CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

Nationally Accredited with 'A^{+}' Grade by NAAC

TIRUCHIRAPPALLI

PG AND RESEARCH DEPARTMENT OF MICROBIOLOGY

M.Sc., MICROBIOLOGY

SYLLABUS

2024 -2025 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 2023-2024 and onwards)

Semester	Course	Title	Course Code	Inst./ Hrs/Week	Credit	Hrs	Marks		Total
							Int.	Ext.	
I	Core Course – I (CC I)	General Microbiology and Microbial Diversity	23PMB1CC1	6	5	3	25	75	100
	Core Course – II (CC II)	Biological Macromolecules	23PMB1CC2	6	5	3	25	75	100
	Core Course – III (CC III)	Molecular Biology and Microbial Genetics	23PMB1CC3	6	5	3	25	75	100
	Core Practical – I (CP)	General Microbiology and Microbial Diversity, Biological Macromolecules, Molecular Biology and Microbial Genetics(P)	23PMB1CC1P	8	5	3	40	60	100
	Discipline Specific Elective Course – I(DSE)	A. Biological Instrumentation	23PMB1DSE1A	4	3	3	25	75	100
		B. Microalgal Technology	23PMB1DSE1B						
		C. Molecular Taxonomy and Phylogeny	23PMB1DSE1C						
	TOTAL			**30**	**23**				**500**
15 Days INTERNSHIP during Semester Holidays									
II	Core Course- IV (CC)	Bacteriology and Mycology	23PMB2CC4	6	5	3	25	75	100
	Core Course – V(CC)	Immunology and Immunotechnology	23PMB2CC5	6	5	3	25	75	100
	Core Choice Course – I (CCC)	A. Microbial Metabolism	23PMB2CCC1A	5	4	3	25	75	100
		B. Microbial Physiology	23PMB2CCC1B						
		C. Microbial Growth and nutrition	23PMB2CCC1C						
	Core Practical–II (CP)	Bacteriology, Mycology, Immunology and Immunotechnology (P)	23PMB2CC2P	9	5	3	40	60	100
	Discipline Specific Elective Course – II (DSE)	A. Medical Microbiology	23PMB2DSE2A	4	3	3	25	75	100
		B. Public Health Microbiology	23PMB2DSE2B						
		C. Medical Parasitology	23PMB2DSE2C						
	Internship	Internship	23PMB2INT	-	2	-	-	100	100
	Extra Credits Course	SWAYAM	As Per UGC Recommendation						
	TOTAL			**30**	**24**	-	-	-	**600**

III	Core Course-VI (CC)	Virology	23PMB3CC6	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 GeneTechnology	22PMB3CCC2B						
		C. Biosafety and Intellectual Property Rights	22PMB3CCC2C						
	Core Practical-III (CP)	Virology, Food and Dairy Microbiology (P)	23PMB3CC3P	6	4	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 LaboratoryTechnology	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**	**23**	**-**	**-**	**-**	**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	23PMB4PW	9	4	-	-	100	100
		TOTAL		**30**	**20**	**-**	**-**	**-**	**500**
		GRAND TOTAL		**120**	**90**	**-**	**-**	**-**	**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	19	400
4.	Discipline Specific Elective- (DSE)	3	9	300
5.	Generic Elective Course - (GEC)	2	4	200
6.	Project	1	4	100
7.	Internship	1	2	100
	Total	22	90	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**
23PMB1CC1	**GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY**	**CORE**	**6**	**5**

Course Objectives

To enable the students to understand the history, biology of microorganisms, growth and control of microbes the diversity of microbes

Prerequisites

Basic knowledge and concepts of microbiology

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand the history and principles of Microscopy	K1, K2
CO2	Analyze and explain bacteria, fungi, algae, protozoa and virus	K3, K4
CO3	Determine and apply pure culture techniques and sterilization methods.	K3, K4
CO4	Evaluate and categorize microbial biodiversity and kingdom concepts	K4, K5
CO5	Criticize and manage Extremophiles and conservation of microbial diversity.	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. Microscopy– Principles and applications. Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Sample preparation for SEM & TEM. Atomic force, Confocal microscope. Micrometry – Stage, Ocular and its applications.	20	CO1, CO2, CO3	K1, K2, K3, K4
II	Bacteria – Size, shape and arrangements, cell wall of Gram positive and Gram negative bacteria, Structure and function of flagella, fimbriae and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. General characteristics and nature of Archaeobacteria, Cyanobacteria, Mycoplasma, Rickettsiae, Chlamydia, Spirochaetes, Actinobacteria, Protozoa, Algae, Fungi, lichens and Viruses.	20	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	Microbial techniques - Safety guidelines in Microbiology Laboratories. Sterilization, Disinfection and its validation. Staining methods–Simple, Differential and Special staining. Pure cultures techniques, Maintenance and preservation of pure cultures. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth, Batch culture, Synchronous growth, Measurement of growth and factors affecting growth.	15	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	Microbial Biodiversity - Introduction to microbial biodiversity, kingdom concepts- Haeckel's three kingdom concept, Whittaker's five kingdom concept, Carl Woes three domain system, Cavalier - smith eight kingdom concept. Major characteristics used in microbial taxonomy – morphological, physiological, metabolic, serological and molecular. Bacterial classification (outline) according to Bergey's manual of systemic Bacteriology. Basic understanding of classification of algae-Fritch, fungi-Alexopoulos, viruses- ICTV and protozoa.	20	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6,
V	Extremophiles- Thermophiles, Mesophiles, Psychrophiles, Acidophilic, Alkalophilic and Halophilic microorganisms-habitats and biotechnological applications. Conservation of microbial biodiversity.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study for Enrichment (Not included for End Semester Examinations)** Giant bacteria, Cultivation of Anaerobic organisms. Modern methods and Nomenclature of microbial taxonomy	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Dave Wessner, Christine Dupont, Trevor Charles, Josh Neufeld. Microbiology (3rdEdition), Wiley, 2020.
2. Bhagwan Rekadwad. Microbial Systematics: Taxonomy, Microbial Ecology, Diversity (1st Edition), CRC Press, 2020.
3. Michael J. Le Boffe, Burton E. Pierce. Microbiology: Laboratory Theory & Application (1st Edition), Morton Publishing Company, 2019.
4. Jeffrey C. Pommerville. Fundamentals of Microbiology (12th Edition), Jones & Bartlett Learning, 2021.
5. Bhagwan Rekadwad. Microbial Systematics: Taxonomy, Microbial Ecology, Diversity (1st Edition), CRC Press, 2020.
6. Anita Pandey, Avinash Sharma. Extreme Environments: Unique Ecosystems – Amazing Microbes (1st Edition), CRC Press, 2021.
7. Ravi V. Durvasula and D. V. Subba Rao. Extremophiles: From Biology to Biotechnology (1st Edition), CRC Press, 2018.

Reference Books

1. Gerard Tortora , Berdell Funke, Christine Case, Derek Weber, Warner Bair. Microbiology: An Introduction (12th Edition), Pearson, 2020.
2. Barry Chess. Talaro's Foundations in Microbiology: Basic Principles (7th Edition), Mc Graw Hill, 2020.
3. Lourdes Norman-McKay. Microbiology: Basic and Clinical Principle, (1st Edition), Pearson, 2018.
4. Joanne Willey, Kathleen Sandman, Dorothy Wood. Prescott's Microbiology (12th edition), Mc Graw Hill, 2022.
5. Richa Salwan and Vivek Sharma. Physiological and Biotechnological Aspects of Extremophiles (1st Edition), Academic Press, 2020.
6. Satyanarayana, T, Johri, B. N. Microbial Diversity: Current Perspectives and Potential Applications (1st Edition), Dream tech Press, 2021.
7. Masrure Alam and Bipransh Tiwary. Extremophiles: Diversity, Adaptation and Applications, Bentham Science Publishers, 2023.

Web References

1. https://microbenotes.com/category/basic-microbiology/
2. https://microbiologyinfo.com/
3. https://www.biologydiscussion.com/notes/microbiology-notes/notes-microbiology-biology/34235
4. https://www.britannica.com/science/microbiology
5. https://byjus.com/neet/classification-of-microorganisms-notes/
6. https://microbenotes.com/microbiology-of-extreme-environments/

Pedagogy

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

Course Designer

Dr. S. Jenny

SEMESTER I	INTERNAL MARKS :25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDIT**
23PMB1CC2	**BIOLOGICAL MACROMOLECULES**	**CORE COURSE – II (CC II)**	**6**	**5**

Course Objective : This course is designed to provide comprehensive knowledge to the students regarding the structure and functions biological molecules**.**

Prerequisites

To Comprehend and analyze the basics of biological molecules.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Define the structure and functions biological molecules.	K1
CO2	Recite the interrelationship between various biomolecules and consequences of any deviation from normal.	K1
CO3	Critique knowledge about the structure and functions of blood, hormones and phytohormones.	K4
CO4	Generalize the basic idea of metabolic regulators' characteristic features.	K6
CO5	Expand the interrelationships among biological energy, functions and health.	K6

Mapping with Programme Outcomes:

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 "2" – Moderate (Medium) Correlation

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

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	Carbohydrate: Definition, sources, classification, structure of glucose, biologica significance, digestion and absorption Proteins: Definition, sources, classification and structure of proteins (Primary, secondary tertiary), Amino acids– structure- classification - essential andnonessential, protein and non protein amino acids.	18	CO1, CO2, CO4, CO5	K1, K2, K3, K4, K5
II	Lipids: Definition, sources, classification structure, properties and functions, Fatty acids saturated, unsaturated and essential fatty acids Nucleic acids: Definition, structure, forms and functions of DNA. Types, structure and functions of RNA (mRNA, tRNA, rRNA).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Hormones: Definition, classification of hormones, Human- Endocrine glands – Pituitary, thyroids, Para thyroid, pancreas, adrenal, testis and ovary. Phytohormones: Structure and functions of auxin, gibberellins, cytokinins and abscissic acid.	18	CO1, CO2, CO3, CO4	K2, K3, K4, K5
IV	Vitamins – Definition, sources, deficiency syndromes and functions of Fatsoluble vitamins (A, D, E and K) and Water-soluble vitamins (B complex and C). Minerals Zn, Ca, Iodine, Fe, andMg.	18	CO1, CO2, CO3, CO4	K2, K4 K5, K6
V	Blood: Introduction, origin, composition, characterization, functions and coagulation of blood. General account and secondary metabolites. Major and accessory microbial pigments – chlorophylls, carotenoids, phycobilins and anthocyanins.	18	CO1, CO4 , CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment (Not included for End Semester Examinations** Diseases associated with deficiency of endocrine hormones- hypo and hyper secretions. Life style diseases and metabolic diseases. Diet biochemical- health. Food as drug.	-	CO1, CO2, CO3, CO4	K2, K3, K4, K5

Text Books:

1. Chandrabhan Verma, Dakeshwar Kumar Verma (2023).Handbook of Biomolecules, Fundamentals, Properties and Applications 1st Edition. Elsevier publishers.
2. Shikha Kaushik and Anju Singh (2023) Biomolecules from Genes to Proteins. De Gruyter.
3. Ambika Shanmugam (2016). Fundamentals of Biochemistry for Medical students. 8th Edition, Wolters Kluwer (India) Pvt ltd.
4. Rafi (2014). Textbook of Biochemistry for medical students, 2nd edition, Universities Press, (India)Pvt. Ltd,Hyderabad, India.
5. Charlotte W Prattand Sathyanarayana U and Chakrapani U (2013) Biochemistry,4th edition, Elsevier publishers.

Reference Books:

1. Prof. P.K. Gupta (2022). Biomolecules and cell biology. 1st Edition. Rastogi Publications.
2. Devasena (2021). Biomolecules. Mjp Publishers.
3. Dr. Swapnil Yadav (2020). Biomolecules and Cell Biology. Mahaveer Publications.
4. Lubert Stryer; Jeremy Berg; John Tymoczko; Gregory Gatto (2019).Biochemistry,9th Edition. Macmillon Publication.
5. Mohammad Fahad Ullah (2016).Illustrated Notes on Biomolecules. Partridge Singapore.

Web links:

1. https://byjus.com/biology/biomolecules/
2. https://en.wikipedia.org/wiki/Biomolecule
3. https://www.sciencedirect.com/topics/engineering/biomolecule
4. https://ncert.nic.in/textbook/pdf/lech205.pdf
5. https://ncert.nic.in/textbook/pdf/kebo109.pdf

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**
23PMB1CC3	**MOLECULAR BIOLOGY AND MICROBIALGENETICS**	**CORE COURSE-III (CC III)**	**6**	**5**

Course Objective

- To impart the current updated knowledge on molecular genetics of prokaryotes.
- To understand the Genetic replication and repair mechanisms
- To learn about gene transfer mechanisms and their importance in natural evolution
- To provide the required fundamental details on prokaryotic and eukaryotic molecular genetics.

Prerequisites

To obtain basic knowledge in the field of molecular biology.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Explain about molecular genetics of prokaryotes.	K2
CO2	Illustrate transcription and translation.	K3
CO3	Summarize about organization of gene in prokaryotes and eukaryotes.	K4
CO4	Illustrate fundamental details on gene transfer mechanisms.	K5
CO5	Discuss about the processes behind mutations and other genetic changes.	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	Identification of genetic material (Griffith, Avery and Hershey and Chase experiments). Organization of genetic material: Bacteria – Eukaryotes: nucleus and nucleosomes, lamp brush and giant chromosomes. DNA replication - Meselson – Stahl experiment, Molecular mechanisms of DNA Replication – bidirectional and rolling circle replication. Differences between prokaryotic and eukaryotic replication. Pi X 174 replication. Plasmids – types, structure and replication. Inhibitors of DNA replication - DNA repair – mechanism of excision repair, SOS repair and mismatch repair.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Process of transcription – initiation, elongation – termination. Synthesis of mRNA in prokaryotes and eukaryotes. RNA splicing. Synthesis of rRNA and tRNA. RNA processing – capping and polyadenylation. Inhibitors of transcription. Genetic code, process of translation – initiation, elongation and termination. Signal sequences and protein transport. Inhibitors of translation.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Organization of Genes in Prokaryotes and Eukaryotes - Introduction - Operon concept, lac, trp, arabinose operons, promoters and repressors. Regulation of gene expression – Transcriptional control – promoters, terminators, attenuators and anti-terminators; Induction and repression; The lac operon – catabolite repression; trp operon, two component regulatory system. Translational control – ribosome binding,codon usage, antisense RNA; post-transcriptional gene silencing – RNAi.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Transformation – competence cells, regulation, generalprocess; Transduction – general and specialized; Conjugation – Discovery, mechanism of F+ v/s F-, Hfr+ v/s F-, F' v/s F-, triparental mating, self-transmissible and mobilizableplasmids, pili.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Types and molecular basis of mutation– Agents of mutation - Importance of mutations in evolution of species. Discovery ofinsertion sequences, complex and compound transposons – T10, T5, and retroposon – Nomenclature- Insertion sequences – Mechanism – Transposons of E. coli, Bacteriophage and Yeast. Isolation, analysis and detection methods of Mutants. Uses of Mutants. Importance of transposable elements in horizontal transfer of genes and evolution. Mobile genetic Elements – IS elements.	18	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

VI	**Self Study for Enrichment** **(Not included for End Semester Examination)** Discuss gene-therapy workflow from production to qualitycontrol	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books

1. Krishnaiah G.R. (2019). Microbial Genetics & Molecular Biology (1st edition) Blue Rose Publisher
2. Verma P. S. and Agarwal A. K. Cell Biology, (2018). Genetics, Molecular Biology, Evolution andEcology S. Chand Publishing.
3. Primrose S.B. and Twyman R.M. (2016). Principles of Gene Manipulation and Genomics (8th edition)Wiley-Blackwell Publisher.
4. Gerald Karp, Janet Iwasa,(2015). Wallace Marshall Karp's Cell and Molecular Biology: Concept andExperiments (8th edition) Wiley Publisher.
5. David Freifelder, John E. Cronan and Stanley R Maloy (2014). Microbial Genetics (2nd edition) Jones& Bartlett Publishers.

Reference Books

1. Hartl, Daniel L.(2019). Genetics: Analysis of genes and genomes. (9th Edition) Jones & Bartlett Learning.
2. Peter Snustad D and Michael J. Simmons, (2015). Principles of Genetics (7th Edition) Wiley.
3. Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter,(2014). Walter Molecular Biology of the Cell (6th Edition) Garland Science, W. W. Norton &Company.
4. Krebs J. E., Kilpatrick T. and Goldstein E. S. Lewins,(2014). Genes IX Viva Books Pvt Ltd. 2014
5. Larry Snyder, Joseph E. Peters, Tina M. Henkin, Wendy Champness,(2014). Molecular Genetics of Bacteria (4th Edition) ASM Press.

Web References

1. .https://books.google.co.in › books 2.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

Pedagogy

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

Course Designer

Ms.S.Sathya

Semester: I	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS./WEEK**	**CREDITS**
23PMB1CC1P	**GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY, BIOLOGICAL MACROMOLECULES, MOLECULAR BIOLOGY AND MICROBIAL GENETICS (P)**	**CORE PRACTICAL**	**8**	**5**

Course objective

To educate hands-on skills on the first-line experimental methods of General Microbiology and MicrobialDiversity, Biological Macromolecule, Molecular Biology and Microbial Genetics.

Prerequisites

The stakeholders will acquire a strong basic knowledge in common microbiology laboratory procedures.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Understand fundamental techniques of microscopy, staining and sterilization.	K1, K2
CO2	Illustrate the preparation of bacterial growth media, plating and growth measurement techniques.	K2, K3
CO3	Analyze and quantify the biological macromolecules.	K2, K3, K4
CO4	Interpret DNA extraction and gene transfer mechanisms, analyze and identify by gel electrophoresis.	K3, K4, K5
CO5	Discuss isolation of mutants and separation of proteins.	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	3	2	3	3	3	3	3
CO2	3	3	2	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	2	3	3	2
CO4	3	2	3	2	3	3	3	3	2	3
CO5	3	3	3	3	2	3	3	3	3	3

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

"3" - Substantial (High) correlation "-" - indicates there is no correlation

Syllabus

I. General Microbiology and Microbial Diversity

1. Washing and cleaning of glass wares: Sterilization methods – moist heat, dry heat, and filtration.
2. Light microscopic techniques: Wet mount to show different types of microbes and hanging drop method.
3. Staining techniques - Simple staining, Gram's staining, Acid fast staining, Meta chromatic granule staining, Spore and Capsule staining.
4. Media Preparation: Preparation of liquid, solid and semisolid media.
5. Preparation of Agar deeps, Slants and Plates and Biochemical test media.
6. Pure culture techniques: Spread Plate, Pour plate, and Streak plate.
7. Fungal slide culture technique.
8. Direct counts – Total cell count, Turbidometry and Viable count method.
9. Determination of Bacterial growth curve.
10. Effect of physical and chemical factors on growth.

II. Biological Macromolecules

1. Preparation of buffer (Tris, Phosphate, Acetate buffer).
2. Determination of (H+) ion concentration.
3. Carbohydrate reducing sugars - Anthrone method/Benedicts method.
4. Estimation of Aminoacids - Ninhydrin method.
5. Protein–Lowry's method/Biuret method/ Bradford assay.
6. Estimation of Nucleic acid - DNA (diphenyl amine method) and RNA (Orcinol method).

III. Molecular Biology and Microbial Genetics

1. Isolation of Plasmid and genomic DNA from *E. coli*.
2. Characterization of DNA/plasmid by agarose gel electrophoresis and molecular weight determination.
3. Isolation of antibiotic resistant microbes.
4. Isolation of mutants by spontaneous mutation – Gradient plate technique.
5. Replica plating technique.
6. Transformation: Competent cell preparation.
7. Separation of proteins by polyacrylamide gel electrophoresis (SDS-PAGE)
8. Demonstration of PCR.

Reference Books:

1. Dubey R.C. and Maheshwari D. K. (2023). *Practical Microbiology*, 4th Edition. S. Chand Publisher.

2. James G. Cappuccimo and Chad T. Welsh. (2023). *Microbiology: A Laboratory Manual, Global Edition*, 11th Edition. Pearson Education, Publication.

3. Collee J. G., Fraser A.G., Marmion B. P. and Simmons A. (2023). *Mackie & McCartney Practical Medical Microbiology*. 14th Edition Reprint. Elsevier.

4. Saha R. (2022). *Microbiology Practical Manual*, 2nd edition**.** CBS Publishers & Distributors.

5. Prem Prakesh Sharma and Abhay Dashora. (2021). *Practical: Fundamentals of Genetics*. 1st Edition. Himanshu Publications.

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. Brown T.A. (2020). *Gene Cloning and DNA Analysis: An Introduction*. 8th Edition. John Wiley and Jones, Ltd.

9. Soundravally Rajendiran, Pooja Dhiman. (2019). *Biochemistry Practical Manual*,1st Edition. Elsevier.

10. Ashwani Kumar, Gakhar S K and Monika Miglani. (2019). *Molecular Biology: A Laboratory Manual*.Dreamtech Press.

Web References

1. https://ttk.elte.hu/dstore/document/893/book.pdf

2. https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC103J-lab-manual.pdf

3. https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/

4. https://www.slideshare.net/PatriciaCosta17/practical-handbook-of-microbiology

5. https://www.researchgate.net/publication/320508474_Molecular_Biology_Laboratory_manual

Pedagogy

Chalk and talk, Power Point Presentation, Demo Video and Group Discussions.

Course Designer

Dr. N. Jeenathunisa

Semester: I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS./WEEK**	**Credits**
23PMB1DSE1A	**BIOLOGICAL INSTRUMENTATION**	**ELECTIVE COURSE-I**	**4**	**3**

Course Objectives

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

Prerequisites

Basic understanding of experimental protocols on biological research.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Explain the principles and working mechanisms of laboratory instruments.	K1, K2
CO2	Discuss chromatography techniques and molecular biology techniques.	K3, K4
CO3	Illustrate molecular techniques in biological applications.	K4, K5
CO4	Acquire knowledge on spectroscopic techniques	K5, K6
CO5	Demonstrate the use of radio isotopes in various techniques.	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	1
CO2	3	3	3	2	2	3	2	3	2	3
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	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 laboratory Instruments. Aerobic and anaerobic incubator – Biosafety Cabinets - Fume Hood, pH meter, Lyophilizer, Flow cytometry. Centrifugation techniques: Basic principles of centrifugation: Principles, methodology and applications of differential, rate zonal and density gradient centrifugation	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	General principles of chromatography - Chromatographic Performance parameters; Types- Thin layer chromatography, Paper Chromatography, Liquid chromatography (LPLC &HPLC), Adsorption, ion exchange, Gel filtration, affinity, Gas liquid (GLC).Two dimensional chromatography.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K6
III	Electrophoresis: General principles - moving boundary electrophoresis - two dimensional electrophoresis- Principle and applications - Disc gel, Agarose gel, SDS – PAGE, Immuno electrophoresis. PCR and its application-Thermocycler. Auto analyzer, Next-generation sequencer and Molecular Dogging. Blotting techniques -Southern, northern and western blotting.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K6,
IV	Spectroscopic techniques: Principle, simple theory of absorption of light by molecules, electromagnetic spectrum, instrumentation and application of UV-visible, Raman, FTIR spectrophotometer, spectrofluorimetry, Atomic Absorption Spectrophotometer, NMR, GC-MS.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6,
V	Radio isotopic techniques: Principle and applications of tracer techniques in biology. Radioactive isotopes - radioactive decay; Detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, auto radiography and its applications.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study for Enrichment (Not included for End Semester Examinations)** DNA Finger printing, RFLP, RAPD and AFLP application.	-	CO1, CO2, CO3, CO4, CO5	K4, K5, K6

Text Books

1. Gurdeep R. Chatwal and Sham K. Anand. (2022). Instrumental Method of Chemical Analysis. Himalaya Publishing House.
2. Kour H. (2021.) Instrumental Methods of Chemical Analysis. Pragati Prakashan.
3. Mitchell G. H. (2017). Gel Electrophoresis: Types, Applications and Research. Nova Science Publishers Inc.
4. Mohammad Raies, Asima Hamid, Gulzar Ahmad, Holme D and Peck H. (2019).Analytical Biochemistry. Book Enclave.
5. Jayaraman J. (2020). Laboratory Manual in Biochemistry. (2nd Edition). New Age International (P) Ltd., Publishers.

Reference Books

1. Kaur H (2021) Spectroscopy. Pragati Prakashan.
2. Douglas A. Skoog, James Holler, Stanley R. Crouch. (2020). Principles of InstrumentalAnalysis(7th edition). Cengage India Private Limited.
3. Raymond P.W. Scott. (2020) Techniques and Practice of Chromatography. CRC Press.
4. Gurumani N. (2019). Research Methodology for Biological Sciences. (Kindle Edition) MJPPublishers.
5. Ponmurugan P. and Gangathara P. B. (2021). Biotechniques. (1st Edition). MJP Publishers.

Web References

1. https://norcaloa.com/BMIA
2. http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction-types-uses-and-other-details-with-diagram/12489
3. https://www.watelectrical.com/biosensors-types-its-working-and-applications.
4. http://www.wikiscales.com/articles/electronic-analytical-balance/
5. https://study.com/academy/lesson/what-is-chromatography-definition-types-uses.

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**
23PMB1DSE1B	**MICROALGAL TECHNOLOGY**	**ELECTIVE COURSE- I**	**4**	**3**

Course Objectives

To enable the students to understand the Principles and techniques of microalgae

Prerequisites

Basic knowledge and concepts of microalgal Technology

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand the different groups of algae	K1, K2
CO2	Analyze and explain about the cultivation and harvesting of algae	K3, K4
CO3	Determine and apply commercial applications of various algal products	K3, K4
CO4	Evaluate and categorize microalgae for environmental applications	K4, K5
CO5	Criticize and manage microalgae as alternate fuels	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	Introduction to Algae- General characteristics. Classification of algae according to Fritsch. Salient features ofdifferent groups of algae. Distribution -Freshwater, brackish water and marine algae. Identification methods. Economically important microalgae.	12	CO3	K3, K4
II	Cultivation of freshwater and marine microalgae - Growth media. Isolation and enumeration of microalgae. Laboratory cultivation and maintenance. Outdoor cultivation - Photobioreactors - construction, types and operation; raceway ponds - Heterotrophic and mixotrophic cultivation - Harvesting of microalgae biomass.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	Microalgae in food and nutraceutical applications - Algal single cell proteins. Cultivation of *Spirulina, Chlorella* and *Dunaliella.* Microalgae as aquatic, poultry and cattle feed. Microalgal biofertilizers. Value-added products from microalgae. Pigments - Production of microalgal carotenoids and their uses. Phycobiliproteins - production and commercial applications. Polyunsaturated fatty acids as active nutraceuticals. Microalgal secondary metabolites - Pharmaceutical and cosmetic applications. Macroalgae-seaweeds as a source of polysaccharides.	12	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	Microalgae in environmental applications. Phycoremediation - Domestic and industrial waste water treatment. Sequestration of carbon dioxide. Scavenging of heavy metals by microalgae. Negative effects of algae. Algal blooms, algicides for algal control.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6,
V	Microalgae as feed stock for production of biofuels - Carbon-neutral fuels. Lipid-rich algal strains - *Botryococcus braunii*. Drop-in fuels from algae - hydrocarbons and biodiesel, bioethanol, biomethane, biohydrogen and syngas from microalgae biomass. Life cycle analysis of algae biofuels.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study for Enrichment (Not included for End Semester Examinations)** Bio-remediation – waste water treatment- organic manure for sustainable agriculture.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Sharma O.P. (2021). Algae. Tata McGraw-Hill Education

2. Shekh A., Schenk P., Sarada R. (2021). Microalgal Biotechnology. Recent Advances, Market Potential and Sustainability. Royal Society of Chemistry.
3. Asraful Alam., Jing-Liang Xu**.** Microalgae Biotechnology for Food, Health and High Value Products. (2020). Springer.
4. Bhagwan Rekadwad. Microbial Systematics: Taxonomy, Microbial Ecology, Diversity (1st Edition), CRC Press, 2020.

Reference Books

1. Gerard Tortora , Berdell Funke, Christine Case, Derek Weber, Warner Bair. Microbiology: An Introduction (12th Edition), Pearson, 2020.
2. Barry Chess. Talaro's Foundations in Microbiology: Basic Principles (7th Edition), Mc Graw Hill, 2020.
3. Satyanarayana, T, Johri, B. N. Microbial Diversity: Current Perspectives and Potential Applications (1st Edition), Dream tech Press, 2021.
4. Lele. S.S., Jyothi Kishen Kumar (2018). Algal bio process technology. New Age International P(Ltd)

Web References

1. https://www.classcentral.com/course/algae-10442
2. https://onlinecourses.nptel.ac.in/noc19_bt16/preview
3. https://freevideolectures.com/course/4678/nptel-industrial-biotechnology/46
4. https://nptel.ac.in/courses/103103207
5. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microalgae

Pedagogy

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

Course Designer

Dr. R. Nithyatharani

Semester: I	InternalMarks:25		ExternalMarks:75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**HRS./WEEK**	**Credits**
23PMB1DSE1C	**MOLECULAR TAXONOMYAND PHYLOGENY**	**ELECTIVE COURSE -I**	**4**	**3**

Course Objectives:

To gain knowledge about combination of molecular and statistical techniques.

Course Outcome and Cognitive Level Mapping

COs	CO Statement	Cognitive level
CO1	Define and Understand the basics of taxonomy	K1, K2
CO2	Analyze the Chemotaxonomy	K3, K4
CO3	Determine and Explain the DNA hybridization	K3, K4
CO4	Evaluate and categorize the Sequence alignment	K4, K5
CO5	Criticize and manage Sequence alignment	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 Microbial Taxonomy** Introduction to microbial taxonomy – biological classification – Three Domain Concept, morphological taxonomy, biochemical taxonomy, molecular taxonomy, numerical taxonomy – basic concepts of taxonomy. Positive and negative aspects of each taxonomical method	12	CO1, CO2, CO3	K1, K2, K3, K4
II	**Chemotaxonomy** Chemotaxonomy – aspects, significance- primary – proteins, nucleic acid, chlorophyll, polysaccharides and secondary constituents- phenolic compounds, flavonoids, terpenoids. Finger printing, Isozyme typing, pigments & polyamines. Molecular Phylogeny-use of proteins and fatty acids.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	**Molecular taxonomy** Molecular taxonomy – G + C content, DNA – DNAhybridization, DNA- RNA hybridization, Plasmid profiles, RFLP, RAPD, AFLP, STRR & LTRR.- PCR, Real Time-PCR, PFGE (Pulse Field Gel Electrophoresis); Indirect analysis - SDSPAGE, Western blotting, ELISA, 2D-gel electrophoresis. DNA sequencing – Sanger's Dideoxy sequencing and automated sequencing.	12	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	**Types of rRNA** Types of rRNA, Importance of 16S rRNA in microbial identification and taxonomy. Methods of 16S rRNA / rDNA fingerprinting, Isolation of DNA, amplification of 16S rDNA using PCR, Cloning, transformation, Blue-white screening, Plasmid isolation, Dot Blot/Southern blot hybridization using specific probes. Sequencing of 16S rDNA using chaintermination method.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6,
V	**Introduction to Sequence alignment** Introduction to Sequence alignment. Substitution matrices, Scoring matrices – PAM and BLOSUM. Submission of rDNA sequences in GenBank – BankIt & Sequin guidelines. NCBI, EMBL, PDB, DDBJ – retrieving sequences. In silico RNA structure prediction, Restriction enzyme patterns. Ribosomal Database Project - Designing primers, probes and in silico PCR. Evolutionary analysis: distances, Cladistic and Phenetic methods. Sequence comparison, alignment and database searching – ClustalW, FASTA & BLAST. DNA barcoding	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

VI	**Self Study for Enrichment (Not included for End Semester Examinations)** Field trip and Hands on training on algae sample collection, monitoring algal diversity.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Andréa D, Baxevanis BF. Francis O. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd Edition. Wiley Publications.

2. Brendan Wren and Nick Dorrell. (2002). Functional Microbial Genomics (Volume 33) (Methods in Microbiology), Academic Press, UK.

3. Brown TA. (2006). Genomes, John Wiley and Sons, Pvt. Ltd., Singapore.

Reference Books

1. Campbell A, Heyer. 2004, Discovering Genomics, Proteomics and Bioinformatics, Pearson Education,New Jersey
2. Huson DH and Scornavacca C. (2012). Dendroscope: An Interactive Tool for Rooted PhylogeneticTrees and Networks. Syst. Biol: 1–7.
3. Kenneth WA. (1996). Microbial Genome Methods - Boca Raton : CRC Press, Masatoshi N and Sudhir
4. K. (2000). Molecular Evolution and Phylogenetics - Oxford University press, Inc.
5. Molecular Phylogeny of Microorganisms. (2010). by Aharon O and Thane P. Academic Press,

Web References

1. https://www.youtube.com/watch?v=8IJRzcPC9wg
2. https://www.youtube.com/watch?v=ZWnKemKaEWA
3. https://www.youtube.com/watch?v=vqeZBEJyXx4

Pedagogy

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

Course Designer

Dr.V.Aruna

Semester: II	Internal Marks: 25	External Marks: 75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PMB2CC4	**BACTERIOLOGY AND MYCOLOGY**	**CORE COURSE**	**6**	**5**

Course Objectives

To understand the basic information on bacterial and fungal disease. Important knowledge on host and parasitic infections. Create knowledge on the infection caused by the organism. To understand the pathogenesis of bacterial and fungal diseases.

Prerequisites

Apply their acquired knowledge on laboratory techniques on diagnosis of bacterial and fungal disease.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Determine the host – parasite relationship	K2, K3, K4
CO2	Diagnose the various bacterial pathogens	K3, K4
CO3	Illustrate the *Chlamydia trachomatis*	K4, K5
CO4	Describe and Classify the various fungi and its Characterization	K5, K6
CO5	Discuss the fungal diseases	K1, 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	**Introduction to normal flora**: Indigenous normal microbial flora of human body. General attributes and virulence factors of bacteria causing infections. Host Parasite relationships – Nonspecific host immune mechanisms. Ground rules for collection and dispatch of clinical specimens for microbiological diagnosis and discarding of clinical Specimens.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3, K4 K5, K6
II	**Bacteriology:** Morphology, cultural characteristics, pathology, laboratory diagnosis and prevention, Control and treatment of diseases caused by the Following organisms: *Staphylococusi aureus*, *Streptococci pyogens*, *Pneumococci*, *Neisseriae* (*Gonococci* &*Meningococci*), *Corynebacterium diptheriae*, *Mycobacterium tuberculosis*, *M. leprae*, *Clostridium tetani*,	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
III	**Bacteriology:** Morphology, classification, cultural characteristics, pathogenicity, pathology, Laboratory diagnosis and prevention, Control and treatment of diseases caused by the Following organisms: *Salmonella*, *Shigella dysenteriae*, *Vibrio cholerae*, *E.coli*, *Pseudomonas aeruginosa*, *Haemophilus influenza*, *Helicobacter pylori*, *Rickettsiaerickettsi*, *Chlamydiae trachomatis*.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	**Mycology:** Classification of medically important Fungi (Morphology, Infection & Reproduction), Immunity to Fungal Infections. Culture Media and Stains in Mycology, Normal fungal flora of human beings, Specimen collection, preservation, Transportation & Identification of Mycological Agent. Biochemical tests for fungal identification, Anti-fungal agents-sensitivity test.	18	CO1, CO2, CO3, CO4, CO5	K1, K2 K3, K4 K5, K6

V	**Mycology:** Morphology, classification, cultural characteristics, pathogenicity, pathology, Laboratory diagnosis and prevention, Control and treatment of diseases caused by the Following organisms: Pityriasis vesicolor, White piedra, Black piedra, Tinea nigra, Cutaneous Mycosis - Dermatophytes. Subcutaneous Mycosis Mycetoma and Sporotrichosis. Systemic Mycosis- Histoplasmosis and Blastomycosis, Opportunistic Mycosis – Cryptococcus neoformans. Miscellaneous Mycosis- Otomycosis.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
VI	**Self-Study for Enrichment (Not included for End Semester Examinations)** Ground rules for collection and dispatch of clinical specimens for microbiological diagnosis and discarding of clinical Specimens.Culture Media and Stains in Mycology, Normal fungal flora of human beings, Specimen collection,	-	CO1, CO2, CO3,	K2 K3 K4 K5

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.

Web References

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.vnmu.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.E.Priya

Semester: II	Internal Marks:25		External Marks:75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PMB2CC5	**IMMUNOLOGY AND IMMUNOTECHNOLOGY**	**CORE COURSE**	**6**	**5**

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 autoimmunity and autoimmune disease	K4
CO4	Interpret trans plantation 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	**Autoimmunity and autoimmune disease:** Organs specific autoimmune disease – Hashimoto's thyroiditis, Good pastures syndrome, Insulin dependent diabetes mellitus. 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 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.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, 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- double immuno assay, rocket immune assay, Immuno fluorescence and chemi luminescence Assay.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

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. 2ndEdition.KalyaniPublishers*, 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. 7thEdition.* Wiley-Blackwell.

Reference Books

1. Sudha G. and Shubhangi S. (2013) *Textbook of Basic and Clinical Immunology*. Universties Press (India) Pvt. Ltd.
2. Rich R., Fleisher T., Shearer W., Schroeder H., Frew A. and Weyand C. (2018) *Clinical Immunology: Principle sand Practice.* Elsevier.
3. Abbas A.K., Lichtman A.H. and Pillai S. (2019) *Basic Immunology (Functions and Disorders of the Immune System). 6thEdition.* Elsevier.
4. Punt J. (2019) *Kuby Immunology.8th Edition*. Mac millan 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.

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1. https://www.jaypeedigital.com/eReader/chapter/9788184480610/ch1
2. https://www.ncbi.nlm.nih.gov/books/NBK562228/
3. https://www.healthline.com/health/autoimmune-disorders
4. https://www.slideshare.net/MMASSY/transplantation-and-tumor-immunology
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7474384/

Pedagogy

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

Course Designer

Dr.V.Aruna

Semester: II	Internal Marks: 25	External Marks: 75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PMB2CCC1A	**MICROBIAL METABOLISM**	**CORE CHOICE COURSE**	**5**	**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

CONumber	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

"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 - 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.	15	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 - types based on carbon, energy and electron sources. Measurement of cell numbers, cell mass	15	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	**Respiration-** Aerobic respiration: glycolysis, Pentose Phosphate pathway, TCA cycle. Glyoxylate cycle. Respiratory electron transport in mitochondria and bacteria. Anaerobic respirations: sulfate, nitrate, carbonate respirations and their ecological significance.	15	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
IV	**Bacterial Photosynthesis** - Brief account of photosynthesis – oxygenic and anoxygenic photosynthesis. fixation of C02- Calvin cycle - C3-C4 pathway. Chemo lithotrophic oxidations - Sulfur, Iron, Hydrogen and Nitrogen oxidations. Methanogenesis, Basic aspects of bioenergetics – entropy, enthalpy, equilibrium constant, artificial electron donors, inhibitors, uncouplers, energy bond, phosphorylation.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

V	**Microbial Biosynthesis**-Biosynthesis of Peptidoglycan, Amino acids, Fatty acids, Vitamins – Biosynthesis of Poly Hydroxy Alkanoate (PHA) and Poly Hydroxy Butyrate (PHB)	15	CO1, CO2, CO3, CO4 , CO5	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).	-	CO1, CO2, CO3, CO4 , CO5	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 Pathogensis. ASM Press.
2. Rabus, R. (Oldenburg) Saier Jr., M.H. (La Jolla, CA. (2022). Microbial Physiology. Karger Publication.
3. Walid EI Sharoud. (2011). Bacterial Physiology: A Molecular Approach. Springer.
4. G.N.Cohen.(2011). Microbial Biochemistry. Springer.

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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

Dr.N.Pushpa

Semester : II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PMB2CCC1B	**MICROBIAL PHYSIOLOGY**	**CORE CHOICE COURSE**	**5**	**4**

Course Objectives

This course will help the students gain knowledge about the Microbial physiology and metabolism by understanding microbial nutrition and growth characteristics.

Prerequisites

Differentiating concepts of aerobic and anaerobic respiration and how these are manifested in the form of different metabolic pathways in microorganisms.

Course Outcome and Cognitive Level Mapping:

CO Number	CO Statement	owledge evel
CO1	To impart among the learners the fundamental principles of microbial physiology	K1, K2, K4
CO2	To provide the role / functions of various enzymes of bacterial cell.	K1, K2, K3
CO3	To understand the route of a cell to metabolize carbohydrate, protein and fatty acids.	K1, K2, K3
CO4	To highlight the microbial enzymes' profiles and their activity.	K1, K2, K4
CO5	Attain insight about aerobic respiration and Photosynthesis of Green, Purple bacteria and Cyanobacteria.	K1, K2, K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3	3	3	3	3	3
CO2	2	3	2	3	3	3	3	2	3	3
CO3	3	2	3	3	2	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3
CO5	2	3	2	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	**Microbial nutrition and growth**: Nutritional requirements of microbes - Autotrophs, Heterotrophs, Photoautorophs, Chemoautotrophs, Copiotrophs, Oligotrophs, Factors influencing microbial growth – pH, temperature, substrate and osmotic condition. Bacterial growth curve & importance of the growth phases – Generation time - Growth measurements – batch, continuous and synchronous. Diauxic growth.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5 K6
II	**Bacterial enzymes** – classification & nomenclature, properties, kinetics of enzyme action – Michaelis-Menton equation for simple enzymes - coenzymes and cofactors, isozymes. Factors affecting enzyme activity.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Anabolism** – bacterial phototsynthesis – oxygenic – anoxygenic, synthesis of carbohydrate – catabolism of glucose – EMP – HMP – ED pathways, TCA cycle – electron transport system, Phosphorylation, oxidative and substrate level phosphorylations.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Protein metabolism** – synthesis and degradation of amino acids – glycine tyrosine, cysteine, serine, glutamine, synthesis of peptides and proteins – urea cycle	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Lipid metabolism** – biosynthesis of fatty acids and cholesterol – oxidation of fatty acids. Anaerobic Respiration – Nitrate, sulphate and methane respiration – Fermentations – alcoholic, propionic, mixed acid, lactic acid fermentation.	15	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5
VI	**Self Study for Enrichment** **(Not included for End Semester Examination)** Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction Fermentation-Alcohol fermentation and Pasteur effect.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books

1. Moat G, John W. Foster and Michael P. Spector (2002). Microbial physiology. Fourth
2. edition, A John Wiley son, Inc. publication. New Delhi.

3. Dubey RC and Maheshwari DK (2022). A Text of Microbiology. Revised edition, S. Chand and Company Ltd., New Delhi
4. Namita Gupta, Rani Gupta (2021), Fundamentals of Bacterial Physiology and Metabolism, Springer
5. Rajan S and Selvichristry (2019). Exam Oriented Biochemistry. CBS Publishers, New Delhi
6. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.

References

1. Nelson David L, Albert L Lehninger and Michael M Cox. Lehninger (2008) Principles of biochemistry. Macmillan.
2. Murray RK, Granner DK, Mayes PA and Rodwell VW. (2004) "Harper's Biochemistry, Appleton and Lange: New York, NY.
3. Dubey, R.C. & D.K. Maheshwari. (2022) A Text Book of Microbiology, S. Chand and Company Ltd., New Delhi.

Web links

1. https://www.elsevier.com/books/bacterial-physiology-and metabolism/ sokatch/ 978-1-4832-3137-2 14.
2. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Bruslind)/11%3A_Microbial_Nutrition
3. https://microbiologynotes.org/introduction-to-the-microbial-nutrition/
4. https://www.youtube.com/watch?v=SCTMQNmZtdw
5. https://www.youtube.com/watch?v=VzAjOPzUIP4
6. https://www.youtube.com/watch?v=0OMNyVzLnVc

Pedagogy

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

Course Designer

Dr. S. Jeyabharathi

Semester: II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/WEEK**	**CREDITS**
23PMB2CCC1C	**MICROBIAL GROWTH AND NUTRITION**	**CORE CHOICE COURSE**	**5**	**4**

Course Objective

Understand mechanism of uptake of nutrients in microbial cells. Study the microbial growth and kinetics of growth. Understand influence of environmental factors on microbial growth.

Prerequisite

Basic Knowledge of microbial growth nutrition concepts

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Examine the properties of a good culture medium.	K3,K4
CO2	Determine the microorganisms of Pure culture methods	K4,K5
CO3	Evaluate the nutritional categories of microorganisms on the basis of carbon and energy source	K4, K5
CO4	Illustrate the microbial Transport	K5,K6
CO5	Demonstrate the microbial Growth	K6,K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3	3	3	2	2	3
CO2	3	3	3	3	2	3	3	3	3	2
CO3	3	2	3	3	2	3	3	3	3	3
CO4	3	3	2	3	3	3	3	3	2	3
CO5	3	3	3	2	3	2	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	**Cultivation media**: Properties of a good culture medium. General ingredients of culture media and their role. Definition, Concept, Use and Types of different culture media – Living and Non - living media, Synthetic, Non-synthetic, Natural, Selective, Differential, Enriched, Enrichment, Assay, Minimal, Maintenance and Transport Medium and Buffers in culture medium.	15	CO1 CO2 CO3 CO4	K1 K2 K3 K4 K5
II	**Pure culture methods**: Definitions - pure culture, mixed culture, consortium, axenic culture, contamination. Isolation of microorganisms: Principle and method of isolation-streak plate pour plate, spread plate, single cell isolation. Cultivation of anaerobes: Gas Pak Anaerobic jar.	15	CO1 CO2 CO3 CO4	K1 K2 K3 K4
III	**Microbial Nutrition**: Major bio-elements: carbon, oxygen, hydrogen, phosphorus, and sulfur. Minor bio-elements: manganese, zinc, cobalt, molybdenum, nickel, and copper. Growth factors - temperature, pH, and osmotic pressure. Sources of energy. Nutritional categories of microorganisms on the basis of carbon and energy source.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6.
IV	**Microbial Transport:** Modes of nutrition: osmotrophic, phagotrophic. Nutrient transport and membrane function- primary and secondary transport, porins, OMP, carrier proteins. Passive diffusion. Facilitated diffusion. Active transport mechanism. Group translocation.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
V	**Microbial Growth:** Binary fission, Budding, fragmentation and formation of conidiophores. Mathematical expression of growth. Growth curve and diauxic growth. Measurement of growth: cell number, cell mass and cell activity. Different types of bacterial cultures –Batch culture, continuous culture, synchronous culture.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
VI	**Self -Study for Enrichment (Not included for End Semester Examination)**	-	CO1 CO2 CO3	K1 K2 K3

	Cultivation of anaerobes: Gas Pak Anaerobic jar, Mathematical expression of growth and OMP.		CO4 CO5	K4 K5

Text Books

1. Albert G. Moat, John W. Foster, Michael P. Spector (2022). *Microbial Physiology*. Wiley-Liss, Inc.
2. Ram Reddy. S and Reddy S.M.(2022). *Microbial Physiology. 2nd Edition* Scientific Publishers.
3. MeenaKumari S (2016). *Microbial Physiology.* Lightning Source Publisher.
4. Rani Gupta, Namita Gupta (2021). *Fundamentals of Bacterial Physiology and Metabolism.* Springer link.
5. Gerhard Gottschalk (2012*). Bacterial Metabolism. 2nd edition.* Springer.

Reference Books

1. Monika Rustagi (2016). *Bacterial Metabolism.*Medtech Publisher.
2. Byung Hong Kim, Geoffrey Michael Gadd (2021).*Bacterial Physiology and Metabolism.* Lightning Source Publisher.
3. Salle AJ. Fundamental principles of Bacteriology, 7th edition, Tata McGraw- Hill publishing company limited, New Delhi. 1996.
4. Doelle HW. Microbial Metabolism, Academic Press. 2005.
5. Lansing M. Prescott JP, Harley and Donald A Klein. Microbiology, 5th edition, McGraw Hill Company, New York. 2003. Nduka Okafor. (2011). *Environmental Microbiology of Aquatic and Waste Systems*. Springer Dordrecht Heidelberg London

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1. https://learn.chm.msu.edu/vibl/content/differential/
2. https://deogiricollege.org/iqac/science/biotech/Pure_culture_techniques.pdf
3. https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Bruslind)/11%3A_Microbial_Nutrition
4. https://onlinelibrary.wiley.com/doi/book/10.1002/3527600728
5. https://acikders.ankara.edu.tr/pluginfile.php/140179/mod_resource/content/0/07.pdf

Pedagogy

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

Course Designer

Dr.E.Priya

Semester: II	Internal Marks: 40	External Marks: 60		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PMB2CC2P	**BACTERIOLOGY, MYCOLOGY, IMMUNOLOGY AND IMMUNOTECHNOLOGY(P)**	**CORE PRACTICAL**	**9**	**5**

Course Objectives

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 identification	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

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

Syllabus

BACTERIOLOGY, MYCOLOGY

1. Staining of clinical specimens - Wet mount, Differential and Special staining methods.
2. Isolation and identification of bacterial pathogens from clinical specimens - cultivation in basal, differential, enriched, selective and special media - Biochemical identification tests.
3. Antimicrobial sensitivity testing - Kirby bauer method and Stokes method.
4. Minimum inhibitory concentration (MIC) test.
5. Minimum bactericidal concentration (MBC) test.
6. Mounting and staining of VAM spores.
7. Examination of different fungi by Lactophenol cotton blue staining.
8. Examination of different fungi by KOH staining.

IMMUNOLOGY AND IMMUNOTECHNOLOGY

1. Preparation of bacterial antigen by homogenization.
2. Latex agglutination – RF, ASO and CRP.
3. Haem agglutination – Blood grouping and TPHA.
4. Immunodiffusion techniques – single radial, double immunodiffusion techniques.
5. Counter immune electrophoresis.
6. ELISA –HbsAg.
7. Preparation of lymphocytes from peripheral blood by density gradient method.
8. Peripheral blood smear and differential staining.
9. Purification of immunoglobulin by ammonium sulphate precipitation method and SDS-PAGE analysis.
10. Immunochromatography: Demonstration

Reference Books

1. Jacquelyn Black, (2015) Microbiology: Principles and Explorations 9th Edition.
2. Abul Abbas Andrew H. Lichtman, Shiv Pillai, (2014) Cellular and Molecular immunology, 8th edition, Elsevier.
3. Power and Daginawala, (2012), General Microbiology, Himalaya Publishing House.
4. Power and Daginawala,(2017), General Microbiology, Himalaya Publishing House, **Vol-II.**

5. Kathleen park Talaro,(2014), Foundations in Microbiology, McGraw Hill. Science, 9th Edition.

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1. https://universe84a.com/immunochromatographic-test/
2. https://www.slideshare.net/AhmedRiyadh17/counter-immunoelectrophoresis
3. https://www.stma.org/sites/stma/files/pdfs/AlanWindham_Microscopic_Identification_of_Turfgrass_Diseases_STMA.pdf
4. https://www.iitg.ac.in/biotech/BTechProtocols/RadialImmuno.pdf
5. https://www.bioted.es/protocolos/RADIAL-IMMUNODIFFUSION-ENG.pdf

Pedagogy

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

Designer

Ms.S.Sathya

Semester: II	Internal Marks: 25	External Marks: 75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PMB2DSE2A	**MEDICAL MICROBIOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE COURSE**	**4**	**3**

Course Objective

Introduce the basic concepts of medical microbiology and Epidemiology Impart basic knowledge on various types of infection, host parasite relationshipand virulence factors associated with the pathogen.

Prerequisites

Basic knowledge and concepts of microbial pathogens and various controlmeasures.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Remember the basics of medical microbiology and Epidemiology	K1
CO2	Understand various types of infection	K2
CO3	Apply to know host parasite relationship and virulence factors associated withthe pathogen.	K3
CO4	Analyze diseases caused by bacterial and protozoa	K4
CO5	Evaluate on various viral and fungal diseases	K5

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 medical microbiology** Introduction to medical microbiology, Historical background, Classification of medically important microorganisms, Disease cycle, transmission of pathogen and its routes. Host parasite relationship, pathogenicity and virulence in relation with bacteria, Virus, fungi and parasites. Epidemiology and Public Health: Epidemiological principles in prevention and control of diseases; Endemic, epidemic, pandemic and sporadic diseases; Concepts of mortality/ morbidity rates, incidence and prevalence	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5, K6.
	Infection and its types Infections: types of infection, sources of infection, reservoirs and vectors of infection, predisposing factors. Host-parasite relationship governing the infection and establishment of disease. Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, respiratory tract, gastrointestinal tract, urogenital tract, concept of probiotics; Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection and nosocomial infection.	12	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5, K6.
III	**Bacterial diseases and Protozoan diseases** Classification of medically important microorganisms; Classification of pathogenic bacteria. Staphylococcus, Streptococcus, Neisseria; Corynebacterium, Clostridium, Vibrio, Yersinia, Haemophilus, Mycobacterium, Spirochetes,	12	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5, K6.

	Bordetella, Rickettsiae, Chlamydia. Protozoandiseases: Causative agents, Symptoms, mode of transmission, prophylaxis and control: Malaria			
IV	**Viral and Fungal diseases** General properties of viruses Host interactions: Pox viruses; Herpes virus, Hepatitis viruses Picorna viruses, Ortho myxo viruses and Human Immunodeficiency viruses (HIV) Fungal diseases of man, Epidemiology. Dermatophytes, dimorphic fungi, opportunistic fungal pathogens. Description and classification of pathogenic fungi and their laboratory diagnosis, treatment. Superficial mycoses, subcutaneous mycoses, systemic mycoses.	12	CO1, CO2, CO3, CO4, CO5,	K1, K2**,** K3, K4**,** K5**,** K6**,**
V	**Antimicrobial agents** Antimicrobial agents: Antibiotics, Antifungal and Antivirals. Antibiotic and chemotherapeutic agents: Sulfur drugs, Antibiotics and their classification, Mode of action, chemical nature of different antibiotics. Antibiotic assay and sensitivity test. Antiviral drugs-Antibiotic/Drug resistance – origin, cause, and clinical implication with special references of multidrug resistant bacteria. Superbugs.	12	CO1, CO2, CO3, CO4, CO5,	K1, K2**,** K3, K4**,** K5**,** K6**,**
VI	**Self Study for Enrichment (Not included for End Semester Examinations)** knowledge on various types of infection, host parasite relationshipand virulence factors associated with the pathogen.	-	CO1, CO2, CO3, CO4, CO5,	K1, K2**,** K3, K4**,** K5**,** K6**,**

Text Books

1. Apurba s. Essentials of Microbiology (3rd Edition). jaypee brothers Medical Publishers, 2020**.**
2. Warren E. Review of Medical Microbiology and Immunology. (17th edition). McGraw Hill/ Medical,2022.
3. Ananthanarayanan. R. and C.K. Jayaram Panicker. Textbook of Microbiology Orient Longman, 1997.
4. Jawetz Melnick. Medical Microbiology (28th edition). McGraw Hill/ Medical,2019.
5. Aejaz iqbal. Medical Microbiology (1st edition). Notion Press**,** 2020.

Reference Books

1. Saumya singh. Medical Microbiology (1st edition), CBS Publishers, 2022.
2. Michael. J. Pelczar, JR, E.C.S. Chan, Noel R. Krieg. Microbiology.TATA McGraw Hill. pp: 673-763,2020.
3. Arora. Medical mycology (2nd edition). CBS Publishers,2019.
4. Reena ray gosh. Medical mycology (1st edition). CBS Publishers, 2019.
5. Saravanan P. Virology (1st edition). MJP Publisher,2021.

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1. https://www.microbe.net/resources/microbiology/web-resources/
2. https://www.omicsonline.org/medicalmicrobiology-diagnosis.phpguides. emich/immunology
3. https://content.kopykitab.com/ebooks/2017/04/10504/sample/sample_10504.pdf

Pedagogy

Chalk and Talk, Assignment, Seminar and Group Discussion.

Course Designer

Ms. R. Kiruthiga

Semester: II	Internal Marks : 25	ExternalMarks:75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23PMB2DSE2B	**PUBLIC HEALTH MICROBIOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE COURSE**	**4**	**3**

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	COGNITIVELEVEL
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.	12	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.	12	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.	12	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.	12	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– techniques used	12	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. P falle. (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 Dock rell, 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, 10thEdn.Wolters Kluwer Health.

Web References

1. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/ln_intro_ph_final.pdf
2. https://www.webmd.com/lung/what-are-airborne-diseases
3. https://www.health.state.mn.us/diseases/waterborne/basics.html
4. https://www.who.int/health-topics/foodborne-diseases#tab=tab_1
5. https://www.osmosis.org/answers/nosocomial-infection

Pedagogy

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

Course Designer

Dr.V.Aruna

Semester: II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS /WEEK**	**Credits**
23PMB2DSE2C	**MEDICAL PARASITOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE**	**4**	**3**

Course Objectives

To enable the students to understand the clinically important protozoa, helminths and arthropods and acquire knowledge about the areas in which parasitic infections are endemic.

Prerequisites

Basic knowledge and concepts of clinically important parasites

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand diagnostic techniques in parasitology	K1, K2
CO2	Analyze and explain clinical significance of *Entamoeba histolytica*	K3, K4
CO3	Determine and apply the treatment of *Leishmania donovani*	K3, K4
CO4	Evaluate and categorize the *Plasmodium* spp.	K4, K5
CO5	Criticize and manage *Taenia solium*	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	**Introduction and classification of parasites:** Scope and historical landmarks in Parasitology. Basic principles and nomenclature aspects of parasites. Classification of Parasites – Protozoa and helminthic infection. Laboratory Diagnostic Techniques in Parasites – Direct Identification and Indirect Identification. Concentration methods - flotation techniques and sedimentation techniques	12	CO1, CO2, CO3	K1, K2**,** K3, K4
II	**Amoebae:** Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - Amoebae: *Entamoeba histolytica, Naegleria fowleri, Acanthamoeba*	12	CO1, CO2, CO3, CO4	K1, K2**,** K3, K4**,** K5
III	**Flagellates:** Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - Flagellates: *Giardia lamblia, Trichomonas vaginalis, Trypanosoma*, *Leishmania.*	12	CO1, CO2, CO3, CO4,	K1, K2**,** K3, K4**,** K5,
IV	**Sporozoans:** Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - Sporozoans: *Plasmodium, Toxoplasma gondii, Cryptosporidium parvum, Cyclospora cayetanensis.*	12	CO1, CO2, CO3, CO4, CO5	K1, K2**,** K3, K4**,** K5**,** K6**,**
V	**Cestodes and Nematodes:** Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention – *Taenia solium, Ancylostoma duodenale* and *Wuchereria bancrofti.*	12	CO1, CO2, CO3, CO4, CO5	K1, K2**,** K3, K4**,** K5**,** K6
VI	**Self Study for Enrichment (Not included for End Semester Examinations)** Isolation, identification, clinical manifestations of medically important parasites	-	CO1, CO2, CO3, CO4, CO5	K1, K2**,** K3, K4**,** K5**,** K6

Text Books

1. Apurba S Sastry, Sandhya Bhat. (2018). Essentials of Medical Parasitology. 2nd Edition. Jaypee Brothers Medical Publishers.
2. Sougata Ghosh. (2021). Paniker's Text book of Medical Parasitology. 9th Edition. Jaypee Brothers Medical Publishers.

3. Nagoba, B.S. (2020). Medical Microbiology and Parasitology: Prep Manual for Undergraduates, 4th Edition. Elsevier India.
4. Baveja, V. and Baveja, C.P. (2019). Medical Parasitology. 4th Edition. Arya Publishing Company.
5. Sumeeta Khurana, Abhishek Mewara. (2021). Textbook of Medical Parasitology. 1st Edition. Universities Press India Pvt. Ltd

Reference Books

1. Nanda Maheshwari. (2022). Clinical Microbiology & Parasitology for DMLT Students. 4th Edition. Jaypee Brothers Medical Publishers.
2. Arora. D.R. (2020). Medical Parasitology. 5th Edition. CBS Publisher.
3. Shyamasundari, K. and Hanumantha Rao. K. (2021). Medical Parasitology.1st Edition. MJP Publishers.
4. Rajan, S. and Selvi Christy, R. (2018). Essentials of Microbiology. 4th Edition. CBS Publishers and Distributors Pvt. Ltd.
5. Joanne M. Willey, Kathleen M. Sandman and Dorothy H. Wood (2022). Prescott's Microbiology. 12th Edition. McGraw-Hill Education.
6. Apurba S Sastry and Sandhya Bhat. (2022). Essentials of Medical Microbiology. 4th Edition. Jaypee brothers med Pub Pvt Ltd.

Web References

1. https://byjus.com/biology/parasites-symbiosis/
2. https://www.brainkart.com/article/Parasite-and-Host_41024/
3. https://byjus.com/biology/entamoeba-histolytica-life-cycle/
4. https://microbenotes.com/giardia-duodenalis/
5. https://www.onlinebiologynotes.com/plasmodium-falciparum-morphology-life-cycle-pathogenesis-and-clinical-disease/
6. https://www.meduniwien.ac.at/hp/fileadmin/tropenmedizin/Lehre/Helminths_and_Helminthiasis_Kompatibilitaetsmodus.pdf

Pedagogy

Power point presentations, Group Discussions, 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**
23PMB3CC6	**VIROLOGY**	**CORE COURSE**	**6**	**5**

Course objective

The course is designed to develop the student with enough knowledge about general account of viruses, bacteriophages, plant, animal and human viral diseases. To train up the student in gaining knowledge about instrumentation relevant to virology.

Prerequisites

Basic Understanding of Etiology and Diagnostic Management of 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 : Brief outline on discovery of viruses, nomenclature and classification of viruses; Distinctive properties of viruses; morphology & ultrastructure. Capsids and theirarrangements - types of envelopes and their composition-viral genome, Virus related agents (viroids, Virusoids, prions and Satellite viruses).	15	CO1, CO2, CO3	K1, K2, K3
II	General Methods of Diagnosis and Serology : Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures. cell strains, cell lines and transgenic systems. Assay of viruses – physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy). Infective assay (plaque method, end point method) – Infectivityassay of plant viruses.	15	CO1, CO2, CO5	K1, K2, K3, K4
III	Bacterial Viruses : Bacteriophage - structural organization - one step growth curve - life cycle - Lytic and Lysogenic, Classification, Morphological groups - virulent dsDNA phage, ssDNA phage, phage lambda, Temperate and Transposable phage, Phage Mu, M13, T4, P1, Bacteriophage typing, Phage therapy.	15	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
IV	Plant Viruses : Classification and nomenclature; effects of viruses on plants; Common virus diseases of plants - Tobamo virus group, Potex virus, Poty virus, Tymo virus, Tomato spotted wilt, Cauliflower mosaic virus, Potato leaf roll virus, Rice tungro virus, Mosaicdisease of sugarcane; Transmission of plant viruses with vectors - insects, nematodes, fungi - without vectors (contact, seed and pollens). control measures of plant viruses.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	Animal Viruses : Classification and nomenclature of animal human viruses. Epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses - Picorna,Rhabdo, Rota, HIV, SARS, Influenza, Oncogenic viruses. DNA viruses; Pox, Herpes, Adeno, Hepatitis viruses. Viral vaccines, interferons, and antiviral drugs.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study Enrichment (Not included for End Semester Examinations)** Cultural Characters of Viruses, Qualitative and Quantitative estimation of Viruses, Structure and life cycle of viruses, Etiology and Classification of viruses and Viral Prophylaxis.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. GeoBrooks, Karen Carroll, Janet Butel and Stephen Morse. *Medical Microbiology(*26th Edition). McGraw Hill Publication, 2020.
2. Jawetz, Melnick and Adelberg's. *MedicalMicrobiology*(24thEdition), Hill Medical Publication division,2019.
3. Ananthanarayan and Jayaram Paniker. *Text book ofMicrobiology*(11thEdition). London:Oxford University press, 2020.
4. Baijayantimala Mishra. Textbook of Medical Virology (2nd edition). CBS publishers and distributors pvt ltd, 2021.
5. Dorothy H. Crawford. VIRUSES (2nd edition). Oxford University Press,2021.

Reference book

1. Luke S. P. Moore and James C. Hatcher .Infectious Diseases, Microbiology and Virology(1st edition).Cambridge University Press; 1st edition,2019.
2. Saravanan P. Virology(1st edition). MJP Publisher,2021.
3. Van G. Wilson. Viruses: Intimate Invaders(1st edition). Springer Nature Switzerland AG,2022.
4. Reeti Khare. Guide to clinical and diagnostic virology(1st edition). ASM Press,2019.

Web References

1. https://samicrobiology.files.wordpress.com/2018/08/modern-viro1ogy.pdf
2. https://www.jfmed.uniba.sk/fileadmin/jlf/Pracoviska/ustav-mikrobiologie-aimunologie/distancna_vyuka/ang_12_lect_viruses.pdf
3. https://eazhar.kau.edu.sa/Files/0030203/files/19623_Lec-1%20General% 20Virology_ Medical%20Virology.pdf
4. https://www.virology.ws/wp-content/uploads/2012/03/020_3310_17.pdf
5. https://content.kopykitab.com/ebooks/2017/04/10504/sample/sample_10504.pdf

Pedagogy

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

Course Designer

Dr. S. Jeyabharathi

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

CO Number	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, SO2 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 Qulaity 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)** Food Borne Disease Outbreaks - Objectives of Investigation, Field Investigation, Lab Testing and Preventive Measures.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

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
1. 3.https://www.sciencedirect.com/topics/food-science/food-borne-disease
2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/dairy-microbiology
3. 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 ethicalcontexts 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 withsolutions 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 remediesthereto.	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	P0 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

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-secutiry/
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. Receombinant 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 ntimicrobials, vaccines, drug carriers and therapeutics.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

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
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 Cartegana 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 patenting–disclosure/non-disclosure; Financial assistance for patenting-introduction to existing schemes, Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, 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	**VIROLOGY, FOOD AND DAIRY MICROBIOLOGY (P)**	**CORE**	**6**	**4**

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

VIROLOGY

1. Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs.
2. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs.
3. Study of the structure of important bacterial viruses (ϕX 174, T4, λ) using electron micrograph.
4. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique.
5. Studying isolation and propagation of animal viruses by chick embryo technique.
6. Study of cytopathic effects of viruses using photographs
7. Perform local lesion technique for assaying plant viruses.

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, HrudayanathThatoi , Supriya Dash (2020). Practical Biotechnology: Principles and Protocols. Dreamtech Press.
2. SiddraIjaz& Imran UlHaq. (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=lB9-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 EXAMINATION**	**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 helps to 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 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.	12	CO1, CO2, CO3, CO4	K2, K3, K4, 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

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	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
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 safetyand standardization act and quality control of foods.

Prerequisites

To Comprehend and analyze the basics of food adulteration.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive 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. HellbergKaren Everstine Steven A. Sklare (2020). Food Fraud: A Global Threat with Public Health and Economic Consequences. Academic PressInc.
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 stormingactivity.

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	Cognitive 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 processing, section cutting, staining cytology.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

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 Vidhyanathan 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.firebaseapp.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, 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.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, 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_assurancehttps://www.omicsonline.org/scholarly/food-quality-assurance-journals-articles-pptslist.phphttp: //www.fao. org/3/v 5380e/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 Pharmaeutical 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
"2" – Moderate (Medium) Correlation
"3" – Substantial (High) 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:25		External Marks:75	
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 students to understand scope and popular databases of bioinformatics and methods of biostatistics. This syllabus gives abroad 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

CO Number	CO Statement	Cognitive 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. Siddesh and 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 lifesciences, medicine. Kindle Edition.
3. William T. Loging (2016). Bioinformatics and computational biology in drug discovery and Cambridge University press
4. R.S.N. Pillai &V.Bagavathi (2016). Statistics Theory and Practice, S.Chand
5. Bernard Rosner (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	ExternalMarks:75		
COURSECODE	**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
"2"- Moderate (Medium) Correlation
"3"- Substantial (High) 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,A Hypertext book Computational biology.2022
5. Alona S.Russe ,Computational biology. 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	Cognitive 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 tuberene 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 morter- Self assembled nanolayers - the bits that do things - proteins – DNA Computer	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

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, 1st edition, 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

CO Number	CO Statement	Cognitive 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
"2"- Moderate (Medium) Correlation
"3"- Substantial (High) 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.

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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:

CO Number	CO Statement	Cognitive 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 entrepreurs, 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 *Agaricus campestris*, *Agaricus bisporus*, and *Volvariella volvaciae*; Preparation of compost, filling tray beds, spawning, maintaing optimal temperature, casing, watering, harvesting, storage. Biofertilizers- Historical background, Chemical fertilizers versus biofertilizers. *Rhizobium sp*, *Azospirillum sp*, *Azotobacter sp*, 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.
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