutions in a global and societal context.
- To select suitable ethical principles, commit to professional responsibilities and human values, and contribute value and wealth for the benefit of society

Prerequisites

Basic Knowledge of Cyber Security

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Understand the cyber security threat landscape	K1,K2
CO2	Develop a deeper understanding and familiarity with various types, cyber crimes, vulnerabilities, and remedies thereto.	K2, K3
CO3	Analyse and evaluate existing legal frameworks and laws on cyber security.	K4, k5
CO4	Analyse and evaluate the digital payment system security and remedial measures.	K4, K5
CO5	Analyse and evaluate the cyber security risks, plan suitable security controls	K4, k5

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO 2	PO 3	PO 4	PO 5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	2
CO4	3	3	3	3	2	3	3	3	3	2
CO5	3	3	3	3	2	3	3	3	3	2

“1” – Slight (Low) Correlation 2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation “-” indicates there is no correlation

SyllabusTheory:

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Overview of Cyber Security: Cyber security increasing threat landscape, -Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyber warfare, Case Studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Cyber Crimes: Cyber Crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber-squatting, Pharming, Cyber espionage, Cryptojacking, Darknet-illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cyber crime against persons –cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Cyber Law: Cyber Crime and legal landscape around the world, IT Act, 2000 and its amendments. Limitations of IT Act, 2000. Cyber Crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies-AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Data Privacy and Data Security: Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA). Social media-data privacy and security issues.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	Cyber security Management, Compliance and Governance: Cyber security Plan-cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

VI	Self Study for Enrichment (Not included for End Semester Examinations) Case Studies: Largest Cyber Attacks : Yahoo Data Breach, Equifax Data Breach, WannaCry Malware Attack, Simple Locker.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
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Reference Books

1. Vivek Sood, (2017). *Cyber Law Simplified*. McGraw Hill Education
2. Sumit Belapure and Nina Godbole, (2011). *Computer Forensics and Legal Perspectives*. Wiley India Pvt. Ltd.
3. Dorothy F. Denning, (1998). *Information Warfare and Security*. Addison Wesley.
4. Henry A. Oliver, (2015). *Security in the Digital Age: Social Media Security Threats and Vulnerabilities*. Create Space Independent Publishing Platform.
5. Natraj Venkataramanan and Ashwin Shriram, (2016). *Data Privacy Principles and Practice*. 1st Edition, CRC Press.
6. W.Krag Brothy, (2008). *Information Security Governance, Guidance for Information Security Managers*. 1st Edition, Wiley Publication.
7. Martin Weiss, Michael G.Solomon, (2015). *Auditing IT Infrastructures for Compliance*. 2nd Edition, Jones & Bartlett Learning.

Web References

1. <https://www.tutorialspoint.com/principles-of-information-system-security>
2. <https://www.geeksforgeeks.org/principle-or-information-system-security/>
3. <https://www.techtarget.com/searchsecurity/definition/cybersecurity>
4. <https://www.ukessays.com/essays/computer-science/analysis-of-the-yahoo-data-breaches.php>
5. <https://www.csoonline.com/article/3444488/equifax-data-breach-faq-what-happened-who-was-affected-what-was-the-impact.html>
6. <https://www.techtarget.com/searchsecurity/definition/WannaCry-ransomware>
7. <https://www.cloudflare.com/learning/ddos/syn-flood-ddos-attack/>

Practicals:

List of Exercises: (Not included for End Semester Examinations)

1. Platforms for reporting cyber crimes.
2. Checklist for reporting cyber crimes online
3. Setting privacy settings on social media platforms.
4. Do's and Don'ts for posting content on Social media platforms.
5. Registering complaints on a Social media platform.
6. Prepare password policy for computer and mobile device.
7. List out security controls for computer and implement technical security controls in the personal computer.
8. List out security controls for mobile phone and implement technical security controls in the personal mobile phone.
9. Log into computer system as an administrator and check the security policies in the system.

Web References

1. <https://cybercrime.gov.in/>
2. https://cybercrime.gov.in/webform/crime_onlinesafetytips.aspx
3. <https://www.digitalvidya.com/blog/social-media-dos-and-donts/>
4. <https://www.medianama.com/2023/02/223-platform-grievance-appellate-committees-social-media/>
5. <https://www.ibm.com/topics/security-controls>
6. <https://docs.oracle.com/cd/E19683-01/817-0365/concept-2/index.html>

Pedagogy

Chalk and Talk, Group discussion, Seminar & Assignment.

Course Designer

From UGC SYLLABUS

Semester : III	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB3CCC2B	MICROBIAL GENE TECHNOLOGY	CORE CHOICE COURSE- II	5	4

Course Objective

To enable the students to understand various tools and techniques for microbial gene manipulation.

Prerequisites

To obtain basic knowledge in the field of gene technology.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Explain the gene analysis and Techniques	K2,K3
CO2	Illustrate Restriction enzymes	K3,K4
CO3	Summarize the DNA sequence analysis	K4,K5
CO4	Intrepret Nature of vectors	K5,K6
CO5	Discuss about application of gene	K5,K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	3	2	3	3	3	3	3	3	3
CO3	3	2	3	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	2	3	3	2	3	3	3

1- Slight (Low) correlation 2- Moderate (Medium) correlation

3- Substantial (High) correlation “-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Gene Analysis and Techniques : Isolation of DNA and RNA from microbes. Handling & Quantification of Nucleic acids - Radiolabelling of Nucleic acids - End labeling - Nick translation - Labelling by primer extension - PFGE and its applications - Blotting techniques - Nucleic acid hybridization	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Restriction enzymes : Nomenclature - Classification - restriction and Methylation - Type II restriction endonuclease - use of restriction endonucleases - Restriction mapping and its applications - DNA modifying enzymes - nucleases - polymerases - DNA ligases.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	DNA sequence analysis ; Maxam - Gilbert (Chemical) sequencing - Sangar - Coulson (DiDeoxy/enzymatic) sequencing . Automated DNA sequencing. Genome sequencing and Physical Mapping of genomes. PCR - methods and its application, Advantages. DNA fingerprinting in forensic application. Microarray and its applications	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Vectors - nature - uses of vectors- types of vectors - Plasmids, Bacteriophages - Cosmid - Shuttle vectors; cloning strategies - cloning and selection of individual genes. Gene libraries; cDNA and genomic libraries - artificial chromosomes - BAC and YAC.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Applications : Gene Annotations; Gene silencing; Human Genome Project; Legal aspects of rDNA technology and cloning. Development of gene functions. Recombinant DNA products and applications - Insulin, Hepatitis B antigen vaccine, Growth hormones.	15	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6
VI	Self Study for Enrichment (Not included for End Semester Examination) Nanobiologics - Bioactive peptides as hormones, a	-	CO1, CO2, CO3,	K1 K2, K3,

	ntimicrobials, vaccines, drug carriers and therapeutics.		CO4, CO5	K4, K5, K6
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Text Books

1. Chaudhuri, Keya (2012) Microbila genetics, The Energy And Resources Institute
2. Brown.T.A(2016) Gene Cloning and DNA Analysis An Introduction,Wiley-Blackwell.
3. Jodgand.S.N. (2016) Gene Biotechnology. Himalaya Publishing House
4. Somnath De, (2017) Basic Concept of Recombinant DNA Technology, Edupedia Publications Pvt Ltd
5. Monika Jain. Recombinant DNA Techniques: A Textbook (2020) Narosa Publication

Reference Books

1. Kumar, Ashok, (2011) Molecular Biology and Recombinant DNA Technology: A Practical BookJain Book agency
2. Rajagopal.K, (2012) Recombinant Dna Technology and Genetic Engineering McGraw Hill Education.
3. Bal Ram Singh, Raj Kumar,(2022)Practical Techniques in Molecular Biotechnology, Cambridge University Press.

Web References

1. <https://download.e-bookshelf.de/download/0007/2863/08/L-G-0007286308-0008738665.pdf>
2. [https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_\(OpenStax\)/12%3A_Modern_Applications_of_Microbial_Genetics/12.01%3A_Microbes_and_the_Tools_of_Genetic_Engineering](https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(OpenStax)/12%3A_Modern_Applications_of_Microbial_Genetics/12.01%3A_Microbes_and_the_Tools_of_Genetic_Engineering)
3. <https://www.slideshare.net/lanimanahan/microbial-genetics-and-genetic-engineering>
4. <https://www.heavenlyfuel.com/jbframework/uploads/2017/06/Molecular-Biotechnology.pdf>
5. https://portal.abuad.edu.ng/lecturer/documents/1585662755MICROBIAL_BIOTECHNOLOGY__Fundamentals_of_Applied_Microbiology,_Second_Edition.pdf

Pedagogy

Chalk and talk, Power Point Presentation, Quiz, Assignments, Group Discussions, Seminar, and Assignment.

Course Designer

Ms.S.Sathya

Semester III	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB3CCC2C	BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS	CHORE CHOICE COURSE- II (CCC)	5	4

Course Objective

The course is intended to make the students to develop and apply a personal understanding of biosafety and Intellectual property rights, and their impact on day-to-day life.

Prerequisites

Creates awareness on biosafety and intellectual property rights in the field of biological research.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Describe fundamentals of biosafety	K1,K2
CO2	Illustrate guidelines of biosafety	K2,K3
CO3	Explain importance of Intellectual rights	K3,K4
CO4	Interpret basics of patents and concept of prior art	K4,K5
CO5	Discuss patent filling code of conduct	K5,K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	3	2	3	3	3	3	3	3	3
CO3	3	2	3	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	2	3	3	2	3	3	3

1- Slight (Low) correlation

2- Moderate (Medium) correlation

3- Substantial (High) correlation

“-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Biosafety: Historical Background, Introduction to Biological Safety Cabinets, Good manufacturing practice and Good lab practices (GMP and GLP)., Primary Containment for Biohazards, Biosafety Levels, GMOs, LMOs and their environmental impact.	15	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	Biosafety Guidelines: Biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations of Government of India; Roles of Institutional Biosafety Committee – RCGM and GEAC; Risk Analysis and Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.	15	CO1, CO2, CO3, CO4	K1, K2, K3, K4
III	Introduction to Intellectual Property: Concept of Intellectual Property, Kinds of Intellectual Property: Patents, Copyrights, Designs, Trademarks, Geographical Indication. Protection of GMOs IP as a factor in R&D. Introduction to GATT & TRIPS Agreement, Indian Patent Act 1970 & recent amendments.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Basics of Patents and Concept of Prior Art: Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet (EPO), PATENTScope (WIPO), IPO)	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Patent filing procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while	15	CO1, CO2, CO3,	K1, K2, K3,

	patenting–disclosure/non-disclosure; Financial assistance for patenting-introduction to existing schemes, Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies.		CO4, CO5	K4, K5, K6
VI	UNIT VI – Self study for Enrichment (Not included for End Semester Examination) Biosafety assessment procedures in India and abroad, Web based information of biosafety on GMO, IPR agencies, Biological Patentability and Patent agent.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books

1. Usharani B., Anbazhagi S. and Vidya C. K. (2019). *Biosafety in Microbiological Laboratories*. 1st Edition. Notion Press.
2. Sateesh M.K. (2020). *Bioethics and Biosafety*. Dreamtech Press.
3. Chawla H.S. (2020). *Introduction to Intellectual Property Rights*. Oxford & IBH publishing.
4. Verkey E. and Isaac J.S. (2021). *Intellectual Property*. Eastern Book Company.
5. Reddy G.B. (2023). *Intellectual Property Rights and the Law*. Gogia Law Agency.

Reference Books

1. Damodar Reddy S.V. (2019). *Intellectual Property Rights - Law and Practice*. 1st Edition. Asia Law House.
2. Nithyananda K. V. (2019). *Intellectual Property Rights: Protection and Management*. Cengage Learning India Private Limited.
3. Lydia Pallas L. and Joseph Scott. M. (2021). *Intellectual Property Law: Cases & Materials*. Semaphore Press, Inc.
4. Peter S. Menell, Mark A. Lemley, Robert P. Merges and Shyamkrishna Balganesh. (2021). *Intellectual Property in the New Technological Age*. Clause 8 Publishing.
5. Sibi. G. (2021). *Intellectual, Property Rights, Bioethics, Biosafety and Entrepreneurship in biotechnology*. Wiley Publications.

Web References

1. <http://www.cbd.int/biosafety/background.shtml>
2. <http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section 3.html>
3. <http://ipindia.nic.in/writereaddata/Portal/ev/rules-index.html>
4. <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>.
5. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
6. World Intellectual Property Organization – www.wipo.int

7. Indian Patent Office – www.ipindia.gov.in

8. <https://dst.gov.in/sites/default/files/E-BOOK%20IPR.pdf>

Pedagogy

Chalk and talk, Power Point Presentation, Quiz, Assignments, Group Discussions, Seminar, Assignment.

Course Designer

Dr. N. Jeenathunisa

Semester III	Internal Marks : 40		External Marks : 60	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs./Week	CREDITS
22PMB3CC3P	MOLECULAR BIOLOGY AND MICROBIAL GENETICS, FOOD AND DAIRY MICROBIOLOGY (P)	CORE	6	5

Course Objective

- To enable the Students to understand the Basic Knowledge in Molecular Biology and Microbial genetics.
- To understand the production process Applications of Microbial products.
- To acquire a Skills about the various Techniques in Recombinant DNA Technology.
- To gain the brief Knowledge about Protein separation.

Course Outcome and Cognitive level Mapping

CO Number	CO Statement	Cognitive level
CO 1	Predict the application of Immobilization	K3
CO 2	Determine the Commercial production methods of Microbial Products	K4
CO 3	Compare the genomic and plasmid DNA separation methods	K5
CO 4	Expand the knowledge about PCR, Restriction digestion and ligation of DNA	K6
CO 5	Critique knowledge about microbial isolation from spoiled food	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	3	3	3	3	2	3
CO2	3	2	3	3	2	2	3	2	3	3
CO3	3	2	2	3	3	3	2	3	3	2
CO4	2	3	3	2	3	3	3	2	3	2
CO5	3	3	2	3	2	3	3	3	2	2

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-“ indicates there is no correlation

Syllabus

MOLECULAR BIOLOGY AND MICROBIAL GENETICS

1. Isolation of Antibiotic Resistant Microbes
2. Isolation of Mutants by Spontaneous Mutation – Gradient plate technique
3. Isolation of Auxotrophic and Antibiotic Resistant Mutants by Physical and Chemical Mutagens
4. Competent Cell Preparation and Bacterial Transformation
5. Generalized Transduction in E.coli
6. Isolation and Quantification of Genomic DNA and Plasmid DNA from E.coli
7. Characterization of Plasmid DNA by Agarose gel electrophoresis
8. Restriction Digestion and Ligation of DNA
9. Polymerase Chain Reaction
10. Random Amplified Polymorphic DNA
11. Restriction Fragment Length Polymorphism
12. Insilico method of RFLP and Secondary Structure Prediction of RNA
13. Separation of Protein by SDS PAGE
14. Transfer of Protein - Western blot

FOOD AND DAIRY MICROBIOLOGY

1. Milk microbiology –Breed count, Direct microscopic count and Standard plate count, Presumptive test for coliforms.
2. Testing the quality of milk - Methylene blue reductase test, Resazurin test and alkaline phosphatase test.
3. Isolation of microbes from fermented foods (bread, cheese, yoghurt) – bacteria, fungi and yeast.
4. Isolation of bacteria, fungi and yeast from spoiled food (tomato, potato, grapes).

Reference Books:

1. Swagat Kumar Dash, Hrudayanath Thatoi, Supriya Dash (2020). Practical Biotechnology: Principles and Protocols. Dreamtech Press.
2. Siddra Ijaz & Imran UI Haq. (2019). Recombinant DNA Technology. Cambridge Scholar UK.
3. Gunasekaran, P. (2018). Laboratory Manual in Microbiology. New Age International Publishers, New Delhi.
4. Michael L. Shuler, Fikret Kargi & Matthew DeLisa. (2017). Bioprocess Engineering: Basic Concepts. Prentice Hall, US.
5. Brown TA. (2016). Gene cloning and DNA Analysis Introduction. Blackwell Science Ltd., London.

Web Reference

1. <https://www.youtube.com/watch?v=ug23mkwRylw>
2. <https://www.youtube.com/watch?v=kzJHD3KI1ck>
3. <https://www.youtube.com/watch?v=ee-h2xHt66M>
4. <https://www.youtube.com/watch?v=1B9-aGv-jro>
5. <https://www.youtube.com/watch?v=nid2fvN5L5A>

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

Dr. V. Aruna

Semester III	External Marks: 100			
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB3DSE3A	MICROBIOLOGY FOR COMPETITIVE EXAMINATIONS	DISCIPLINE SPECIFIC ELECTIVE COURSE – III (DSE)	4	3

Course Objectives

This course provides a multidisciplinary forum for the discussion of all aspects of microbiology which helpsto develop and impart knowledge for the students to appear in the competitive examination.

Prerequisites

Understand and critically analyze the literature in the field of Microbiology

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Explain the taxonomy principles and concepts	K1, K5
CO2	Understanding the basics of inheritance biology	K2,K3
CO3	Extend the Knowledge about microbes in Agriculture	K4,K5
CO4	Understand the basic concepts of cell development and its impacts	K5,K6
CO5	Expand the knowledge about Bio-Nano-informatics	K5,K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2	3	2	2	3	2
CO2	3	3	2	2	2	3	3	2	3	3
CO3	3	3	3	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	2

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Microbial Taxonomy: Taxonomy - Principles and methods, Concepts of species and hierarchical taxa. Levels of structural organization- Unicellular, colonial and multicellular forms; Taxa & Species concepts- Traditional, typological, evolutionary, biological, phylogenetic concepts. Phylogenetic (among species) versus Tokogenetic (within species) relationships. Taxonomic rank and names. Types of taxonomy- chemotaxonomy, numerical taxonomy and polyphasic taxonomy. Phylogenetic analysis and evolutionary relationship among taxa. Application in Taxonomy and phylogeny, Comparative genomics.	12	CO1, CO2, CO4, CO5	K1, K2, K3, K4, K5
II	Inheritance Biology: Mendelian principles, Concept of gene, Gene mapping, Human genetics - Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Polygenic inheritance, heritability and its measurements, QTL mapping. Structural and numerical alterations of chromosomes - Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination Homologous and non-homologous recombination including transposition	12	CO1, CO2, CO3, CO4	K2, K3, K4, K5
III	Agricultural Microbiology: Biogeochemical cycles -Nitrogen, Carbon, Phosphorous, Sulphur, Iron and their	12	CO1, CO2, CO3,	K2, K3, K4,

	importance. Microbial association with plants- Phyllosphere, Rhizosphere, Mycorrhizae, Nitrogen fixing organism – symbiosis, asymbiosis, associate symbiosis – phosphate solubilizers. Application of bio fertilizers in agriculture. Biology of nitrogen fixation – genes and regulations in Rhizobium. Bacterial, viral and fungal plant pathogens. Disadvantages of chemical pesticides. Microbial pesticides- types, mechanisms, advantages and limitations.		CO4	K5
IV	Developmental Biology: Basic concepts of cell development, Gametogenesis, Spermatogenesis and Oogenesis in mammals, outline of experimental embryology, Morphogenesis and organogenesis in Drosophila. Metamorphosis, Regeneration and Human development	12	CO1, CO4, CO5	K2, K4 K5, K6
V	Bio-Nano-Informatics: Introduction to Bioinformatics- Applications of Bio nanotechnology - Drug and gene delivery – protein mediated and nanoparticle mediated. Uses of nanoparticles in MRI, DNA and Protein Microarrays. Nanomedicines, Antibacterial activities of nanoparticles. Nanotechnology in agriculture. Toxicology in nanoparticles – Dosimetry. Nano therapy for cancer treatment. Nanoscience in India – Nanoscience education abroad – Looking at ethics and society.	12	CO1, CO4 , CO5	K2, K4, K5, K6

VI	Self-Study for Enrichment (Not included for End Semester Examinations) Modern methods of Bacterial taxonomy, Plant growth promoting rhizobacteria (PGPR). Nanoscience in food packaging and water disinfection	-	CO1, CO2, CO3,	K2, K3, K4, K5
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Text Books

1. Bhagwan Rekadwad (2020). Microbial Systematics: Taxonomy, Microbial Ecology, Diversity, First Edition, CRC Press.
2. Kailash Choudhary, (2021). Genetics, The inheritance Biology, First Edition, IFAS Publication.
3. Subba Rao, N.S, (2020). Agricultural Microbiology, Third Edition, Med tech.
4. Michael Barresi and Scott Gilbert, (2023), Developmental Biology, Thirteenth Edition, Sinauer Associates is an imprint of Oxford University Press.
5. Charles P. Poole , Jr, Frank J., and Owens, (2020), Wiley.

Reference Books

1. Surajit Das and Hirak Ranjan Dash, (2018). Microbial Diversity in the Genomic Era, First Edition, Academic Press.
2. Hartl and Daniel L,(2019). Genetics : analysis of genes and genomes, Burlington, Massachusetts : Jones & Bartlett.
3. Bibhuti Bhusan Mishra, Suraja Kumar Nayak, Swati Mohapatra and Deviprasad Samantaray, (2021). Environmental and Agricultural Microbiology: Applications for Sustainability, First edition Wiley-Scrivener.
4. Slack J.M.W, (2021). Essential Developmental Biology, Fourth edition, Wiley-Blackwell.
5. Shah, M.A and Shah K.A, (2019). Nanotechnology, Second Edition, Wiley.

Web References

1. http://vidyamandira.ac.in/pdfs/e_learning/ds_microbio/MICROBIAL%20TAXONOMY%20MCBA%20P1%20T.pdf
2. <https://schools.aglasem.com/ncert-books-class-12-biology-chapter-5/>
3. <https://agrimoon.com/wp-content/uploads/AGRICULTURAL-MICROBIOLOGY.pdf>
4. <http://bgc.ac.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf>
5. <http://www.imedpub.com/journal-nanoscience-nanotechnology-research/>
6. <https://benthamscience.com/journals/nanoscience-and-nanotechnology-asia/>

Pedagogy

Chalk and Talk, Assignment, Seminar, Group Discussion and Quiz.

Course Designer

Dr.N.Sathammai Priya

SEMESTER III	EXTERNAL MARKS: 100			
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDIT
22PMB3DSE3B	FOOD ADULTERATION	DISCIPLINE SPECIFIC ELECTIVE COURSE – III (DSE)	4	3

Course Objective :

This course is designed to provide comprehensive knowledge to the students regarding food safety and standardization act and quality control of foods.

Prerequisites

To Comprehend and analyze the basics of food adulteration.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Define the basics of Food adulteration	K1,K2
CO2	Recite the knowledge about Food Safety and Standards	K1,K2
CO3	Critique knowledge about Standardization of Foods	K4,K5
CO4	Generalize the basic idea of Food additives	K5,K6
CO5	Expand the role of Quality control	K5,K6

Mapping with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	3	3	3	3
CO3	3	3	2	1	3
CO4	3	3	3	3	3
CO5	3	2	2	3	3

“1” – Slight (Low) Correlation “2” – Moderate (Medium) Correlation
 “3” – Substantial (High) Correlation “-” – indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Food adulteration – Introduction of food adulteration, definition. Historical food legislation in India; Central food laboratory, Municipal laboratories, Export inspection council laboratory, Central grain analysis laboratory, standards of weights and measures act, solvent extracted oil, de-oiled meal and edible flour order, export and quality control, inspection act, other acts and orders.	12	CO1, CO2, CO4, CO5	K1, K2, K3, K4, K5
II	Food Safety and Standards Act 2006.vertical standards Vs horizontal standards .Food safety officer; powers, procedures, role of food analyst most important international laws; Codex alimentarius, FDA, USDA, FAO,HACCP,FSSAI and WHO.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Standardization of Foods; Definition, Standards of Quality, for cereals, starchy foods, spices and condiments, sweetening agents, meat and meat products, vinegar, sugar and confectionary, beverages-alcoholic and non- alcoholic , carbonated water, milk and milk products , oils and fats , canned foods , fruits and vegetables products.	12	CO1, CO2, CO3, CO4	K2, K3, K4, K5

IV	Food additives – classification, nature and characteristics and use of additives in food such as antioxidants, chelating agents, coloring agents - algal colorants (natural & artificial), curing agents, emulsions, flavors and flavor enhancers, flour improvers, humectants and anti-caking agents, nutrient supplements, non-nutritive sweeteners, pH control agents, stabilizers and thickeners.	12	CO1, CO2, CO3, CO4	K2, K4 K5, K6
V	Consumer protection; role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories for companies ,private testing laboratories, Quality control laboratories of consumer co-operatives. Consumer education, consumer problems rights and responsibilities, Consumer protection act (COPRA 1986), tips for wise purchasing, redressal measures how to give complaints and proforma of complaints.	12	CO1, CO4 , CO5	K1, K2, K3, K4, K5
VI	Self-Study for Enrichment (Not included for End Semester Examinations) New adulterants in foods, National and International regulatory bodies. Raising agents – types and their role in food processing.	-	CO1, CO2, CO3, CO4	K2, K3, K4, K5

Text Books:

1. Mousumi Sen (2021). Food Chemistry: Role of Additives, Preservatives and Adulteration, John Wiley and Sons.
2. Jonathan Rees (2020). Food Adulteration and Food Fraud (Food Controversies). Reaktion Books
3. Fredric Accum (2019). A Treatise on Adulterations of Food, And Culinary Poisons, Lector House LLP
4. Rowland J. Atcherley (2019). Adulteration of Foods. Wentworth Press.
5. Mason (2019). Adulteration of Foods. Forgotten Books.

Reference Books:

1. Rosalee S. Hellberg Karen Everstine Steven A. Sklare (2020). Food Fraud: A Global Threat with Public Health and Economic Consequences. Academic Press Inc.
2. James Bell (2019). The Analysis and Adulteration of Foods. Forgotten Books.
3. Harvey Washington Wiley (2019). Foods and Food Adulterants, Vol. 4. Forgotten Books.
4. John W. (2019). Spink Food Fraud Prevention: Introduction, Implementation, and Management (Food Microbiology and Food Safety). Springer
5. William Ernest Mason (2018). Adulteration of Food Products. Forgotten Books.

Web links:

1. <https://www.vedantu.com/biology/food-adulteration>
2. <https://www.publichealthnotes.com/food-adulteration-types-of-food-adulteration-and-mitigation-measures/>
3. https://en.wikipedia.org/wiki/Adulterated_food
4. <https://www.slideshare.net/SurajPanpatte1/different-methods-of-food-adulteration>
5. <https://www.sciencedirect.com/topics/food-science/food-adulteration>

Pedagogy

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

Course Designer

Dr.P.F.Steffi

Semester III	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB3DSE3C	BIOMEDICAL LABORATORY TECHNOLOGY	Discipline Specific Elective Course – III (DSE)	4	3

Course Objective

Biomedical Laboratory Technology is a laboratory science effectively and comprehensively meets the requirements of students to develop manpower for health sector by providing them the necessary knowledge and skill to ensure the quality services in health care sector.

Prerequisites

To provide the fundamental laboratory skills that students need to prepare for a career in the biomedical sciences.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Knowledge level
CO1	Understand the basic human biology	K1, K2
CO2	Interpret the features of basic equipment's of laboratory	K2, K3
CO3	Analyze the metabolism and classification of biomolecules	K3, K4
CO4	Interpret the significance of hematology and blood bank	K4, K5
CO5	Discuss the significance of microbiology, clinical pathology and histopathology	K5, K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	3	2	3	3	3	3	3	3	3
CO3	3	2	3	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	2	3	3	2	3	3	3

1- Slight (Low) correlation

2- Moderate (Medium) correlation

3- Substantial (High) correlation

“-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Anatomy and Physiology: Definitions and Terms in Anatomy and Physiology. Structure and function of human cell - Elementary tissues of human body. Organ Systems: Cardio Vascular, Respiratory, Digestive, Urinary, Reproductive, Musculoskeletal, Nervous and Endocrine.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	Instrumentation: Autoclave, Hot Air Oven, Incubators, Laminar Air Flow, Filtration, colony counter, Centrifuge, pH meter, Colorimeter, Spectrophotometer and Microscopy. Glassware – Description of Glassware, its use, handling and care.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
III	Biochemistry: Glucose and Glycogen Metabolism, Classification of proteins and functions, Classification of lipids and functions. Enzymes: Definition, Nomenclature, Classification and Factors affecting enzyme activity. Vitamins & Minerals, Acids and bases. LFT, RFT, GFT.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Hematology and Blood Bank: Origins, development and morphology of blood cells, composition of blood and its functions. Basic concepts of anemia, leukemia and hemorrhagic disorder. Methods of estimation of hemoglobin, determination of PCV. Blood group - methods and typing, Blood transfusion and hazards.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	Microbiology, Clinical Pathology and Histopathology: Principles and methods of sterilization, disinfection, antiseptics. Culture media, Methods of maintenance and preservation of microbes. Principles and types of staining. Collection, Transportation and processing of clinical samples for Microbiological investigations. Analysis of urine, sputum, semen, gastric and stool samples. Histopathology - methods of examination of tissues and cell, Fixation of tissues, tissues	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

	processing, section cutting, staining cytology.			
VI	UNIT VI – Self study for Enrichment (Not included for End Semester Examination) Management of Biomedical Waste, Technologies and Treatment for Biomedical Waste.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books

1. Kanai L. Mukherjee. (2023). Medical Laboratory Technology. 4th Edition. Mc Graw Hill India.
2. Nanda M. (2021). Clinical Pathology Hematology and Blood Banking (For DMLT Students). Jaypee Brothers Medical Publishers (P) Ltd.
3. Satish G. (2021). The Short Textbook of Medical Laboratory for Technicians. Jaypee Brothers Medical Publishers (P) Ltd.
4. Arora D.R. and Arora B.B. (2020). Textbook of Microbiology. CBS Publishers & Distributors.
5. Chaurasia B.D. (2019). Human Anatomy. 8th Edition. CBS publishers.
6. Vasudevan D.M., Sreekumari S. and Vidhyathan K. (2019). Textbook of Biochemistry for Medical students. 9th Edition. Jaypee Brothers Medical Publishers (P) Ltd.

Reference Books

1. Kanai L. Mukherjee and Anuradha Chakravarthy. (2022). Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests. 4th Edition. Mc Graw Hill India.
2. Jamie A. Davies. (2021). Human Physiology: A Very Short Introduction. Oxford University Press.
3. Harsh M. (2021). Practical Pathology. Jaypee Brothers Medical Publishers (P) Ltd.
4. Gary W Procop and Elmer W. Koneman. (2020). Koneman's Color Atlas and Textbook of Diagnostic Microbiology. Jones and Bartlett Learning.
5. Elaine N. Marieb and Katja Hoehn. (2019). Human Anatomy & Physiology. Pearson Education.
6. Talib V.H. (2019). Handbook Medical Laboratory Technology. CBS Publishers & Distributors.

Web links:

1. <https://www.pdfdrive.com/medical-laboratory-technician-hematology-serology-blood-banking-and-immunohematology-e21321666.html>
2. <https://www.pdfdrive.com/medical-laboratory-technician-microbiology-afsc-90470-e17289142.html>
3. <https://www.pdfdrive.com/introduction-to-medical-laboratory-technician-e184576491.html>
4. <http://downloadinfobook1.firebaseio.com/Medical-Laboratory-Technology-Kanai-Mukherjee-PDF-c3f0077fe.pdf>
5. <https://www.cdc.gov/labtraining/index.html>

Pedagogy

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

Course Designer

Dr. N. Jeenathunisa

Semester : III	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB3GEC1	FOOD QUALITY TESTING	GENERIC ELECTIVE COURSE	3	2

Course Objective

Food testing is an important part to ensure food safety through surveillance and enforcement.

Prerequisites

Safety of food is a basic requirement governing the quality of food found anywhere along the food chain.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Explain the basics of food quality	K2,K3
CO2	Illustrate the nutritional value of foods	K3,K4
CO3	Summarize the Concepts of quality management	K4,K5
CO4	Intrepret Food Quality Laws and Regulations	K5,K6
CO5	Discuss about HACCP system	K5,K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	3	2	3	3	3	3	3	3	3
CO3	3	2	3	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	2	3	3	2	3	3	3

1- Slight (Low) correlation 2- Moderate (Medium) correlation

3- Substantial (High) correlation “-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Human nutrition, Basic food groups, Balanced diet. Food processing, preservation and storage. Physico-chemical properties of food, enzymes in food. The various factors contributing towards quality of food - Appearance, Color, Taste, Odour, Nutritional value, Adulterants. Concept of quality: Quality attributes- physical, chemical, nutritional, microbial, and sensory; Their measurement and evaluation; Sensory instrumental methods for testing quality.	9	CO1, CO2, CO3, CO4,CO5	K1, K2, K3, K4,K5
II	Food adulteration, toxication of food, prevention of food borne diseases. Fermented food products. Production of nutrient rich foods. Agro-product preservation methods. Quality of animal feed and poultry feed. Quality control in food processing. Quality control for exportable foods.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Concepts of quality management: Objectives, importance and functions of quality control, Quality management systems in India, Sampling procedures and plans, Food Safety and Standards Act 2006, Domestic regulations, Global Food safety Initiative, Various organizations dealing with Inspection, traceability and authentication, certification and quality assurance –PFA, FPO, MMPO, MPO, AGMARK, BIS; Labeling issues, International food standards.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Food Quality Laws and Regulations: Quality assurance, Total Quality Management,	9	CO1, CO2,	K1, K2,

	GMP/GHP, GLP, GAP, Sanitary and hygienic practices, documentation and audits; Indian & International quality systems and standards like ISO and Food Codex, Export Import policy, export documentation.		CO3, CO4, CO5	K3, K4, K5, K6
V	HACCP system: Hazard analysis Critical Control Point: Definition, principles, Guidelines for the application of HACCP system. HACCP Quality manuals. Quality Improvement Techniques: Quality Improvement Plans (QIP); Quality Control Circles (QCC) and Total quality management (TQM).	9	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6
VI	Self Study for Enrichment (Not included for End Semester Examination) Laboratory quality procedures and assessment of laboratory performance, Applications in different food industries, Food adulteration and food safety.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books

1. Bhatia, R. and Ichhpujan, R.L. (2014) Quality assurance in Microbiology. CBS Publishers and Distributors, New Delhi. .
2. Kher, C.P. (2000) Quality control for the food industry. ITC Publishers, Geneva.
3. Philip, A.C. Reconceptualising quality (2001) New Age International Publishers, Bangalore.
4. Jood, S. and N. Khetarpaul, (1991) Food Preservation. Agrotech Publishing Academy. Jaipur.
5. Manay, S. N. and M. Shadaksharawamy, (2001) Foods, Facts and Principles. 3rd Edition, New age International. New Delhi.

Reference Books

1. Yong-Jin Cho, Sukwon Kang. (2011) Emerging Technologies for Food Quality and Food Safety Evaluation, CRC Press.
2. Alli Inteaz, (2003) Food Quality Assurance: Principles and Practices, CRC Press.
3. Vasconcellos J. Andres, (2003) Quality Assurance for the Food Industry: A Practical Approach, CRC Press.

Web References

1. https://en.wikipedia.org/wiki/Quality_assurance<https://www.omicsonline.org/scholarly/food-quality-assurance-journals-articles-pptslist.php><http://www.fao.org/3/v5380e/V5380E05.htm>
2. <https://www.aaps.ca/principles-of-qaqc-in-the-food-industry.php>
3. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1019>
4. <http://egyankosh.ac.in/bitstream/123456789/11486/5/Unit-1.pdf>
5. https://www.researchgate.net/publication/304351925_Relationship_between_sensory_and_instrumental_measurement_of_texture

Pedagogy

Chalk and talk, Power Point Presentation, Quiz, Assignments, Group Discussions, Seminar, and Assignment.

Course Designer

Dr. E.Priya

Semester: IV	Internal Marks:25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	CREDITS
22PMB4CC8	BIOPROCESS TECHNOLOGY	CORE COURSE	6	5

Course Objective

To train the students on bioprocess technology so as to develop them for employment in bioprocess industry. To learn the screening of industrial strains, fermenters, media, fermentation process and downstream process.

Prerequisites

Basic knowledge and concepts of Microbial fermentation and techniques.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO 1	List the Concept and History of Strain development	K1, K2
CO 2	State the Fermentor and Fermentation media	K3, K4
CO 3	Explain the Fermentation Products	K3, K4
CO 4	Describe the Production of Pharmaceutical Products	K4, K5
CO 5	Prepare the Production and Purification Industrial Important Microbial Products.	K5, K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	3	2	3	2	2	1
CO2	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	2	2	3	2	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3

“1” – Slight (Low) Correlation

“3” – Substantial (High) Correlation

“2” – Moderate (Medium) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Bioreactor / Fermenter - Introduction, Definition. Types - Batch, Fed-Batch, Continuous. Solid substrate fermentation, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation). Operation of Bioreactors, Physico-chemical standards used in bioreactors, limitations of bioreactors, Growth Kinetics, Thermal death kinetics. Advantages & disadvantages of solid substrate & liquid fermentations.	18	CO1, CO2, CO3,	K1, K2, K3, K4,
II	Strain- Strain selection, Strain development, Methods, Preservation of strains, maintenance and strain improvement by mutation of gene transfer. Media formulation, Sterilization. Criteria for good Medium, Medium requirements for fermentation processes, Carbon Nitrogen, Minerals, Vitamins & other complex nutrients, Oxygen requirements, Quality control Analysis.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
III	Downstream processing – extraction, Separation techniques. concentration, recovery & purification techniques. Chromatography-Ion Exchange, Molecular Sieve, Affinity, HPLC, HPTLC, GC, GC-MS, Distillation, Fluid Extraction & Electrodialysis, Centrifugation, Sonification Techniques.	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	Enzyme technology –Genetic engineering & Protein engineering of enzymes, Immobilized cells and enzymes (Ca-alginate beads, poly acrylamide), industrial applications of immobilized enzymes. Industrial production of Ethyl alcohol, Acetic Acid (Vinegar), Citric acid, lactic acid, α -amylase, protease penicillin, tetracycline and vitaminB12, Production of herbal drugs. SCP, Beer, Wine and Yoghurt.	18	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,
V	Biological fuel generation – Biogas, Biodiesel, Bioethanol and hydrogen from Biomass. Biotechnology in specific medical & industrial applications - Retting of jute, microbial process for immunization (Production of monoclonal antibodies), Deterioration of paper, textiles, painted surfaces and their prevention, Biofilms, microbial biopolymers, biosurfactants.	18	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,
VI	Self Study for Enrichment (Not included for End Semester Examinations) Principles of Fermentation Technology, stages offer mentation processes. Design of various commercial media for Industrial fermentation - Medium optimization methods.	-	CO1, CO2, CO3, CO4, CO5,	K1, K2, K3, K4, K5, K6,

Text Books

1. Kalaiselvan P T and Arul Pandi I (2021), Bioprocess technology, MJP publishers pvt ltd, India.
2. Priti Patel and Khushbu Panchal (2020), Bioprocess technology , Scholars' Press pvt ltd, India.
3. Cruger.W and A.Cruger (2017), A Textbook of Industrial Microbiology (2e), Sinauer Associates, Sunderland,US.
4. Michael L Shuler and FikretKargi (2015), Bioprocess Engineering: Basic Concepts, Prentice-Hall of India Pvt Ltd, India
5. Stanbury P.F., Whitaker A. and Hall S.J (2017), Principles of Fermentation Technology. Elsevier India Pvt Ltd, India.
6. Casida, L.E.J.R (2019). Industrial Microbiology, 2019. Second Edition. New age International (P) Ltd., Publishers. New Delhi, India.

Reference Books

1. Michael L Shuler FikretKarg. (2017). Bioprocess Engineering Basic concepts, 2nd Edition, Prentice Hall International services.
2. Peter F Stanbury, Allan Whitaker, Stephen J Hall. (2016). Principles of Fermentation Technology, 2nd Edition, Elsevier Science Ltd. Netherlands
3. Wulf Crueger and Anneliese Crueger. (2000). Biotechnology-A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishing Corporation New Delhi, India
4. Pauline M. Doran. (2012). Bioprocess Engineering Principles, Elsevier.Netherlands
5. Joe, M.M. P.K.Sivakumar&K.Sukesh (2018). An Introduction to Industrial Microbiology.S. Chand Publishing. India

Web References

- 1.<https://www.youtube.com/watch?v=emUoAVOBGec>
- 2.<https://www.youtube.com/watch?v=eXEpiarmYkY>
- 3.https://www.youtube.com/watch?v=Tdb0N_PMpEI
- 4.<https://www.youtube.com/watch?v=opfPTm3z0rE>
- 5.https://www.youtube.com/watch?v=YT34E_DJH24

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity

Course Designer

Dr. S. Jeyabharathi

Semester: IV	Internal Marks:40		External Marks:60	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB4CCC3A	BIOINFORMATICS AND BIOSTATISTICS	CORE CHOICE COURSE	6	4

Course Objective:

The important objective of this course is to enable the student to understand scope and popular databases of bioinformatics and methods of biostatistics. This syllabus gives a broad account of sequence alignment and approaches to drug discovery using bioinformatics techniques.

Prerequisite

Basic knowledge and concept of bioinformatics and applications of biostatistics

Course Outcome

COs	CO Statement	Knowledge level
CO1	Understand scope and popular databases of bioinformatics	K2, K3
CO2	Explain sequence alignment methods	K4, K5
CO3	Explain drug development using bioinformatics	K5, K6
CO4	Compute the measures of central tendency	K4, K6
CO5	Examine the various large sample testing of hypothesis	K4, K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	3	3	3	3
CO2	2	3	2	3	3	3	3	2	3	3
CO3	3	2	3	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	2	3	3	2	3	3	3

1-Slight (Low) correlation

2-Moderate (Medium) correlation

3-Substantial (High) correlation

“-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Important contributions - aims and tasks of bioinformatics - applications of bioinformatics - challenges and opportunities. Computer -types, servers and operating system, internet basics - HTML. Biological databases- primary, composite and secondary - Nucleic acid database, Protein database sequence. Structure databases, bibliographic databases - specialized genomic resources.	18	CO1, CO2, CO3	K1, K2, K3, K4, K5
II	Sequence analysis of biological data -significance and Types of sequence alignment-pair wise alignments (FASTA & BLAST) - Models - Global, Local, End space free alignment and gap penalty. Multiple sequence alignment-methods, Clustal W.	18	CO1, CO2, CO3	K1, K2, K3, K4, K5
III	Bioinformatics in drug development: Discovering a drug - target identification and validation-identifying the lead compound – optimization of lead compound-chemical libraries. Cheminformatics and pharma co informatics. NGS.	18	CO1, CO2, CO3	K1, K2, K3, K4, K5
IV	Measures of central tendency - Mean, Median, Mode, Geometric mean and Harmonic mean - Measures of Dispersion- Range, Mean Deviation, Standard Deviation- Correlation-Regression.	18	CO4, CO5	K1, K2, K3, K4, K5,
V	Hypothesis Testing and Large sample tests - Population and sample-Estimation Theory- Point Estimation - Interval Estimation – Testing of hypothesis-Test of significance of mean for Large samples-Test of significance of difference between two means for Large samples- Test of significance for difference between of two standard deviations for Large samples- Test of significance for single proportion for Large samples- Test of significance of difference between two sample for large samples	18	CO4, CO5	K1, K2, K3, K4, K5, K6
VI	Self Study for Enrichment (Not to be included for End Semester Examination) Homology Search, Phylogenetic tree construction (MEGA), Protein structure prediction (Secondary & Tertiary), RNA Structure prediction, function prediction (proteins), Protein-protein interaction.		CO1, CO2, CO3	K1, K2, K3, K4, K5

Text books

1. R. Amjesh and S.S.Vinochandra (2019). Bioinformatics for Beginners, Lamber Academic Publishing
2. C.S.V.Murthy (2016). Bioinformatics, Himalaya Publishing House
3. Gautam B. Singh (2015). Fundamentals of Bioinformatics and Computational Biology, Springer Cham Heidelberg, New York
4. K. Subramanian & A. Santha (2012). Statistics for Management Scitech publications
5. P.N.Arora&P.K. Malhan (2012). Biostatistics Himalaya Publishing House

Reference books

1. K.G. Srinivasa, G.M. Siddeshand S.R. Manisekhar (2020). Statistical Modelling and machine leaning principles for bioinformatics techniques, tools and applications (Algorithms for intelligent systems), Springer publications.
2. NoorAhmad Shaik (2019). Essentials of bioinformatics in silico life sciences, medicine. KindleEdition
3. William T. Loging (2016). Bioinformatics and computational biology in drug discovery and Cambrindge University press
4. R.S.N. Pillai & V.Bagavathi (2016). Statistics Theory and Practice, S.Chand
5. BernardRosner (2006). Fundamentals of Biostatistics, Lengage learning

Weblinks

1. https://en.wikipedia.org/wiki/Sequence_alignment
2. <https://www.technologynetworks.com/drug-discovery/articles/target-identification-validation-in-drug-discovery-312290>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3058157>
4. https://en.wikipedia.org/wiki/Sequence_database
5. https://saylordotorg.github.io/text_introductory-statistics/s12-02-large-sample-tests-for-a-popul.html
6. <https://www.analyticsvidhya.com/blog/2017/03/conditional-probability-bayes-theorem/>

Pedagogy

Power point presentation, Seminar, Assignment and Quiz

Course Designer

Dr.P.Bhuvaneswari

Dr.R. Radha

Semester: IV	Internal Marks: 25	External Marks: 75		
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDITS
22PMB4CCC3B	COMPUTATIONAL BIOLOGY	CORE CHOICE COURSE	6	4

Course Objective: The important objective of this course is to enable the students to understand scope and popular sequence of computational biology.

Prerequisites:

Basic knowledge and concept of Computational biology.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive level
CO1	Understand scope and popular sequence of statistics	K1, K2
CO2	Explain multiple sequence alignment methods	K3, K4
CO3	Explain protein 3-D structure alignment	K3, K4
CO4	Compute neural network concepts	K4, K5
CO5	Examine the analysis and prediction of regulatory regions	K5, K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2	2	3	3	2	2
CO2	2	2	2	2	3	2	2	3	2	2
CO3	3	2	1	2	3	3	2	2	3	1
CO4	2	3	2	3	2	2	3	2	2	2
CO5	2	2	3	2	2	1	2	3	2	3

“1”- Slight (Low) Correlation

“3”- Substantial (High) Correlation

“2”- Moderate (Medium) Correlation

“-“ indicate there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Sequence alignment algorithms: pairwise alignment - Local and Global alignment concepts -dynamic programming methodology- Smith-Waterman algorithm — Databases searches for homologous sequences - FASTA and BLAST - Statistics of alignment score – p-value – E-value.	18	CO1, CO2, CO3	K1, K2, K3, K4
II	Multiple sequence alignment – methods of multiple sequence alignment Progressive alignment – Clustal W, T-Coffee – Application of multiple sequence alignment - PRINTS, BLOCKS, PRINTS, PRODOM, PFAM – principles and methods for phylogenetic tree construction – NJ, ML and MP –evolutionary models	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	Protein 3-D structure - comparison and alignment – structure superposition – RMSD– structure alignment methods – DALI, SSAP, CE – multiple structure alignment.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	Protein Secondary structure prediction – Chou-Fasman, Garnier - Osguthorpe-Robson (GOR) methods – Neural network concepts and secondary structure prediction – amphipathic helix prediction – transmembrane structure prediction.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Fragment assembly - Genome sequence assembly - Gene finding methods: content and signal methods – Analysis and prediction of regulatory regions - Probabilistic models: Markov chain – random walk – Gene identification and other applications.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	Self Study for Enrichment (Not to be included for End Semester Examination) structure superposition, Neural network concepts and secondary structure prediction, - Probabilistic models		CO1, CO2, CO3	K1, K2, K3, K4, K5

Text Books

1. Robbe Wiinschiers, Computational Biology : A practical Introduction to Biodata processing and Analysis with Linux, MySQL, and R. (Second Edition), Springer Publication,2013.
2. Shawn T. O'Neil, A Primer for Computational biology.2017
3. Bernhard Haubold, Thomas Wiehe, Introduction to Computational biology: An Evolutionary Approach. Springer Publication,2008.
4. Scott T.Kelley and Dennis Didulo,AHypertext book Computational biology.2022
5. Alona S.Russe ,Computationalbiology.Nova science Publishers.2009
6. B.Thiagarajan,Pa.Rajalakshmi, Computational biology.(1st Edition),MJP Publishers.2013

Reference Books

1. David W. Mount, Bioinformatics – Sequence and Genome analysis, Cold Spring Harbor Laboratory Press, New York, 2001.
2. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi (2003).
3. D. Higgins and W. Taylor (Eds), Bioinformatics- Sequence, structure and databanks, Oxford University Press, New Delhi (2000).
4. R. Durbin, S.R. Eddy, A. Krogh and G. Mitchison, Biological Sequence Analysis, Cambridge Univ. Press, Cambridge, UK (1998).
5. A. Baxevanis and B.F. Ouellette. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley- Interscience, Hoboken, NJ (1998).
6. P.E. Bourne and H. Weissig (Eds.) Structural Bioinformatics, John-Wiley and Sons, 2003
7. C. Gibas and P. Jambeck, Developing Bioinformatics Computer Skill, 1st Edition, O'Reilly, 2001O'Reilly, 2001.

Web Reference

1. <https://dspace.mit.edu/bitstream/handle/1721.1/103560/6-047-fall2008/contents/lecture-notes/index.htm>
2. <https://ocw.mit.edu/courses/6-047-computational-biology-fall-2015/67001fcd838c877d>
3. <https://www.brics.dk/DS/00/5/BRICS-DS-00-5.pdf>
4. <https://www.technologynetworks.com/drug-discovery/articles/target-identification-validation-in-drug-discovery-312290>.

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity.

Course Designer

Dr.J.Ambika

Semester: IV	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	CREDITS
22PMB4CCC3C	MICROBIAL NANOTECHNOLOGY	CORE CHOICE COURSE	6	4

Course objective

The most important objectives that are frequently found in nanobiology involve applying nanotools to relevant medical/ biological problems and refining these applications. Microbes are playing an important role in the synthesis of nanoparticles. This syllabus would enlighten the students to understand basic concepts and application of nanotechnology.

Prerequisite

Basic knowledge and concept of nanoparticles and its application

Course Outcome:

CO Number	CO Statement	Knowledge level
CO1	Apply the basics of Nanoscience, able to differentiate particles at macro, micro and nano level	K4, K5
CO2	Know how to synthesize nano particles on a laboratory scale	K2, K5
CO3	Critique knowledge about characterization of nanoparticles	K3, K4
CO4	Explain the application of nanoparticles	K3, K5,
CO5	Expand about merits and demerits of nanoparticles	K5, K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	3	3	2	2	3	2	3
CO2	3	3	2	3	3	2	2	3	3	3
CO3	2	3	3	2	3	3	3	2	3	3
CO4	2	3	3	3	2	3	2	3	3	3
CO5	3	3	2	3	3	3	3	2	3	3

“1” – Slight (Low) Correlation

“2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation

“-“ indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Introduction to bio nanotechnology - Milestones in History – bio nanotechnology – concept and future prospects – application in Life Sciences. Terminologies – nanotechnology, bio nanotechnology, nano biomaterials, biocompatibility, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles, nano sensors. Biotechnology to bio nanotechnology, Current status of bio nanotechnology.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	Microbial nanotechnology –Microbial synthesis of Nanoparticles. Synthesis of nanodrugs – metal nanoparticles and drug delivery vehicles – Nano shells – T ectodentrimers Nanoparticle drug systems – Diagnostic applications of nanotechnology. Preparation of nano biomaterials – Polymeric scaffolds collagen, Elastins: Mucopolysaccharides, cellulose and derivates; Dextrans; Alginates; Pectins; Chitin.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Types of nanoparticles and methods of characterization - Nanoparticles – types, functions – Silver, Gold and Titanium. Physical and chemical properties of nanoparticles. Characterization of nanoparticles – UV-Vis spectroscopy, particle size analyzer, Electron Microscopy – HRTEM, SEM, AFM, EDS, XRD	18	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5
IV	Applications of bio nanotechnology - Drug and gene delivery – protein mediated and nanoparticle mediated. Uses of nanoparticles in MRI, DNA and Protein Microarrays. Nanomedicines, Antibacterial activities of nanoparticles. Nanotechnology in agriculture. Toxicology in nanoparticles – Dosimetry. Nano therapy for cancer treatment – Interior artery expansions – Replacing joints with better stuff. - Radioactive tubere ne cages in Nuclear medicine.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Merits and demerits of nanoparticles – drug targeting, protein detection, MRI, development of green chemistry – commercial viability of nanoparticles. Cleaning the air with Nanotechnology – Nanotechnology for water treatment. Microbial nanoparticles. Nanocarbon ball as deodorizer in ferment process. Biomotors for engineered devices. Possible harm from Nanomaterials. Nanoscience in India – Nanoscience education abroad – Looking at ethics and society. Disadvantages – pollution and health risks associated with nanoparticles.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

VI	Self Study for Enrichment (Not to be included for End Semester Examination) Nanobiometrics - Introduction – lipids as nano-bricks and mortar- Self assembled nanolayers - the bits that do things - proteins – DNA Computer	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
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Text Books

1. T. Pradeep (2017). NANO: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw Hill Education Publisher
2. Risal Singh Shipra MitalGupta (2018). Introduction to Nanotechnology, Oxford University Press.
3. Chattopadhyay K.K.. (2019). Introductionto Nanoscience and Nanotechnology Prentice Hall India Learning Private Limited.

Reference Books

1. M. A. Shah and K. A. Shah. (2019). Nanotechnology, Wiley; Second edition.
2. N. Sriraam. (2019). Biomedical and Clinical Engineering for Healthcare Advancement, 1edition, Business Science Reference
3. Mahendra Rai, Patrycja Golińska (2020). Microbial Nanotechnology, 1st edition, CRC Press

Web links

1. <https://www.ncbi.nlm.nih.gov/pubmed/17947022>
2. <https://www.springeropen.com/p/nano>
3. <https://www.worldscientific.com/worldscibooks/10.1142/7364>
4. <http://www.imedpub.com/journal-nanoscience-nanotechnology-research/>

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment,Brain Storming activity.

Couse Designer

Dr. P.Bhuvaneswari

Semester: IV	Internal marks: 40	External marks: 60		
COURSECODE	COURSE TITLE	CATEGORY	HRS / WEEK	CREDIT
22PMB4CC4P	BIOPROCESS TECHNOLOGY (P)	CORE PRACTICAL	6	5

Course Objective:

- To understand the rules and procedures to be observed in a laboratory
- To familiarize and understand the parts and use of microscopes.

Prerequisite

- The technical skills are understood on immobilization and purification techniques of enzymes.

Course Outcome and Cognitive Level Mapping

COS	CO Statement	Knowledge Level
CO1	Illustrate media preparation, sterilization	K2
CO2	Describe about the Ethanol production	K2
CO3	Organized view of industrially important products from microbes	K3
CO4	To isolate the industrially important microorganisms.	K4
CO5	Explain about the isolation of microbes from foods.	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3	2	2	3	2	3
CO2	3	3	2	3	3	2	2	3	3	3
CO3	2	3	3	2	3	3	3	2	3	3
CO4	2	3	3	3	2	3	2	3	3	3
CO5	3	2	2	3	3	3	3	2	3	3

“1”- Slight (Low) Correlation

“3”- Substantial (High) Correlation

“2”- Moderate (Medium) Correlation

“-“ indicate there is no correlation

Syllabus

1. Media preparation, Sterilization.
 2. Culture transfer technique, Isolation of Pure culture.
 3. Culture optimization (pH, Temperature, Carbon & Nitrogen sources).
 4. Bacterial Growth Curve.
 5. Production and analysis of Ethanol using *Saccharomyces cerevisiae*
 6. Microbial production of citric acid using *Aspergillus niger*.
 7. Immobilization of cells for enzyme production.
 8. Alcohol production by yeast fermentation and its estimation.
 9. Techniques to determine microbial contamination.
 10. Purification of enzymes by salting and dialysis and column chromatography technique.
- .

References

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. John P. Harley Microbiology Lab Manual (2007) 7th edition McGraw Hill Medical Publication division.
6. Donal M. Weir, John Steward (1993) Immunology – VII edition. ELBS, London.
7. Richard M. Hyde (1995). Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing company.

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Quiz, Seminar

Course Designer

Dr.J.Ambika

Semester: IV	Internal marks: 25		External marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS/WEEK	CREDIT
22PMB4GEC2	ENTREPRENEURIAL MICROBIOLOGY	GENERIC ELECTIVE COURSE	3	2

Course Objective:

This course is designed to provide comprehensive knowledge to the students regarding Entrepreneurial Microbiology.

Prerequisites

To Comprehend and analyze entrepreneurial microbiology.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Define the basics of entrepreneur development	K1
CO2	Recite the knowledge about fermentation products	K1
CO3	Critique knowledge about mushroom cultivation	K4
CO4	Generalize the basic idea of patents	K6
CO5	Expand the role of brewing	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2	3	2	3	2	3
CO2	3	3	2	3	3	2	2	3	3	3
CO3	2	3	3	2	3	3	3	2	3	2
CO4	2	3	3	3	2	3	2	3	2	3
CO5	3	3	2	3	3	3	3	2	3	3

“1” – Slight (Low) Correlation “2” – Moderate (Medium) Correlation

“3” – Substantial (High) Correlation “-” indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Introduction to Entrepreneur- Entrepreneur development, activity, Institutes involved, Government contributions to entrepreneurs, risk assessment. Industrial Microbiology, Definition, scope and historical development.	9	CO1, CO2, CO4, CO5	K1, K2, K3, K4, K5
II	Microbial cells as fermentation products- Bakers yeast, food and feed yeasts, Bacterial Insecticides, Legume Inoculants, Mushrooms, Algae. Enzymes as fermentation products. Bacterial and Fungal Amylases, Pectinases, Invertases, and other enzymes.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Mushroom cultivation and Composting- Cultivation of <i>Agaricus campestris</i> , <i>Agaricus bisporus</i> , and <i>Volvariella volvaciae</i> ; Preparation of compost, filling tray beds, spawning, maintaining optimal temperature, casing, watering, harvesting, storage. Biofertilizers- Historical background, Chemical fertilizers versus biofertilizers. <i>Rhizobium sp</i> , <i>Azospirillum sp</i> , <i>Azotobacter sp</i> , as Biofertilizers.	9	CO1, CO2, CO3, CO4	K2, K3, K4, K5
IV	Patents and secret processes- History of patenting, composition, subject matter and characteristics of a patent, Inventor, Infringement, cost of patent. Patents in India and other countries.	9	CO1, CO2, CO3, CO4	K2, K4, K5, K6
V	Brewing- Media components, preparation of medium, Microorganisms involved, maturation, carbonation, packaging, keeping quality, contamination, by products.	9	CO1, CO4, CO5	K1, K2, K3, K4, K5
VI	Self-Study for Enrichment (Not included for End Semester Examinations) Proteolytic Enzymes, Fermentation Economics, Production of Industrial alcohol, organic farming.	-	CO1, CO2, CO3, CO4	K2, K3, K4, K5

Text Books

1. A. C. Shukla (2023). Entrepreneurship with Microorganisms (Developments in Applied Microbiology and Biotechnology), Academic Press Inc.
2. Natarajan Amaresan, Dhanasekaran Dharumadurai, Olubukola Oluranti Babalola (2023). Food Microbiology Based Entrepreneurship: Making Money from Microbes, Springer Verlag, Singapore.
3. Dr. Rohit Shankar Mane, Rachana Nagarkar, Arnav Padhi (2022). Entrepreneurship in Microbiology, Scientist R Academy.
4. Natarajan Amaresan, Dhanasekaran Dharumadurai, Diana R. Cundell (2022). Industrial Microbiology Based Entrepreneurship: Making Money from Microbes, Springer.
5. Natarajan Amaresan, Dhanasekaran Dharumadurai, Olubukola Oluranti Babalola (2022). Agricultural Microbiology Based Entrepreneurship: Making Money from Microbes, Springer Verlag, Singapore.

Reference Books:

1. Apurba SSastry, Sandhya Bhat (2023). Essentials of Medical Microbiology, Jaypee Brothers Medical Publishers.
2. C.P Baveja (2022). Textbook of Microbiology, Arya Publishing.
3. Dorothy Wood, Joanne Willey, Kathleen Sandman (2022). Prescott's Microbiology, 12th Edition, McGraw-Hill Education.
4. V Baveja C P Baveja (2022). Text and Practical Microbiology for MLT 3rd Edition, Arya Publishing Company.
5. Apurba SSastry, Sandhya Bhat (2021). Essentials of Practical Microbiology, Jaypee Brothers Medical Publishers.

Weblinks:

1. [https://en.wikipedia.org/wiki/Bioinformatics#:~:text=Bioinformatics%20\(%2F%CB%8Cba%C9%AA.,sets%20are%20large%20and%20complex.](https://en.wikipedia.org/wiki/Bioinformatics#:~:text=Bioinformatics%20(%2F%CB%8Cba%C9%AA.,sets%20are%20large%20and%20complex.)
2. <https://www.genome.gov/genetics-glossary/Bioinformatics>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122955/>
4. <https://academic.oup.com/bioinformatics>
5. <https://www.britannica.com/science/bioinformatics>

Pedagogy

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

Course Designer

Dr.P.F.Steffi