CAUVERYCOLLEGE FOR WOMEN(AUTONOMOUS)

Nationally Accredited with 'A' Grade by NAAC

ISO 9001:2015 Certified

TIRUCHIRAPPALLI

PG AND RESEARCH DEPARTMENT OF MICROBIOLOGY

B.Sc., MICROBIOLOGY

SYLLABUS

2023 -2024 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 B.Sc., MICROBIOLOGY PROGRAMME

PONO.	On completion of B.Sc., Microbiology, the students will be able to
PO1	**Academic Excellence and Competence:** Elicit firm fundamental knowledge in theory as well as practical for coherent understanding of academic field to pursue multi and inter disciplinary science careers in future.
PO2	**Holistic and Social approach:** Create novel ideas related to the scientific research concepts through advanced technology and sensitivity towards sustainable Environmental practices as well as social issues.
PO3	**Professional ethics and Team Work:** Explore professional responsibility through projects, internships, field trip/industrial visit and mentorship Programmes to transmit communication skills.
PO4	**Critical and Scientific thinking:** Equip training skills in Internships, Research Projects to do higher studies in multidisciplinary path with higher level of specialization to become professionals of high-quality standards.
PO5	**Social Responsibility with ethical values:** Ensure ethical, social and holistic values in the minds of learners and attain ender parity for building a healthy nation.

PROGRAMME SPECIFIC OUTCOMES FOR B.Sc., MICROBIOLOGY

PSO NO.	Students of B.Sc., Microbiology will be able to	Pos Addressed
PSO1	Improve their knowledge on the basic concepts for retaining competence and confidence which enables them to develop interest in the new arena of Microbiology	**PO1, PO5**
PSO2	Acquire expertise in practical work within dependent equipment Handling skill along with collection and interpretation of scientific data	**PO2, PO3**
PSO3	Legitimize knowledge by emerging multiple aspects of current research.	**PO3, PO5**
PSO4	Pursue the importance of substantial original Research to meet the current and future expectation.	**PO4, PO1**
PSO5	Beware of the ethical issues for the benefit of the society by adding skilled scientific work for across the country.	**PO5, PO2**

Cauvery College for Women (Autonomous)

PG & Research Department of Microbiology

B.Sc., Microbiology

Learning Outcome Based Curriculum Framework (CBCS-LOCF)

(For the Candidates admitted from the Academic year 2023-2024 and onwards)

Semester	Part	Course	Title	Course Code	Inst. Hrs.	Credits	Exam			Total
							Hrs.	Marks Int	Marks Ext	
I	I	Language Course-I (LC) Tamil / other languages	ப ொரத்தமிழ்–I	23ULT1	6	3	3	25	75	100
			Poetry, Grammar and History of Sanskrit Literature	23ULS1						
			Hindi Ka Samanya Gyan aur Nibandh	23ULH1						
			Foundation Course: PaperI- French-I	23ULF1						
	II	English Language Course- I(ELC)	General English -I	23UE1	6	3	3	25	75	100
	III	Core Course – I(CC)	Fundamentals of Microbiology and Microbial Diversity	23UMB1CC1	5	5	3	25	75	100
		Core Practical - I (CP)	Fundamentals of Microbiology and Microbial Diversity (P)	23UMB1CC1P	3	3	3	40	60	100
		First Allied Course- I (AC)	Biochemistry I	23UMB1AC1	4	3	3	25	75	100
		First Allied Course- II (AC)	Biochemistry I (P)	23UMB1AC1P	4	3	3	40	60	100
	IV	Ability Enhancement Compulsory Course-I (AECC)	UGC Jeevan Kaushal life skills - Value Education	23UGVE	2	2	-	100	-	100
	TOTAL				**30**	**22**				**700**
II	I	Language Course-II(LC)Tamil / Other languages	ப ொரத்தமிழ் - II	23ULT2	6	3	3	25	75	100
			Prose, Grammar and History of Sanskrit literature	23ULS2						
			Hindi Literature & Grammar -II	22ULH2						
			Basic French-II	22ULF2						
	II	English Language Course- II(ELC)	General English – II	23UE2	6	3	3	25	75	100
		Core Course – II (CC)	Microbial Physiology	23UMB2CC2	4	4	3	25	75	100

	III	Core Practical - II (CP)	Microbial Physiology and Molecular Biology (P)	23UMB2CC2P	3	3	3	40	60	100
		Core Course -III (CC)	Molecular Biology	23UMB2CC3	3	3	3	25	75	100
		First Allied Course – III (AC)	Biochemistry II	23UMB2AC2	4	3	3	25	75	100
		Ability Enhancement Compulsory Course-II (AECC)	Environmental Studies	22UGEVS	2	2	-	100	-	100
	IV	Ability Enhancement Compulsory Course-III (AECC)	Innovation and Entrepreneurship	22UGIE	2	1	-	100	-	100
	Extra Credit Course		SWAYAM	As Per UGC Recommendation						
	TOTAL				**30**	**22**				**800**

III	I	Language Course-III(LC) Tamil*/Other Languages*	பொதுத்தமிழ் - III	23ULT3	6	3	3	25	75	100
			Hindi Literature & Grammar-III	22ULH3						
			Intermediate French-I	22ULF3						
			Drama, Grammer and History of Sanskrit Literature	23ULS3						
	II	English Language Course-II(ELC)	Learning Grammar Through Literature-I	23UE3	6	3	3	25	75	100
	III	Core Course–IV(CC)	Virology	23UMB3CC4	5	5	3	25	75	100
		Core Practical – III(CP)	Virology (P)	22UMB3CC3P	3	3	3	40	60	100
		Second Allied Course-I (AC)	Biostatistics	23UMB3AC3	5	3	3	25	75	100
		Second Allied Course-II (AP)	Biostatistics (P)	23UMB3AC2P	3	3	3	40	60	100
	IV	Generic Elective Course- I (GEC) (Offer to Other Department)	A. Mushroom Technology	22UMB3GEC1	2	2	3	25	75	100
			B. Basic Tamil-I	22ULC3BT1						
			C. Special Tamil-I	22ULC3ST1						
	Extra Credit Course		SWAYAM	As Per UGC Recommendation						
	TOTAL				**30**	**22**				**700**

15 Days INTERNSHIP during Semester Holidays

	I	Language Course-IV (LC) Tamil*/Other Languages*	பொதுத்தமிழ் - IV	23ULT4	6	3	3	25	75	100
			Hindi Literature & Functional Hindi	22ULH4						
			Intermediate French-II	22ULF4						
			Alankara, Didactic and Modern Literature and Translation	23ULS4						

IV	II	English Language Course -IV(ELC)	Learning Grammar Through Literature-II	23UE4	6	3	3	25	75	100
	III	Core Course – V(CC)	Immunology	23UMB4CC5	6	5	3	25	75	100
		Core Practical -IV(CP)	Immunology (P)	22UMB4CC4P	4	4	3	40	60	100
		Second Allied Course-III (AC)	Bioinformatics	22UMB4AC4	4	3	3	25	75	100
		Internship	Internship	22UMB4INT	-	2	-	-	-	100
	IV	Generic Elective	A. Biofertilizer Technology	22UMB4GEC2	2	2	3	25	75	100
			B. Basic Tamil-II	22ULC4BT2						
		Course- II (GEC)	C. Special Tamil-II	22ULC4ST2						
		Skill Enhancement Course–I(SEC)	Herbal Medicine (P)	22UMB4SEC1P	2	2	3	40	60	100
	Extra Credit Course		SWAYAM	As Per UGC Recommendation						
				TOTAL	**30**	**24**				**800**

V	III	Core Course –VI(CC)	Medical Microbiology	23UMB5CC6	6	5	3	25	75	100
		Core Course -VII(CC)	Agricultural and Environmental Microbiology	23UMB5CC7	6	5	3	25	75	100
		Core Course – VIII(CC)	Microbial Biotechnology	23UMB5CC8	6	5	3	25	75	100
		Core Practical – V(CP)	Medical Microbiology, Agricultural and Environmental Microbiology and Microbial Biotechnology (P)	23UMB5CC5P	3	3	3	40	60	100
		Discipline Specific Elective – I (DSE)	A. Organic Farming	23UMB5DSE1A	5	3	3	25	75	100
			B. Medical Parasitology	23UMB5DSE1B						
			C. Fundamentals of Botany and Zoology	23UMB5DSE1C						
	IV	Ability Enhancement Compulsory Course-IV(AECC)	UGC Jeevan Kaushal -Professional Skills	22UGPS	2	2	-	100	-	100
		Skill Enhancement Course –II(SEC)	Biofertilizer Technology (P)	22UMB5SEC2P	2	2	3	40	60	100
	Extra Credit Course		SWAYAM	As Per UGC Recommendation						
				TOTAL	**30**	**25**				**700**
VI	III	Core Course – IX(CC)	Fermentation Technology	23UMB6CC9	6	5	3	25	75	100
		Core Course –X(CC)	Food and Dairy Microbiology	23UMB6CC10	5	4	3	25	75	100
		Core Course –XI (CC)	Cyber security	22UGCS	5	4	3	25	75	100
		Core Practical – VI(CP)	Fermentation Technology and Food and Dairy	22UMB6CC6P	3	3	3	40	60	100

			Microbiology (P)							
		Discipline Specific Elective – II (DSE)	A. Microbial Genetics and Recombinant DNA Technology	23UMB6DSE2A	5	3	3	25	75	100
			B. Microbial Ecology	23UMB6DSE2B						
			C. Biological Techniques	23UMB6DSE2C						
		Project	Project Work	22UMB6PW	5	4	-	-	100	100
	V	Gender Studies	Gender Studies	22UGGS	1	1	-	-	-	100
		Extension activity		22UGEA	0	1	-	-	-	-
				TOTAL	**30**	**25**				**700**
				GRANDTOTAL	**180**	**140**				**4400**

Courses & Credits for UG Science Programmes

Part	Course	No. of Courses	Credits	Total Credits
I	Tamil/ Other Language	4	12	12
II	English	4	12	12
III	Core (Theory& Practical)	17	69	99
	Project Work	1	4	
	Internship	1	2	
	First Allied	3	9	
	Second Allied	3	9	
	DSE	2	6	
IV	GEC	2	4	15
	SEC	2	4	
	AECC-I -Universal Human Values	1	2	
	AECC-II-Environmental Studies	1	2	
	AECC-III-Innovation and Entrepreneurship	1	1	
	AECC-IV Professional Skills	1	2	
V	Gender Studies	1	1	02
	Extension Activities	_	1	
		44		**140**

Internalandexternal marksfortheoryandpractical papersareasfollows:

Subject	Internal Marks	External Marks
Theory	25	75
Practical	40	60

For Theory:

a) Thepassing minimum for CIAshallbe40%out of 25marks (i.e. 10marks)

b) ThepassingminimumforEndSemesterExaminationsshallbe40%outof75marks(i.e.30marks)

For Practical:

a) The passing minimum for CIA shall be40%out of40marks (i.e. 16marks)

b) The passing minimum for End Semester Examinations shall be 40% outof6 0marks(i.e.,24 marks)

Internal Component (Theory)

Component	Marks
Quiz	10
Assignment &Seminar	10
CIA -I	05
Total	25

Internal Component (Practical)

Component	Marks
RecordNote	10
ContinuousPerformance inPractical(Attendance andObservation)	15
CIA	15
	40

Question Paper Pattern for different courses+

Semester: I	Internal Marks : 25		External Marks : 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs./ Week**	**CREDITS**
23UMB1CC1	**FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY**	**CORE**	**5**	**5**

Course Objective

- This subject aims to introduce the history and development of Microbiology. The contents of this course will help students understand history, biology of microorganisms, growth and control of microbes.
- Thus, the beginners are rightly exposed to foundation of Microbiology which would lead them towards progressive advancement of the subject.

Course Outcome and Cognitive level Mapping

CO Number	CO Statement	Cognitive level
CO 1	Remember and understand the Development of Microbiology	K1, K2
CO 2	Analyze the Size and Shape of Microorganisms using Microscope	K3
CO 3	Evaluate the knowledge about Bacteria and Viruses	K4
CO 4	Compare the various Preservation Methods for preserving Microbes.	K5
CO 5	Summarize various modes of classification of microbes	K5

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

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	History and scope of Microbiology - Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Flemming. Role of microorganisms in fermentation, Germ theory of disease, Development of variousmicrobiological techniques and golden era of microbiology. Microscopy: Principles and applications of bright field, dark field, phase contrast, fluorescent SEM and TEM.	15	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.
II	General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, spores, and gas vesicles.	15	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.
III	Sterilization: Principles and methods – physical methods- moist heat, dry heat, filtration and media preparation. Cultivation of microbes- Types of culture media-Stab, slant, broth, semisolid, solid media. Aerobic and Anaerobic culture techniques- Pure culture techniques – Maintenance and preservation of microbes. Principles and types of staining– Simple, differential, Capsule staining.	15	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.
IV	Introduction to microbial biodiversity- Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Ecological niche. Basic concepts of Eubacteria, Archaebacteria and Eucarya. Conservation biodiversity	15	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.
V	International codes of nomenclature. Binomial nomenclature – species concept – Kingdom, division, class, order, family, and genus. Principles of classification – morphological, physiological biochemical basis of classification. Molecular basis of classification – chemotaxonomy & numerical taxonomy.	15	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.

VI	**Self Study for Enrichment (Not to be included for External Examination)** Microscopic operations, Criteria for Classification of Microorganisms, cellular organizations, Isolation and identification of Microorganisms,	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Books

1. Dubey RC and Maheswari DK. (2015). *A Text Book of Microbiology*. 5th Edition. SChand, NewDelhi.
2. Ananthanarayan Paniker (2020). *A Text book of Microbiology*. 11th Edition.University Press.Singapore.
3. Madigan MT, Martinko JM, and Parker J. (2019). *Biology of Microorganisms*.12th Edition,MacMillan Press.England.
4. Pelczar MJ, Chan ECS and Kreig NR. (2015). *Microbiology*, 5th edition.McGraw-Hill. BookCo. Singapore.
5. Atlas RA and Bartha R. (2019). *Microbial Ecology. Fundamentals and Application*. 4th edition Benjamin Cummings, New York.

Reference Books

1. Prescott L. M, Harley, J.P. and Helin, D.A. (2017). *Microbiology,* 5th Edition**.** McGraw Hill.
2. Tortora GJ, Funke BR and Case CL. (2020). *Microbiology: An Introduction*. 9th Edition, Pearson Education, Singapore.
3. Black JG. (2018). *Microbiology-principles and explorations*, 6th edition. John Wiley andSons, Inc. New York.
4. Moselio Schaechter and Joshua Leaderberg (2019). *The Desk encyclopedia ofMicrobiology*.2nd edition. Elseiver Academic press, California.
5. Madigan MT, Martinko JM, and Parker J. (2019). *Biology of Microorganisms*, 12th Edition. MacMillan Press, England.

Web Reference

1. https://microbenotes.com/history-of-microbiology/
2. https://byjus.com/biology/prokaryotic-and-eukaryotic-cells/
3. https://byjus.com/biology/archaebacteria/
4. https://thebiologynotes.com/sterilization-physical-and- chemical-methods/
5. https://microbenotes.com/microbiology-of-extreme-environments/

Pedagogy

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

Course Designer

Dr.P.Bhuvaneswari

Semester : I	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB1CC1P	**FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY (P)**	**CORE PRACTICAL**	**3**	**3**

Course Objective

- To understand the rules and procedures to be observed in a laboratory.
- To know and familiarize with equipment and apparatus used in microbiology practical exercises.
- To familiarize and understand the parts and use of microscopes.
- To appreciate the abundance and diversity of microorganisms in different habitats

Course Outcome and Cognitive Level Mapping

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive Level
CO1	Recall the safety practice in microbiological laboratory	K1
CO2	Demonstrate the pure culture technique	K2
CO3	Develop the microscopic techniques and staining methods	K3
CO4	Determine about preparation of different media	K4
CO5	Discuss different microorganisms in different media	K6

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

"1"–Slight (Low) Correlation "2" – Moderate(Medium) Correlation

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

Syllabus

1. Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility – Autoclave, hot air oven, and membrane filtration.
2. Media preparation: liquid media, solid media, semi-solid media, agar slants and agar plates.
3. Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation-quality control of media, growth supporting properties, sterility check of media.
4. Pure culture techniques: Spread plate, streak plate and pour plate, decimal dilution.
5. Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production.
6. Microscopy: light microscopy and bright field microscopy.
7. Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining.
8. Study on Microbial Diversity using Hay Infusion Broth-Wet mount to show different types of microbes, hanging drop method.

Text Books

1. Saha, R (2022).Microbiology Practical Manual (2nd edition) CBS Publishers & Distributors Pvt. Ltd. India.
2. Das, S (2020).Microbiology Practical Manual (1st edition) CBS Publishers & Distributors Pvt. Ltd. India.
3. Gunasekaran, P. (2018). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
4. R C Dubey and D K Maheswari (2010). Practical Microbiology. S. Chand Publishing.
5. James G Cappucino and N. Sherman MB(2013). A lab manual Benjamin Cummins, New York.

Reference Books

1. Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C. Brown publishers.
2. Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India
3. Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS
4. Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and BartlettPublication.
5. Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications.

Web References

1. http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403.
2. https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
3. https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
4. https://microbiologyinfo.com/top-and-best-microbiology-books/

Pedagogy

Chalk and talk, Power Point Presentation and Group Discussions

Course Designer

Dr. E.Priya

Semester : I	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB1AC1	**BIOCHEMISTRY I**	**FIRST ALLIED COURSE - I**	**4**	**3**

Course Objective

- To understand the structure, functions of various biomolecules and consequences of deviation from normal

Course Outcome and Cognitive Level Mapping

On the successful completion of the course, students will be able to

CO Number	CO Statement	Cognitive level
CO1	Remember and understand the concept of macromolecules	K1,K2
CO2	Illustrate an idea about structure and function macromolecules	K2,K3
CO3	Categorize the sources of macromolecules	K4
CO4	Classify and relate properties o macromolecules	K3,K4
CO5	Recommend the daily allowances of vitamins and its Significance	K5

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	COGNITIV ELEVEL
I	**Carbohydrates**: Definition, sources, classification-monosaccharide, disaccharide,oligosaccharide and Polysaccharide, biological significance, digestion and absorption of carbohydrates	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	**Proteins**: Definition, sources, classification and structure of proteins - structural and nonstructural proteins, Amino acids–structure classification - essential and nonessential, protein and non-protein amino acids.Biological Significance of Proteins.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
III	**Lipids:** Definition, Properties, Sources, Classification of lipids and fatty acids- saturated, unsaturated and polyunsaturated. Compound lipids - Structure and functions of phospholipids and glycolipids. Biological significance of lipids	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
IV	**Vitamins:** Definition, sources and functionsof Fat soluble vitamins (A, D, E and K) andWater soluble vitamins (B complex and C).	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
V	**Disorders of Metabolism:** Disorders of carbohydrate metabolism: diabetes mellitus, hypoglycemia, Disorders of amino acid metabolism: alkaptonuria, phenylketonuria, Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia and hypercholesterolemia. Disorders of vitamin metabolism – Night blindness, Ricketts,Scurvy, sterility, beriberi and anemia	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment** **(Not to be included for External Examination)** Lactose intolerance - Inborn errors in aminoacid metabolism- Atherosclerosis – Myocardial infarction	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Books

1. Ambika Shanmugam **(**2016**).** Fundamentals of Biochemistry for Medical students.8th Edition, Wolters Kluwer (India) Pvt Ltd.
2. Rafi MD, (2014) Textbook of Biochemistry for medical students,2nd edition, Universities Press, (India) Pvt. Ltd, Hyderabad, India.
3. Charlotte W Prattand Sathya narayana U and Chakrapani U (2013) Biochemistry, 4th edition, Elsevier publishers.
4. DebAC (2011). Fundamentals of Biochemistry,10th edition, New Central Book Agency (p) ltd, London
5. Rajagopal G (2010). Concise textbookofbiochemistry,2ndedition, Ahuja Publishing House.

Reference Books

1. Lubert Stryer; Jeremy Berg; John Tymoczko; Gregory Gatto (2019). *Biochemistry*, 9th Edition. Macmillon Publication.
2. Denise R Ferrier, (2013) *Biochemistry*,6th edition, LWW publishers.
3. Reginald H Garrett and Charles M Grisham (2012). *Biochemistry*, 5th edition. Brooks Colepublishers.
4. Albert L Lehninger, David L Nelson and Michael MCox, (2010). *Lehninger Principles of Biochemistry,* 2nd edition, Wiley publisher

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1. https://www.slideshare.net/namarta28/monosaccharides
2. https://www.tuscany- diet.net/proteins/classification/#: ~:text=egg%20yolk%20phosvitin.
3. http://www.Protein%20classification%20based%20on%20shape,two%20classes%3A%20f ibrous%20and%20globular.
4. https://byjus.com/biology/lipids/#:~:text=There%20are%20two%20major%20types, than % 20alcohol%20and%20fatty%20acids.
5. https://www.thoughtco.com/dna-versus-rna-608191

Pedagogy

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

Course Designer

Dr.B.Thamilmaraiselvi

Semester I	Internal mark:40		External mark:60	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEKS**	**CREDITS**
23UMB1AC1P	**BIOCHEMISTRY I (P)**	**ALLIED**	**4**	**3**

Course Objective

• This course enables the students to explore the basic biochemistry practical skills.

Course Outcome and Cognitive Level Mapping

On the successful completion of the course, students will be able to

CO NUMBER	CO STATEMENT	Cognitive Level
CO 1	Acquire knowledge about preparation of Buffer, principle of colorimeter	K4
CO 2	Analyse the constituents of carbohydrates and proteins	K1
CO 3	Analyse the constituents of lipids, Titrimetric estimation of Glucose	K6
CO 4	Titrimetric estimation Ascorbic acid and colorimetric estimation of DNA	K6
CO 5	Determination of Amino acids by Paper chromatography & Thin layer chromatography	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO 1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	2	1	3	3	3	3
CO 3	3	3	1	3	3	3	2	2	2	3
CO 4	3	3	2	3	3	3	3	1	3	2
CO 5	3	3	3	2	2	3	3	2	2	3

"1" – Slight (Low) Correlation

"2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation

"-" indicates there is no correlation

Syllabus

1. Preparation of Buffer & estimation of pH
2. Verification of Beer Lambert's Law
3. Qualitative Analysis of Carbohydrates
4. Qualitative Analysis of Proteins
5. Qualitative Analysis of Lipids
6. Quantitative estimation of Glucose by Benedict's method
7. Quantitative estimation of Ascorbic acid
8. Qualitative estimation of DNA by Diphenyl amine method
9. Separation of Amino acids by paper chromatography (Demonstration)
10. Separation of Amino acids by Thin layer chromatography (Demonstration)

Text Books

1. Vasudevan and Sabir Kumar Doss (2022). Practical Text book of Biochemistry for Medical students.
2. Damodaran Geetha K.(2016), Practical Biochemistry, JB brother medical publisher.
3. Ranjna Chawla. (2014). Practical clinical Biochemistry, JB brother medical publisher.
4. Manipal manual of clinical Biochemistry.(2013), JB brother medical publisher.
5. Shawn O' Farrell and Ryan T Ranallo (2006). Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia.

Reference Books

1. Vasudevan and Sabir Kumar Doss (2022). Practical Text book of Biochemistry for Medical students.
2. Damodaran Geetha K.(2016), Practical Biochemistry, JB brother medical publisher.
3. Ranjna Chawla.(2014). Practical clinical Biochemistry, JB brother medical publisher.
4. Manipal manual of clinical Biochemistry.(2013), JB brother medical publisher.
5. Shawn O' Farrell and Ryan T Ranallo (2006). Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia.

Web References

1. https://www.youtube.com/watch?v=wmhmAESv72E
2. https://www.youtube.com/watch?v=VzYDk4t97Ok
3. https://www.youtube.com/watch?v=JdXbTWfOc18
4. https://www.youtube.com/watch?v=2LiA_yNMIVs

Pedagogy

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

Course Designer

Dr. N.Pushpa

Semester: II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB2CC2	**MICROBIAL PHYSIOLOGY**	**CORE COURSE**	**4**	**4**

Course Objective

- To impart among the learners the fundamental principles of microbial physiology.
- To understand the kinetics of microbial growth and influence of varied physio chemical parameters.
- To provide basic knowledge about metabolism and respiration.

Prerequisites

General background in microbial physiology

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive level
CO 1	State nutritional requirements and uptake of microorganisms.	K1, K2
CO 2	Explain phases and factors of growth	K3, K4
CO 3	Describe the Carbohydrate metabolism	K3, K4
CO 4	Compute the importance of Anaerobic Respiration and fermentation pathway.	K4, K5
CO 5	Impart knowledge about protein and lipid metabolisms.	K4, K5

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	**Metabolism and Nutrition:** Introduction to Metabolism – Definition, types of metabolism and metabolic pathways. Nutrition – Micro and macro nutrient requirements of microorganisms. Nutritional Classification – Autotrophs, heterotrophs, photoautotrophs, chemoautotrophs, chemolithotrophs, oligotrophs. Transport mechanism – Passive diffusion, Facilitated diffusion, Active transport and group translocation.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
II	**Microbial Growth**: Phases of Growth, Growth curve. Factors influencing the growth of microorganisms – temperature, pH, salt, Osmotic pressure, and radiations. Growth measurements – batch, continuous, synchronous and Diauxic culture.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
III	**Anaerobic Respiration**: Nitrate, sulphate & Methane respiration. Fermentations – alcohol, mixed acid, lactic acid fermentation.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
IV	**Carbohydrate Metabolism**: Embden Mayer– Hoff – Parnas (EMP) pathway, HMP Shut, Kreb's cycle (TCA) cycle - Electron transport chain, Phosphorylation, oxidative and substrate level phosphorylation.	12	CO1, CO2, CO3, CO4	K1, K2, K3, K4
V	**Protein, Lipid and Nucleic acid metabolism**: Synthesis and degradation of amino acids (glycine and threonine), peptides, proteins. Biosynthesis and ß Oxidation of fatty acids, Biosynthesis and degradation of purine and pyrimide.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment (Not to be included for End Semester Examination)** Enzymes: classification & nomenclature, properties, Michaelis-Menton equation for simple enzymes, coenzymes and cofactors, isozymes.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text books

1. Dubey, R.C. and D.K. Maheshwari. (2022) A Text Book of Microbiology, S. Chand and Company Ltd., New Delhi.
2. Rani Gupta and Namita Gupta. (2022). Fundamentals of Bacterial Physiology and Metabolism, Springer Nature, Singapore.
3. Ananthanarayan Paniker. (2020). A Text book of Microbiology. 11th Edition. University Press.

Singapore.
4. Madigan M.T., Martinko J.M., and Parker J. (2019). Biology of Microorganisms. 12th Edition, MacMillan Press. England.
5. Atlas R.A. and Bartha R. (2019). Microbial Ecology. Fundamentals and Application. 4th edition, Benjamin Cummings, New York.

Reference Books

1. Tortora G.J., Funke B.R. and Case C.L.(2020). Microbiology: An Introduction. 9th Edition, Pearson Education, Singapore.
2. Black J.G. (2018). Microbiology-principles and explorations, 6th edition. John Wiley and Sons, Inc. New York.
3. MoselioSchaechter and Joshua Leaderberg. (2019). The Desk encyclopedia of Microbiology. 2nd edition. Elsevier Academic press, California.
4. Madigan M.T., Martinko J.M. and Parker J.(2019). Biology of Microorganisms, 12th Edition. MacMillan Press, England.
5. Michel Mandigan, Kelly S.Bender, Daniel buckley, W Mathew Sattley and David Stahl. (2019). Borck biology of microorganisms, 15th Edition, Pearson.

Web References

1. https://uomustansiriyah.edu.iq/media/lectures/6/6_2017_08_09!09_50_48_AM.pdf
2. https://biologydictionary.net/anaerobic-respiration/
3. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Kaiser)/Unit_7%3A_Microbial_Genetics_and_Microbial_Metabolism/18%3A_Microbial_Metabolism/18.3%3A_Aerobic_Respiration
4. https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals_of_Biochemistry_(LibreTexts)/02%3A_Unit_II-_Bioenergetics_and_Metabolism 22%3A_Biosynthesis_f_Amino_Acids_Nucleotides_and_Related_Molecules/22.02%3A_Biosynthesis _of_ Amino_Acids
5. https://www.youtube.com/watch?v=9CPIs-Qhg-M

Pedagogy

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

Course Designer

Dr. N.Jeenathunisa

SEMESTER:II	INTERNAL MARKS: 25		EXTERNAL MARKS: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDIT**
23UMB2CC3	**MOLECULAR BIOLOGY**	**CORE COURSE –III (CC)**	**3**	**3**

Course Objective:

The paper Molecular Biology encompasses the basic study and understanding the central dogma. It helps in understanding the basic organization of the genome of prokaryotes and eukaryotes. It is followed by prokaryotic and eukaryotic replication, transcription, translation processes and regulation.

Prerequisites

Basic knowledge on function of various genes and proteins for better understanding of cellular life processes.

Course Outcomes and Cognitive Level Mapping

COs	CO Statement	Knowledge level
CO1	Define the basics Prosperities of DNA	K1
CO2	Recite the knowledge about replication of DNA	K1
CO3	Critique knowledge about central dogma of biology	K4
CO4	Generalize the basic idea of Gene transfer mechanisms	K6
CO5	Expand about mutation	K6

Mapping of CO with PO and PSO

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

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

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

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**UNIT I: History and concepts in Molecular Biology** Milestones in history–Definition of nucleic acids-Experimental proofs of DNA as the genetic material (Griffith and Hershey Chase) – Experimental proofs of RNA as the genetic material - Chemistry and molecular structure of DNA double helix – Discovery of DNA structure – Brief account on types and forms of DNA –Definition of a gene. Organization of DNA in eukaryotic cell; Palindromic DNA; Types of RNA-rRNA; mRNA, SnRNA the 5' cap, non- coding region, initiation, coding region, termination codon; Poly (A) region, post transcriptional modification. Brief note on plasmids: structure and its types.	9	CO1, CO2, CO4, CO5	K1, K2, K3, K4,
II	**UNIT II : DNA Replication** Watson and Crick's model of DNA replication (experimental evidence); Enzyme involved in DNA replication (DNA polymerase I, Pol II, Pol III, DNA ligase); Mechanism of DNA replication; Models of DNA replication, inhibitors of DNA replication. Exonuclease and endonuclease. Theta replication and Rolling circle replication. Replication of RNA – reverse transcriptase.	9	CO1, CO2, CO3, CO4,	K1, K2, K3, K4,
III	**UNIT III : Transcription and Translation** DNA Transcription: Definition – Brief account on transcriptional machinery and mechanism of transcription — RNA Translation: Definition – Brief account on translational machinery, mechanisms of translation and Splicing mechanism. Regulation of gene expression: Concept of Gene, Genetic code & its properties. Wobble concept, prokaryotic and eukaryotic ribosomes, detailed account of structure, function and regulation of *lac* operon, *trp*operon and *ara*operon.	9	CO1, CO2, CO3, CO4	K2, K3, K4, K5

IV	**UNIT IV: Gene transfer mechanism** Gene transfer mechanisms: Conjugation, Transformation and Transduction. Discovery of Transformation, Natural competence and its mechanism - Conjugation - Discovery, F+ v/s F-, Hfr+ v/sF. Transduction – Generalized and specialized transductions. Transposons – Structure, genetic organization andmechanism of transposition. PolymeraseChain Reaction & types.	9	CO1, CO2, CO3, CO4	K2, K4, K5, K6
V	**UNIT V : Mutation** Definitions of mutations, mutagenesis and mutants - types of mutations; Gene diversity; Split genes, overlapping gene; Molecular nature of Mutation, Spontaneous and Induced mutation; DNA damage repair – Types of damage (deamination, Oxidative damage, Alkylation, Pyrimidine dimmers. Hybridization techniques: Southern, Northern & Western Blotting. Physical and Chemical mutagens, Carcinogenicity testing (AMES Test)- Applications of Mutations.	9	CO1, CO4 , CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment (Not included for End Semester Examinations** Cancer- Types, properties, causes, treatment and Oncogenes and tumour suppressor genes.	-	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5

Text Books:

1. Clark David (2019) *Molecular Biology,* Academic Cell.
2. Gerald Karp , JanetIwasa and Wallace Marshall(2016) *Karp's Cell and Molecular Biology*, Wiley.
3. Joanne Willey, Linda Sherwood (2016) Prescott's Microbiology, Mc-Graw– Hill Publishing Company Ltd.
4. Veer BalaRastogi (2015) *Principles of Molecular Biology* Med tech.
5. Verma P S and Agarwal V K (2015) Cell biology, Genetics, Molecular Biology Evolution and Ecology, S. Chand and Company Ltd.

Reference Books

1. Tania A. Baker, Stephen P. Bell, Michael Levine and Richard Losick. (2013) *Molecular Biology of the Gene.* 7th Edition. Benjamin/Cummings Publ. Co., Inc., California.
2. Rosalee S. Hell berg T.A. Brown. (2011). *Introduction to genetics: A molecular approach*. 1st Edition. Garland Science.
3. Geoffrey M Cooper (2016) *Cell: A Molecular Approach*, Sinauer Associates Inc.
4. Bernard R Glick and Cheryl L Patten (2017). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, ASM Press.

Web Links:

1. https://pages.jh.edu/rschlei1/Random_stuff/publications/molbiogene.pdf
2. https://www.fmed.uniba.sk/uploads/media/Introduction_to_Medical_and_Molecular_Biology.pdf
3. https://www.aacb.asn.au/documents/item/3400
4. https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental_molecular_biology.pdf
   https://users.ugent.be/~avierstr/pdf/principles.pdf
5. https://pages.jh.edu/rschlei1/Random_stuff/publications/molbiogene.pdf

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

Course Designer

Ms.S.Sathya

Semester: II	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB2CC2P	**MICROBIAL PHYSIOLOGY AND MOLECULAR BIOLOGY (P)**	**CORE PRACTICAL**	**4**	**3**

Course Objective

The objective of this laboratory is to teach a variety of techniques used in physiology and molecular biology research.

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement	Cognitive level
CO 1	Develop the skills to grow microbes in the laboratory.	K1
CO 2	Illustrate effect of pH, temperature and salt on microbes.	K2
CO 3	Evaluate the growth of microbial cell and enzyme hydrolysis reactions.	K3
CO 4	Analyze biochemical test to identify bacteria.	K3
CO 5	Interpret isolation and characterization of genomic and plasmid DNA.	K4

Mapping of CO with PO and PSO

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

1. Effect of pH on the growth of microbes.
2. Effect of Temperature on the growth of microbes.
3. Effect of salt on the growth of microbes.
4. Determination of growth curve – direct count, viable count and spectrophotometric assay.
5. Enzymatic Hydrolysis of Starch, Gelatin, Casein.
6. Oxidase test.
7. Catalase test.
8. Biochemical test -Indole test,Methyl Red test,Voges Proskauer test,Citrate Utilization test, Triple Sugar Iron test and Carbohydrate fermentation test.
9. Isolation of Chromosomal DNA from bacteria.
10. Isolation of Plasmid DNA from bacteria.
11. Characterization of Plasmid DNA by Agarose gel electrophoresis.
12. Demonstration of PCR.

Reference Books

1. Bharti Arora, D.R. Arora. (2020). Practical Microbiology, CBS Publishers & Distributors.
2. MudiliJ.(2020). Introductory Practical Microbiology**,** Narosa Publishers.
3. Das S (2020). Microbiology Practical Manual, CBS Publishers.
4. Swagat Kumar Dash, HrudayanathThatoi and Supriya Dash. (2020). Practical Biotechnology: Principles and Protocols, Dreamtech Press.
5. Saravanan R , D. Dhachinamoorthi and CH. MM. Prasada Rao. (2019). A Handbook of Practical Microbiology, LAP LAMBERT Academic Publishing.
6. Shukla Das and RumpaSaha. (2019). Microbiology Practical Manual, 1st Edition, CBS Publishers and Distributors.
7. Michael J Leboffe and Burton E. (2019). Pierce Microbiology: Laboratory Theory & Application, Morton Publishing Company.
8. Ashwani Kumar, Gakhar S K andMonikaMiglani. (2019). Molecular Biology: A Laboratory Manual, Dreamtech Press.
9. Siddra Ijaz and Imran Ul Haq. (2019). Recombinant DNA Technology, Cambridge Scholar UK.
10. Amita Jain , Jyotsna Agarwal and Vimala Venkatesh. (2018). Microbiology Practical Manual, 1stedition, Elsevier India.

Web References

1. https://www.youtube.com/watch?v=yDAcepSV-tU
2. https://www.youtube.com/watch?v=qGkpw5W25K0
3. https://www.jove.com/v/10511/growth-curves-generating-growth-curves-using-colony-forming-units
4.https://bio.libretexts.org/Courses/North_Carolina_State_University/MB352_General_Microbiology_Laboratory_2021_(Lee)/07%3A_Microbial_Metabolism/7.01%3A_Introduction_to_Biochemical_Tests_Part I
5. https://www.youtube.com/watch?v=gkZ1CMKeP0w
6. https://microbiologyinfo.com/category/biochemical-test/
7. https://www.researchgate.net/publication/320508474_Molecular_Biology_Laboratory_manual

Pedagogy

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

Course Designer

Dr. N.Jeenathunisa

Semester: II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS / WEEK**	**CREDITS**
23UMB2AC2	**BIOCHEMISTRY II**	**FIRST ALLIED COURSE**	**3**	**3**

Course objective

· To Learn about the Types of Blood cells, composition, function, deficiency diseases of RBC and WBC.
· To make the students to know about the structural features of plasma membrane, cellular transport mechanisms with specific examples.
· To acquire about the Endocrine glands and it's structure, classification of Hormones and it's biosynthesis, functions and deficiency diseases.

Prerequisites

To understand the knowledge about the structure and function of plant hormones and secondary metabolites-Alkaloids and flavonoids.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive level
CO 1	Evaluate the basic Concept of Blood and its components, Deficiency Diseases	K2
CO 2	Describe the various models of cell Membrane and transport mechanisms	K2
CO 3	Discuss the Endocrine Glands and their hormones with deficiency diseases	K3
CO 4	Compare the Plant pigments with their biosynthesis and significance	K4
CO 5	Explain the structure of Plant hormones with its structure and function	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	2	3	2	2	3
CO2	2	2	3	2	2	3	2	3	3	3
CO3	3	2	1	3	2	2	2	3	2	2
CO4	2	2	3	2	3	3	3	2	3	2
CO5	3	3	2	3	2	3	2	3	2	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	**Cytochemistry:** Cytochemistry –Plasma membrane-composition and functions–Danielli Davson Model- Fluid mosaic model, Trilaminar model. Mechnaism of cell membrane transport – Active, Passive and Facilitated diffusion – Uni, sym and antiports – Na^+ - K^+ ATPase and iron transport	9	CO1, CO2, CO4, CO5	K1, K2, K3 ,K4,
II	**Haematology :** Blood and it's components: Types of Blood cells – origin – Composition of Blood– Characterization and coagulation Significance of platelets–WBC-Types, structure and functions - Deficiency RBC–Structure, Formation-Functions– Anaemia – Sickle cell - Aplastic-Hemolytic	9	CO1, CO2, CO3, CO4,	K1, K2, K3, K4,
III	**Animal hormones:** Hormones of pituitary, thyroids, parathyroid, pancreas, adrenal Glands-testis and ovarian Hormones –Structure, functions, deficiency diseases associated hormones	9	CO1, CO2, CO3, CO4	K2, K3, K4, K5
IV	**Plant hormones:** Plant hormones – Discovery, structure and functions of Auxins - chemistry, biological function and metabolism of Gibberellins-Functions and mode of action of Cytokinin– Structure and functions of Abscisic acid.	9	CO1, CO2, CO3, CO4	K2, K4, K5, K6
V	**Plant pigments:** Plant pigments – chlorophyll, carotenoids –Phycobilins and anthocyanin structure – Biosynthesis – functions	9	CO1, CO4 , CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment (Not to be included for End Semester Examination)** Hemophilin – Leucocytosis Polycythemia – Thalassemia – Van willebrand disease	-	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5

Text Books

1. William, J. Marshall and Stephan, K. Bangert.2014. 3rd Edition. Clinical Biochemistry – Metabolic and Clinical Aspects – Churchill Livingston, New York.
2. Ambika Shanmugam.2016. Biochemistry for Medical Students. 8th Edition. Wolters Kluwer India Pvt. Ltd.
3. Satyanarayana. 2020.Biochemistry. 5th Edition. Elsevier. RELX India Pvt. ltd,
4. Seema Pavgi Upadhye.2020. Textbook of Biochemistry. 4th Edition. Dreamtech Press.
5. Harper's.2018. Illustrated Biochemistry. 31st Edition. McGraw Hill / Medical Publishers.

References

1. Stryer, L.1995.Biochemistry. 4th Edition. W.H. Freeman and Company, New York.
   Dinesh puri.2020. Textbook of Medical Biochemistry.4th Edition. Elsevier India
2. Donald voet and Judith voet.1990. Biochemistry. John Wiley and Sons, New York.
3. Hubert, Stryer, 1995. Biochemistry – Freeman and Company, New York.
4. Dawn, B.Markus, 1994. Biochemistry. Harwal Publishing, New York.

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1. https://byjus.com/neet/plant-hormones/
2. https://www.hopkinsmedicine.org/health/conditions-and-diseases/hormones-and-the-endocrine-system
3. https://byjus.com/neet/types-of-blood-cells-notes/

Pedagogy

Power point presentations, Group Discussion, Brain Storming Activity.

Course Designer

Dr. N. Pushpa

Semester: II	InternalMarks:100			
COURSE CODE	**COURSETITLE**	**CATEGORY**	**HRS/ WEEK**	**CREDITS**
22UGEVS	**ENVIRONMENTAL STUDIES**	**ABILITY ENHANCEMENT COMPULSORY COURSE**	**2**	**2**

Course Objective

To train the students to get awareness about total environment and its related problems and to make them to participate in the improvement and protection of the environment.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Outline the nature and scope of environmental studies	K1, K2
CO2	Illustrate the various types of natural resources and its importance.	K2
CO3	Classify various types of ecosystem with its structure and function.	K2, K3
CO4	Develop an understanding of various types of pollution and biodiversity.	K3
CO5	List out the various types of social issues related with environment and explain protection acts	K4, K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	3	3	2	2	3	2	3
CO2	3	3	2	3	3	3	2	3	3	3
CO3	2	3	3	2	3	3	3	3	3	2
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 environmental studies Definition, scope and importance. Need for public awareness	06	CO1, CO2, CO3, CO4	K1, K2, K3,
II	Natural Resources: Renewable and non-renewable resources: Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems. Mineral resources: Use and exploitation ,environmental effects of extract incandescing mineral resources. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. Land resources: Land as resources, land degradation, man induced Landslides, soil erosion and desertification. Role of an individual in conservation of natural resources.	06	CO1, CO2, CO3, CO4	K1, K2, K3
III	Ecosystems Concept, Structure andfunction of an ecosystem. Producers, consumers and decomposers. Energy flowing the ecosystem and Ecologicalsuccession. Food chains, food webs andecological pyramids Introduction, types, characteristic features, structure and function of the following ecosystem: - Forest ecosystem, Grassland ecosystem and Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	06	CO1, CO2, CO3, CO4	K1, K2, K3

IV	Biodiversity and Environmental Pollution Introduction, types and value of biodiversity. India as a mega diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Definition, Causes, effects and control measures of: a. Air Pollution b. Water Pollution c. Soil Pollution d. Noise pollution e. Nuclear hazards Solid waste Management: Causes, effects and control measures of urban and industrial wastes. E-Waste Management: Sources and Types of E-waste. Effect of E-waste on environment and human body. Disposal of E-waste, Advantages of Recycling E-waste. Role of an individual in prevention of pollution. Disaster management: floods, earthquake, cyclone and landslides.	06	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	Social Issues and the Environment Water conservation, rainwater harvesting, watershed management. Climate change, global warming, acid rain, ozone layer depletion, Wasteland reclamation. Environment Protection Act Wildlife Protection Act. Forest Conservation Act. Population explosion – Family Welfare Programmes Human Rights – Value Education. HIV/ AIDS - Women and Child Welfare. Role of Information Technology in Environment and human health.	06	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment** **(Not to be included for End Semester Examination)** Global warming – climate change – importance of ozone – Effects of ozone depletion. Biogeography –history, ecology and conservation. International laws and policy	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

References

1. Sarita Kumar . 2021. Fundamentals of Environmental Studies for Undergraduate Courses (1st edition). Sultan Chand
2. Aruna Kumari Nakkella. 2022. Environmental Science (1st edition). Bharti Publications.
3. Pallabigoswami. 2023. Environmental studies (1st edition). Ashok publication.
4. Beard, J.M. 2013. Environmental Chemistry in Society(2ndedition). CRC Press.
5. Girard, J.2013. Principles of Environmental Chemistry (3rdedition). Jones &Bartlett.
6. Brebbia, C.A.2013. Water Resources Management VII. WIT Press.
7. Hites, R.A. 2012. Elements of Environmental Chemistry(2ndedition). Wiley &Sons.
8. Harnung, S.E. &Johnson, M.S. 2012.Chemistryand the Environment. Cambridge University Press.
9. Boeker, E. &Grondelle, R. 2011. Environmental Physics: Sustainable Energy and Climate Change. Wiley.
10. Forinash, K.2010.FoundationofEnvironmentalPhysics. Island Press.
11. Evans, G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2ndedition). Wiley-Blackwell Publications.
12. Williams, D.M., Ebach, M.C.2008. Foundations of Systematics and Biogeography. Springer
13. Pani, B.2007.TextbookofEnvironmentalChemistry. IK international Publishing House.

Pedagogy

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

Course Designer

Dr. B. Thamilmaraiselvi

Semester : III	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB3CC4	**VIROLOGY**	**Core**	**5**	**5**

Course objective

To enable the students to understand the basic knowledge about Viruses and their Specific Isolation, Cultivation Techniques. To provide the students awareness about the etiology, Pathogenesis, Treatment and prophylaxis of some Plant and Animal viral diseases.

Course Outcome and Cognitive Level Mapping:

CO Number	CO Statement	Knowledge level
CO 1	Define the basic knowledge of Viruses	K1,K2, K4
CO 2	Select the suitable Purification and Characterization methodsof Viruses	K1,K2, K3
CO 3	Compare and Contrast Bacteriophages Life cycle	K1,K2, K3
CO 4	Illustrate impacts of the Plant Viral diseases	K1,K2, K4
CO 5	Organised views of Animal Viruses	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	Introduction – Definition, History of virology. General properties of viruses– Cultivation of Viruses– Structure and replications of viruses– classification of Viruses (ICTV classification).	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Purification and Characterization of Viruses, Separation and Characterization of Viral Components. Assay of viruses – physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy). Infective assay of Bacteriophages (plaque method). Infective assay of Plant Viruses.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Bacterial Viruses–Classification and structure of Bacteriophage, The Lytic life cycle (T- Even coli phages) – Lysogenic life cycle (Phage Lambda). Bacteriophage typing, Phage therapy.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Plant Viruses: Common Plant Viral Diseases: TMV, Bunchy top of Banana, Cauliflower Mosaic Virus and Rice Tungro Virus. Satellite Viruses, Viroid. Transmission of Plant Viruses with Vectors - Insects, Nematodes, Fungi - without vectors (Contact, Seed and Pollens). Control Measures of Plant Viruses- Vector Control.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Animal viruses: Common Animal Viral Diseases: Prions, Rinder pest, Blue tongue, Raniketdion, Foot and Mouth Disease. Human Viruses–HIV, Hepatitis Pox, Polio, Rabies, Dengue, SARS – COVID and Oncogenic Viruses. Viral Vaccines. Prevention and Treatment of Viral Diseases. Antiviral agents.	15	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6
VI	**Self Study for Enrichment** **(Not included for End Semester Examination)** Baltimore Classification and LHT viral classification. Quantification of viruses. End point method of Bacteriophages. Study of Animal and Plant viral Replications. Generation of Virus-Virus free planting material, Visit to Virology Labs.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books:

1. Geo. Brooks, Karen C. Carroll, Janet Butel, Stephen Morse. Jawetz Mel nick & Adelbergs Medical Microbiology. 28th Edition, McGraw-Hill Education. 2019.
2. Mahendra Pal Yadav, Raj Kumar Singh, Yashpal Singh Malik. Recent Advances in Animal Virology. Springer. 2020
3. P. Saravanan. Virology. 1st edition, MJP Publishers, Delhi 2021.
4. Ananthanarayan and Paniker's Textbook of Microbiology. 12th E-edition, Universities Press .United States. 2022.
5. Baijayantimala Mishra. Textbook of Medical Virology. 2nd Edition, CBS Publishers & Distributors Pvt Ltd, India. Churchill Livingstone. 2022.

References:

1. Apurba S Sastry, Sandhya Bhat.Essentials of Medical Microbiology 4th edition. Jaypee brothers med Pub Pvt Ltd 2022.
2. Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller MD. Medical Microbiology, 9th edition. Elsevier Publishers 2020.
3. Levinson. Review of Medical Microbiology and Immunology. Mc Graw Hill / Medical Publishers 2021
4. Yi-Wei Tang, Charles W. Stratton. Advanced Techniques in Diagnostic Microbiology. 3rd edition. Springer Publishers 2018.
5. Abbas. Cellular and Molecular Immunology, 10th edition, Elsevier Publishers 2021

Web links:

1. http://www.bocklabs.wisc.edu/ed/virustax.html
2. http:// www.bocklabs.wisc.edu/ed/genomes.html
3. http://www.virology.net/Big_Virology/BVHomePage.html
4. https://www.youtube.com/watch?v=Iy-kidfj7Wc
5. https://www.youtube.com/watch?v=Kt0miFrXMaY
6. https://www.youtube.com/watch?v=zw4jydUY1S8
7. https://www.youtube.com/watch?v=Y5XU61wQS6E
8. https://www.youtube.com/watch?v=4ua3qf1tij8

Pedagogy

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

Course Designer

Dr. S. Jeyabharathi

Semester : III	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22UMB3CC3P	**VIROLOGY (P)**	**Core Practical**	**3**	**3**

Course objective

The practical aims to engage the students with virus detection, diagnosis and laboratory methods that are used in a wide range of Virology and biomedical research settings. To enable the students to perform hands-on training experience on methods and techniques used in virology. The practicals are also designed to offer an alternative learning situation for the ideas that underlie both the virus detection and the techniques.

Course Outcome and Cognitive Level Mapping:

CO Number	CO Statement	Cognitive level
CO 1	Define the basic knowledge of Viruses	K1,K2, K4
CO 2	Select the suitable Purification and Characterization methodsof Viruses	K1,K2, K3
CO 3	Compare and Contrast Bacteriophages Life cycle	K1,K2, K3
CO 4	Illustrate impacts of the Plant Viral diseases	K1,K2, K4
CO 5	Organised views of Animal Viruses	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:

1. Laboratory detection of viral samples (Collection and transport of samples).
2. Isolation of Bacteriophage from sewage.
3. Demonstration of mechanical transfer of viruses in plants.
4. Cultivation of Viruses in Embryonated eggs – Amniotic, Allantoic, Yolk sac routes and Chorio-allantoic membrane.
5. Observation of selected bacterial, plant and animal viruses – T4 and M13 Phage, TMV, CaMV, HIV, Influenza, HSV, HBV, Rabies and Blue tongue virus
6. Visit to Hospitals, Viral Research Institutes and Clinical laboratories.

References:

1. Ananthanarayan and Paniker's Textbook of Microbiology. 12th E-edition, Universities Press. United States. 2022.
2. Yi-Wei Tang, Charles W. Stratton. Advanced Techniques in Diagnostic Microbiology. 3rd edition. Springer Publishers 2018.
3. Baijayantimala Mishra. Textbook of Medical Virology. 2nd Edition, CBS Publishers & Distributors Pvt Ltd, India. Churchill Livingstone. 2022.
4. Geo. Brooks, Karen C. Carroll, Janet Butel, Stephen Morse. Jawetz Mel nick & Adelbergs Medical Microbiology. 28th Edition, McGraw-Hill Education. 2019.
5. Apurba S Sastry, Sandhya Bhat. Essentials of Medical Microbiology 4th edition. Jaypee brothers med Pub Pvt Ltd 2022.

Web links:

1. https://www.youtube.com/watch?v=Iy-kidfj7Wc
2. https://www.youtube.com/watch?v=Kt0miFrXMaY
3. https://www.youtube.com/watch?v=zw4jydUY1S8
4. https://www.youtube.com/watch?v=Y5XU61wQS6E
5. https://www.youtube.com/watch?v=4ua3qf1tij8

Pedagogy

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

Course Designer

Dr. S. Jeyabharathi

Semester III	Internal Marks: 25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs /Week	CREDITS
23UMB3AC3	BIOSTATISTICS	ALLIED	5	3

Course Objective

- Explain the basic concepts of statistics and sampling design.
- Emphasize analytical thinking to solve biological problems.
- Explore the mathematical methods formatted for major concepts.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Remember and recall the basic concepts of biostatistics	K1
CO2	Illustrate the various notions in the respective stream.	K2
CO3	Apply the different terminologies of biostatistics	K3
CO4	Classify the solution of statistical methods using various techniques.	K4
CO5	Explain the solution of bio statistical problems.	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2	2	3	2	3	3
CO2	3	2	2	2	2	2	3	2	3	3
CO3	3	2	2	2	2	2	3	2	3	3
CO4	3	2	2	2	2	2	3	2	3	3
CO5	3	2	2	2	2	2	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	**Importance, Functions, Limitations:** Importance - Statistics in States – Statistics in Economics – Statistics in Business –Statistics in Astronomy – Statistics in Education – Statistics in Accounting Auditing – Statistics in Research – Statistics in Planning–Statistics in Mathematics – Statistics and the Common man–Statistics Functions of Statistics–Limitations of Statistics. **Classification and Tabulation:** Introduction, Meaning of Classification, Chief Characteristics of Classification, Objects of Classification, Roles of Classification, Types of Classification, Geographical Classification, Chronological Classification, Qualitative Classification, Quantitative Classification, Statistical Series, Types of series, Frequency Distribution, Individual observation, Discrete(ungrouped) Frequency Distribution.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Diagrammatic Representation:** Introduction– Advantages– Limitations of a Diagram – Rules for Making a Diagram –Types of Diagrams – One Dimensional Diagram – Two-dimensional diagram –Three-Dimensional Diagram – Pictogram and Cartogram– Selection of a Diagram. **Graphic Presentation:** Advantages of Graphic Presentation, Construction of a Graph, General Rules, Difference between Diagram and Graph of Frequency Distribution: Histogram, Frequency Curves.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Measures of Central Tendency:** Measures of Central Tendency or Average – Characteristics of an Ideal Measure of Central Tendency-Arithmetic Mean-Weighted Arithmetic Mean-Combined Mean-Corrected Mean-Merits, Demerits and Uses of Arithmetic Mean-Median- Calculation of Median- Calculation of Median for Grouped Data- Calculation of Median for Continuous Series- Merits, Demerits and Uses of Median- Mode- Types of Model Series- Computation of Mode for Individual Series-Computation of Mode by Grouping Method- Computation of Mode in a Continuous Frequency Distribution-Merits, Demerits and Uses of Mode- Empirical Relation between Mean, Median and Mode-Mid Range- Geometric Mean -Merits, Demerits and Uses of Geometric Mean - Harmonic Mean- Merits, Demerits and Uses of Harmonic Mean . **Measures of Dispersion:** Variability – Range- Interquartile Range -Mean deviation or Average Deviation - Coefficient of Mean deviation -Standard Deviation-Merits, Demerits and Uses of Standard Deviation-Calculation of Standard Deviation – Individual Observations- Calculation of Standard Deviation – Discrete Series or Grouped Data- Calculation of Standard Deviation –Continuous Series- Limits of Variability-Empirical Relationships.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Skewness, Moments and Kurtosis**: Skewness- Definition of Skewness- Positively and Negatively Skewness-Purpose of Skewness-Difference Between Dispersion and Skewness - Measures of Skewness- Relative Measures- Karl Pearson's	15	CO1, CO2, CO3, CO4,	K1, K2, K3, K4

	Coefficient of Skewness- Bowley's Coefficient of Skewness. **Correlation Analysis:** Correlation –Covariance –Calculation of Covariance- Correlation Analysis- Correlation Coefficient Calculated from Ungrouped Data- Spearson's Rank Correlation Coefficient. **Regression Analysis:** Regression Analysis – Regression Coefficients- Properties of Regression Coefficients – Standard Error of Estimate or Prediction – Linear Regression Line or Equation.		CO5	
V	**Tests of Hypothesis:** Tests of Significance for Small Sampling Theory- Test of Hypothesis about the Population Mean- Test of Hypothesis about the Difference between Two Means (Using t-test)-Paired t-Test for Difference of Means – Testing the Hypothesis for Equality of Two Variances- Chi-Square Distribution- χ^2 - Test of Goodness of fit- χ^2 - Test of Independence of Attributes- Chi-Square Test for a Population Variance.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self -Study for Enrichment:** **(Not included for End Semester Examination)** Graphs of Time Series: Horizontal Line Graphs or Histogram- Continuous or Grouped Frequency class frequency, Magnitude of class Intervals, Cumulative frequency distribution- Frequency Curve- Cumulative Frequency Curve(or) Ogive-Variance and Coefficient of Variation - Scatter or Dot Diagram – Graphical Method - Design of Experiments.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Books

1. Pillai.R.S.N & Bhagavathi (2019).*Statistics Theory and Practice*. S.Chand and Company Limited, New Delhi.
2. Arora. P. N, Malhan. P.K. (2020). *Biostatistics*. Himalaya Publishing house.
3. Subramani. K, Santha.A. (2021). *Statistics for Management*. Scitech Publications (India) Pvt. Ltd.

Chapters and Sections

UNIT-I	Chapter 2: Pages (12 – 18) [1]
	Chapter 6: Pages (50 – 56) [1]
UNIT-II	Chapter 7: Pages (81 – 93) [1]
	Chapter 8: Pages (100-107) [1]
UNIT-III	Chapter 5 Sections 5.1-5.24 [2]
	Chapter 6: Sections 6.1-6.12 [2]
UNIT- IV	Chapter 7: Sections 7. 1-7.9 [2]
	Chapter 8: Sections 8. 1-8.6 [2]
	Chapter 9: Sections 9. 1-9.5 [2]
UNIT- V	Chapter 3: Sections 3.7-3.15 [3]

Reference Books

1. Baride. JP, Kulkarni. AP, Muzumdar. RD. (2003). *Manual of Biostatistics*. Medical publishers (P) Ltd.
2. Khan, Khanum (2004). *Fundamentals of Biostatistics.* Ukaaz Publications.
3. Pillai. R. S. N, Bagavathi. V. (2016). *Statistics Theory and Practice*, S.Chand.

Web References

1. https://www.youtube.com/watch?v=Vz5jztR6QFM&list=PLoNoar1DlEikWKiRSwtu2g-zAS_NdHeVo
2. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003271604164717neeraj_jain_Graphical_Representation.pdf
3. https://youtu.be/2FdhaofDkJg
4. http://digimat.in/nptel/courses/video/102101056/L01.html
5. https://youtu.be/XrGM0OANzaE
6. https://youtu.be/VnBDnVmQm6Y
7. https://youtu.be/NmgbFJ4UwPs
8. http://www.lscollege.ac.in/sites/default/files/e-content/limitations%20of%20statistics.pdf

Pedagogy

Power point presentation, Group Discussion, Seminar, Assignment.

Course Designers

1. Dr.P.Geethanjali
2. Ms.P.Sangeetha

Semester III	Internal Marks: 40		External Marks:60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
23UMB3AC2P	**BIOSTATISTICS (P)**	**ALLIED PRACTICAL**	**3**	**3**

Course Objective

- **Analyze** the different types of data using appropriate statistical software
- **Demonstrate** a good understanding of descriptive statistics and graphical tools
- **Emphasize** analytical thinking to solve biological problems using SPSS.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Identify and collect various data for representation using biological materials.	**K1**
CO2	Illustrate 'chi' square test, standard Deviation using SPSS programme.	**K2**
CO3	Interpret results of commonly used statistical analyses in SPSS Package.	**K2**
CO4	Apply basic statistical concepts commonly used in public health and health Sciences.	**K3**
CO5	Discriminate the basic analytical techniques to generate results.	**K4**

Mapping of CO with PO and PSO

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

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

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

Syllabus

BIOSTATISTICS (P):

Listing the following Programmes using SPSS:

1. Tabulation of Data
2. Frequency Tabulation
3. Simple Bar Chart for Qualitative Variables
4. Simple Bar Chart for Quantitative Variables
5. Pie Chart
6. Line Graph
7. Clustered Bar Charts
8. Histogram
9. Chi-Square Test
10. Descriptive Statistics
11. Correlation
12. Regression

Web References

1. https://www.youtube.com/watch?v=Nbjz6G_Z74A
2. https://www.youtube.com/watch?v=0NeaD1Mojp0
3. https://www.youtube.com/watch?v=m89l1gbP_g0
4. https://www.youtube.com/watch?v=OopxVjGQDOo
5. https://www.youtube.com/watch?v=d57zpZampRk
6. https://www.youtube.com/watch?v=06QOdHv68pM
7. https://www.youtube.com/watch?v=Kp8QFo4XyME
8. https://www.youtube.com/watch?v=Ot-ztTT-9Jk
9. https://www.youtube.com/watch?v=VudrNXCYJt4

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity.

Course Designers

3. Dr.P.Geethanjali
4. Ms.P.Sangeetha

Semester : III	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22UMB3GEC1	**MUSHROOM TECHNOLOGY**	**GENERIC ELECTIVE COURSE**	**2**	**2**

Course Objective

To enable the students to identify the edible and poisonous mushrooms. To provide the students awareness about the marketing trends of Mushrooms. To give the students exposure to the experiences of experts in the field and to functioning mushroom farms.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Differentiate edible and Poisonous mushrooms	K2,K3
CO2	Examine Spawn preparation	K4,K5
CO3	Illustrate the cultivation of mushroom	K5,K6
CO4	Discuss about nutritional value of mushroom	K5,K6
CO5	Determine medicinal value of mushroom	K4,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	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	Introduction – History of mushroom cultivation; Classification and distribution of mushroom; life cycle of mushroom. Identification of poisonous mushrooms.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Spawn preparation - Isolation of pure culture; Nutrient media for pure culture; layout of spawn preparation room; raw material of spawn; sterilization; preparation of mother spawn and multiplication.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Cultivation of mushroom, layout of mushroom shed - small scale and large scale production unit. Types of raw material – preparation and sterilization; Mushroom bed preparation – maintenance of mushroom shed; harvesting method and preservation of mushrooms. short and long term storage of mushroom	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Cultivation of following types of mushroom – milky mushroom, oyster mushroom, button mushroom and medically valuable mushroom - shiitake mushroom and Reishi mushroom. Spent mushroom compost.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Nutrient values of mushroom – protein, carbohydrate, fat, fibre, vitamins and minerals. Preparation of various dishes - soup, sauce, cutlet, omelette, samosa, pickles, curry & biriyani. Pharmacological and economic values of mushroom.	6	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6
VI	**Self Study for Enrichment (Not included for End Semester Examination)** Visit to relevant Labs/Field Visits of mushroom cultivation	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books

1. Paul Stamets, J.S. and Chilton, J.S (2019) Mushroom cultivation A practical guide to growing mushrooms at home, Agarikon Press.
2. Tewan and Pankaj Kapoor S.C. (2020) Mushroom cultivation. Mittal Publication. Delhi.
3. Nita Bahl. 2016. Hand book of Mushrooms, 2nd Edition, Vol I & II.
4. Shu Fing Chang, Philip G. Miles and Chang, S.T. (2004) Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. 2nd ed., CRC press.
5. R.Gogoi, Y.Rathaiah, T.R.Borah (2019) Mushroom Technology Cultivation, Scientific Publisher.

Reference Books

1. Russell, Stephan (2018) The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster,Lion's Maneand Maitake Mushroom at Home. Storey Publishing.
2. B.C.Suman, Sharma V.P(2017) Mushroom India Cultivation in India. Daya Publishing House.
3. Marimuth, (1991) Oyster Mushrooms. Dept. of Plant pathology, TNAU, Coimbatore.

Web References

1. http://www.fungi.com
2. http://www.mushworld.com/home
3. http://forums.mycotopia.net/faq-frequently-asked-questions/5594-mushroom-growershandbook-1-mushworld-com.html.
4. http://forums.mycotopia.net/faq-frequently-asked-questions/6556-mushroom-growershandbook-2-mushworld-com.html
5. http://www.americanmushroom.org/news.html
6. https://www.brainkart.com/article/Mushroom-Cultivation_39985/

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**	**HOURS/WEEK**	**CREDIT**
23UMB4CC5	**IMMUNOLOGY**	**CORE COURSE**	6	5

Course Objectives

The aim of the course is to teach the types of immunity, immune system, antigen, antigen – antibody reaction, T and B cell activation, lymphokines and cytokines, hyper sensitivity reaction, autoimmune diseases and transplantation of immunity.

Prerequisites

Basic knowledge and concepts of immunology

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Understand the history and types of immunity.	K1, K2, K4
CO2	Demonstrate the various antigen- antibody techniques.	K3, K4
CO3	Differentiate the structure of MHC, Cytokines and lymphokines.	K4, K5,K6
CO4	Explain immune technology and its applications.	K4, K6
CO5	Explain the knowledge about hypersensitivity reactions	K5, K6

Mapping with Programme Outcomes

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

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**History and overview of the Immune system**: Cells and organs of the Immune system - Origin, development. Immuno haematology - blood groups, blood transfusion, Rh incompatibility. Immunity - types of immunity - cell mediated, Innate and acquired immunity. Differentiation of T and B cells and their receptors.	18	CO1, CO2, CO4, CO5	K1, K2, K3, K4, K5
II	**Antigen - antibody reactions:** Antigens- properties, types, biology of antigens, Haptens, adjuvants, epitope, paratope, cross reactivity and Forssman antigen. Immunoglobulin - structure, properties, types and functions. Theories of antibody production. Complement- alternative and classical pathways. Antigen - Antibody reaction - Precipitation, Agglutination, Immunodiffusion and Complement Fixation.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Immune response**: Cell mediated and humoral. MHC, Cytokines, lympokines - structure, function and their receptors. Types of vaccines Transplantation Immunology- types of transplants, Tissue typing, Graft - rejection mechanism. Hyper acute, acute and chronic Reactions	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
IV	**Immuno techniques:** Monoclonal antibody production, properties and its applications. ELISA, RIA, Immuno fluorescence - FISH, Immuno electrophoresis and WIDAL.	18	CO1, CO2, CO3, CO4, CO5	K2, K4 K5, K6
V	**Hypersensitivity Reactions**: Introduction, Definition - allergy, allergens, types – Immediate (Type I, Type II, Type III) and delayed (Type IV) Hypersensitivity reactions. Cancer Immunology - Introduction, tumour antigens, types of tumours and immuno therapy. Basic concept of autoimmunity – Organ specific and systemic auto immune diseases.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment (Not included for End Semester Examinations** Clinical manifestations of graft rejection – CRP, Pregnancy test, RPR and VDRL	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5

Text Books

1. AbulK. Abbas, Andrew, H.Lichtman, ShivPillai (2019).Basic Immunology :Functions and Disorders of the Immune System 6th Edition, Elsevier
2. Robert R. Rich, Thomas A Fleisher, William T. Shearer, Harry Schroeder, Anthony
3. J. Frew, Cornelia, M. Wey and (2018). Clinical Immunology: Principles and Practice, Elsevier
4. Abul K. Abbas, Andrew, H. Lichtman, ShivPillai (2017). Cellular and Molecular Immunology 9th Edition, Elsevier
5. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt (2017). Roitt's Essential Immunology, Wiley- Black well

Reference Books

1. A Wesley Burks, Stephen T Holgate, Robyn EO' Hehir, Leonard B.Bacharier, David
2. H. Broide, Gurjit K. Khurana Hershey, Jr. R. Stokes Peebles (2019).Middleton's Allergy E-Book :Principles and Practice, Elsevier
3. Lauren M. Sompayrac (2019). How the Immune System Works, Wiley-Blackwell
4. Kenneth Murphy, Casey Weaver (2016). Janeway'sImmunobiology9thEdition, Garland Science
5. William E.Paul (2012). FundamentalImmunology7thEdition, Kindle Edition

Web links

1. https://www.immunology.org/public-information/what-is-immunology
2. https://aacijournal.biomedcentral.com/articles/10.1186/1710-1492-7-S1-S1
3. https://onlinelibrary.wiley.com/journal/13652567
4. https://www.frontiersin.org/articles/10.3389/fimmu.2019.00684/full
5. https://emedicin e.medscape.com/allergy_immunology

Pedagogy

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

Course Designer

Dr.B.Thamilmaraiselvi

Semester: IV	Internal Marks:40		External Marks:60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22UMB4CC4P	**IMMUNOLOGY (P)**	**CORE PRACTICAL**	**4**	**4**

Course Objective

To enable the students to identify, analyze and observe various techniques in immunology.

Prerequisites

To acquire adequate skill to handle immune techniques.

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement	Cognitive level
CO1	Recall the immunological reactions.	K1
CO2	Demonstrate the advance immunological techniques.	K2
CO3	Develops kills to hem agglutination.	K3
CO4	Competently count blood cells and its differentiation	K3
CO5	Explain various techniques in immunology.	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	3	3	2	2	2	3
CO2	3	2	3	3	2	3	2	2	3	3
CO3	3	3	3	2	3	3	3	3	3	2
CO4	3	3	2	3	2	3	2	2	3	2
CO5	3	3	3	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 (60 Hours)

1. Haemagglutination – ABO Blood grouping.
2. Rh Typing
3. Total count (RBC and WBC).
4. Differential Count (WBC).
5. Agglutination reactions–WIDAL, RPR, CRP.
6. ASO
7. Precipitation reactions: Single and Double immune diffusion.
8. Demonstration of ELISA
9. Demonstration of western blotting

Reference Books

1. AbbasAK, LichtmanAH ,ShivPillai. Cellular and Molecular Immunology, 10th Edition. Elsevier, 2021.
2. Tobili Y. Sam-Yellowe. Immunology: Overview and Laboratory Manual**.** 2021(1st edition) Elsevier.
3. Saha r. Microbiology practical manual (2nd edition).Cbs publishers & distributors pvt. Ltd,2022.
4. Fumiichiro Yamamoto. ABO +logy (1st edition).Assign me a free ISBN; 2023.
5. Abbas. Cellular and Molecular Immunology(10th edition).South Asia Edition Paperback,2021.
6. Shrimati Dharmapal Shetty. CMR-NIIH Practical Guide to Laboratory Immuno hematology (1stedition). Jaypee Brothers Medical Publishers, 2020.

Web link

1. https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelingerlab/documents/Immunology-Lab-Manual.pdf
2. https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/fr
3. Monica Cheesbrough. District Laboratory Practice in TropicalCountries - Part Iand II (Second Edition). Cambridge University Press, New Delhi.
4. https://www.sciencedirect.com/book/9780128180068/clinical-immunology
5. https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf
6. https://www.scribd.com/doc/53764085/Immunotechniques

Pedagogy

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

Course Designer

Ms.R. Kiruthiga

Semester: IV	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDIT**
22UMB4AC4	**BIOINFORMATICS**	**ALLIED COURSE**	**4**	**3**

Course Objective:

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

Prerequisites

To Comprehend and analyze the basics of bioinformatics.

Course Outcomes and Cognitive Level Mapping

COs	CO Statement	Cognitive Level
CO1	Define the basics of bioinformatics	K1
CO2	Recite the knowledge about biological databases	K1
CO3	Critique knowledge about sequences	K4
CO4	Generalize the basic idea of metadata	K6
CO5	Expand the role of molecular biology	K6

Mapping with Programme Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	3	3	2	2	2	3
CO2	3	2	3	3	2	3	2	2	3	3
CO3	3	3	3	2	3	3	3	3	3	2
CO4	3	3	2	3	2	3	2	2	3	2
CO5	3	3	3	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	**Introduction to bioinformatics:** Bioinformatics - Definition, History, Scope and Applications. Opportunities in Bioinformatics. Emerging areas of Bioinformatics	12	CO1, CO2, CO4, CO5	K1, K2, K3, K4, K5
II	**Basic concepts in Molecular Biology:** Introduction to Molecular Biology and genetics. Central dogma of life: DNA – RNA - Protein. Role of Bioinformatics in Human Genome Project. Introduction to Medline, Pubmed, OMIM. Genomics and proteomics (Basic concepts), Data mining.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Biological database:** Biological databases, Importance of databases,Sequence and structure databases: EMBL, DDBJ, GenBank, PIR, SwissProt, CSD, PDB, NCBI.	12	CO1, CO2, CO3, CO4	K2, K3, K4, K5
IV	**Sequence Alignments and Visualization**: Introduction to Sequences, alignments and Dynamic Programming, Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).	12	CO1, CO2, CO3, CO4	K2, K4 K5, K6
V	**Meta data and Search:** Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON.	12	CO1, CO4 , CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment (Not included for End Semester Examinations** EXPASY, OMG / LIFESCIENCE, ENTREZ and SRS.	-	CO1, CO2, CO3, CO4	K2, K3, K4, K5

Text Books

1. Tiago Antao (2022). Bioinformatics with Python Cookbook, Packt Publishing Limited.
2. R. Sundaralingam, V. Kumaresan (2021).Bioinformatics, Saras Publication.
3. Vinita Chougule And MasiddKhalate (2020). Basics in Bioinformatics, Notion Press.
4. Andreas D. Baxevanis, Gary D. Bader, David S. Wishart (2020). BIOINFORMATICS Fourth Edition, Wiley.
5. Arthur Lesk (2019). Introduction to Bioinformatics Fifth Edition, OUP Oxford.

Reference Books:

1. Jonathan Pevsner(2022). Bioinformatics and functional genomics, 3rd edition, John Wiley.
2. Namita Mendiratta, Parag Rastogi, S.C. Rastogi (2022). Bioinformatics: Methods and
3. Applications: Genomics, Proteomics and Drug Discovery, PHI Learning.
4. Dr. Prachi Srivastava, Dr. Neha Srivastava, Er. Prekshi Garg, Er. Payal Trivedi (2021).
5. Bio Informatics (Vision and Approaches), Vayu Education of India.
6. Ken Youens-Clark (2021). Mastering Python for Bioinformatics: How to Write Flexible, Documented, Tested Python Code for Research Computing, Shroff/O'Reilly.
7. S.Gladis Helen Hepsyba, C.R.Hemalatha (2021). Basic Bioinformatics, MJP 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, Groupdiscussion, Seminar, Quiz, Assignment, Brain storming activity

Course Designer

Dr.P.F.Steffi

Semester: IV	Internal Marks:25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	HRS./WEEK	CREDITS
22UMB4GEC2	BIOFERTILIZER TECHNOLOGY	GENERIC ELECTIVE COURSE	2	2

Course Objectives

To enable the students to understand the role of beneficial microorganisms in biofertilizer production technology.

Prerequisites

Basic knowledge and concepts of Biofertilizer Technology

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand importance of biofertilizer	K1, K2
CO2	Analyze and explain mass production of *Rhizobium*	K3, K4
CO3	Determine and apply *Azospirillum* and *Azotobacter* biofertilizer	K3, K4
CO4	Evaluate and categorize Blue green algae biofertilizer	K4, K5
CO5	Criticize and manage production of phosphate biofertilizer and VAM	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	**Biofertilizers**: Definition - types, importance of biofertilizers in agriculture. Advantages and applications of Biofertilizers.	6	CO1, CO2, CO3	K1, K2, K3, K4
II	***Rhizobium*:** characteristics, isolation, identification, mass multiplication, carrier-based inoculants, Field applications.	6	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	***Azospirillum* and *Azotobacter*:** isolation and mass multiplication carrier-based inoculant, field applications. *Azotobacter*- characteristics, isolation, mass multiplication and field applications.	6	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	**Blue green algae as biofertilizer:** isolation, mass culture and field use of BGA inoculants. *Azolla* – mass cultivation and field application.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6,
V	**Phosphate biofertilizers**: isolation, mass production and field application. VAM-isolation, mass production, importance and field application.	6	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study for Enrichment (Not included for End Semester Examinations)** Green manure, organic manure, organic farming, bio compost, vermicomposting – field Application.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Kannaiyan S, Kumar, K., Govindarajan K. (2010). Biofertilizer Technology. 1st Edition. Scientific Publishers.
2. Kumaresan V. (2015). Biotechnology. 1st Edition. Saras Publication.
3. Eric Davis. (2018). Biofertilizer Technology: Importance and their uses. 1st Edition. DSR Book distributors.
4. Dubey R.C. (2022). A Textbook of Biotechnology. 1st Edition. S Chand and company Ltd.
5. Malati Hitendra Aher. (2022). Biofertilizer and Algal Technology. 1stEdition. Sahitya Sagar Publications.
6. Namita Nath, Dharmeswar Barman. (2022). Biofertilizer. 1st Edition. ARB Publications.

Reference Books

1. Anil K Thakur, Susheel K Bassi, Kamajit Singh, Dinesh. (2020). Biofertilizers (Skill Enhancement course). 1st Edition. S Dinesh & Co.
2. Himadri Panda. (2022). The complete technology book on Biofertilizer and organic farming. 3rd Edition. NIIR Project consultancy services.
3. Joanne Willey, Kathleen Sandman, Dorothy Wood. (2022).Prescott's Microbiology. 12thEdition. Mc Graw Hill.
4. Krishnendu Acharya, Surjit Sen, Manjula Rai. (2019). Biofertilizers and Biopesticides. 1st Edition. Techno World.
5. Amitava Rakshit, Vijay Singh Meena, Manoj Parihar, Singh H B, Singh A K. (2021). Biofertilizers: Advances in bio- inoculants. 1st Edition. Woodhead Publishing.
6. Ramanathan N. (2019). Biofertilizer Technology. 1st Edition. Kalyani Publisher.

Web References

1. https://byjus.com/biology/biofertilizers/
2. https://www.onlinebiologynotes.com/biofertilizer-advantages-types-methods-of-application-and-disadvantages/
3. https://biocyclopedia.com/index/biotechnology/plant_biotechnology/biofertilizers/biotech_masscultivation.php#:~:text=Mix%20this%20carrier%20based%20culture,105%20to%20106.
4. https://biotecharticles.com/Agriculture-Article/Blue-Green-Algae-Bio-Fertilizer-1073.html
5. https://krishi.icar.gov.in/jspui/bitstream/123456789/45882/1/AAU-PSB%20Biofertilizer.pdf
6. https://www.biotechnologynotes.com/biotechnology/vesicular-arbuscular-mycorrhiza-vam-biotechnology/1153

Pedagogy

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

Course Designer

Dr. S. Jenny

Semester: IV	Internal Marks: 40	External Marks: 60		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22UMB4SEC1P	**HERBAL MEDICINE (P)**	**SKILL ENHANCEMENT COURSE**	**2**	**2**

Course Objective:

To create a traditional knowledge of medicinally important plants in day to day life.

Prerequisites

To acquire a Practical Knowledge in collection and processing of Medicinal Plants

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive level
CO1	Cultivation of Medicinal Plants	K1
CO2	Recite the knowledge about medicinally important plants.	K2
CO3	Describe about tribal medicine and their uses in diseases.	K3
CO4	Apply the traditional knowledge of medicinal plants in Tamil nadu	K4
CO5	Associate of plants in day to day life	K5

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	3	3	2
CO2	2	2	2	2	1	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 "-" indicate there is no correlation

Syllabus

1. Cultivation of Medicinal Plants, *Aloe vera*, *Senna auriculata ,Zingiber Officinale, Curcuma aromatic, and Curcuma aromatic.*
2. Standardization of herbal Raw material, Extract and Formulation of herbal plants.
3. Preliminary Phytochemical Screening, Quantitative of plant extract.
4. Determination of Aldehyde content.
5. Determination of Total Alkaloids
6. Determination of Flavonoids
7. Determination of Phenols
8. Preparation and evaluation of Turmeric cream.
9. Preparation and Standardization of Herbal lotion.
10. Preparation of herbarium and storage (Herbaira, Museum)

Text Books

1. Iris F. F. Benzie and Sissi Wachtel-Galor,2011. Herbal Medicine, 2nd edition CRC Press/Taylor &Francis;
2. Joanne Barnes, Linda A. Anderson, John David Phillipson.2007,Herbal Medicine.
3. K. G. Ramawat, 2013.Herbal Drugs: Ethnomedicine to Modern Medicine.
4. Dr.Pragati Kumar (Author), Dr. Pranay Wal (Author), Mr. Yatendra Singh (Author),2022.A Text Book of herbal drug technology .

Reference Books

1. Evans M, Shaw A, Thompson E. A, Falk S, Turton P, Thompson T, Sharp D. 2007. BMC Complement Altern Med. 25. Vol. 7. Decisions to use complementary and alternative medicine (CAM) by male cancer patients: Information-seeking roles and types of evidence used.
2. Finkel T, Holbrook N. J. . 2000.Oxidants oxidative stress and the biology of ageing. Nature;408:239–47.
3. Akhtar M.A, Hatwar S.K. 1996.Efficacy of Aloe vera extract cream in management of burn wound. J Clin Epidemiol. ;49 1:24.
4. Ashley F.L, O'Loughlin B.J, Peterson R, Fernandez L, Stein H, Schwartz A.N.2010 The use of Aloe vera in the treatment of thermal and irradiation burns in laboratory animals and humans. Plast Reconstr Surg. 20:383–96.

Web Reference

1. https://openstax.org/books/introduction-anthropology/pages/17-2-ethno medicine#
2. https://en.wikipedia.org/wiki/Plant_morphology

Pedagogy

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

Course Designer

Dr. J. Ambika

Semester V	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB5CC6	**MEDICAL MICROBIOLOGY**	**CORE**	**6**	**5**

Course Objective

To impart the students with advanced knowledge of the characteristics of medically important human diseases. To focus the pathogenicity of the medically important microorganisms. To familiarize the lab diagnosis, prophylaxis and treatment of the diseases

Course Outcome and Cognitive Level Mapping:

CO Number	CO Statement	Cognitive level
CO 1	Describe and Classify the various pathogens and its Characterization.	K3,K4
CO 2	Analyze pathogenicity of bacterial, fungal, viral and protozoan disease	K4, K5
CO 3	Evaluate diagnostic methods of various diseases	K4, K5
CO 4	Explain prevention and treatment of diseases	K3, K5
CO 5	Collection of clinical samples and Identification of pathogens	K5, K6

Mapping with Programme Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	3	3	3	3	2	3
CO2	3	2	3	3	2	2	3	2	3	3
CO3	3	2	3	2	3	3	2	3	3	2
CO4	2	3	3	2	3	1	3	2	3	2
CO5	3	3	2	3	2	3	3	3	2	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 -** History, Koch's and River's Postulates-Normal microbial flora of the healthy human body, Host- pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity - virulence - toxigenicity, carriers and its types, endemic, epidemic, pandemic diseases and epidemiology – Infectious disease cycle.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**BACTERIAL DISEASES -** Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal pneumonia infections (b) *Staphylococcus aureus* infections (c) Meningitis - Neisseria, (d) Leprosy, (e) Leptospirosis, (f) Respiratory diseases: Tuberculosis (g) Gastrointestinal disorders: Typhoid (h) Sexually transmitted diseases: syphilis (i) Anaerobic wound infection – tetanus.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**VIRAL DISEASES** - Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following viral diseases (a) Respiratory diseases: common cold and influenza (b) Neurological diseases: Rabies (c) Muscular diseases – Polio (d) Liver diseases: Viral hepatitis (e) Immunodeficiency disease: - AIDS. A brief account on Prion diseases.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**FUNGAL & PROTOZOAN DISEASES -** Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following fungal and protozoan diseases (a) Fungal – superficial and subcutaneous mycoses, Candidiasis, Histoplasmosis (b) Protozoan: Amoebiasis, Malaria (c) Helminths – Filariasis, Ascariasis. Zoonotic diseases, Nosocomial and Community acquired infections.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**LAB DIAGNOSIS** - Isolation and identification of pathogens from an infected patient: Collection and transport of various clinical specimens (Urine, stool, sputum and blood) for diagnosis, Physical and chemical analysis of urine, Stool and Sputum - concentration methods – General methods of isolation and identification of bacterial, fungal, viral pathogens and protozoan parasites.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text books

1. Aejaz Iqbal and Zafar Nowshad (2020). Medical microbiology: Millennium Edition, Notion Press
2. Baveja V and Baveja C P (2019). Medical Parasitology, Arya Publishing company
3. Mishra B (2018), Text Book of Medical Virology, CBS
4. Ananthanarayan and Paniker (2013). A Text book of Microbiology, Kindle Edition

Reference books

1. Sastry Apurba S and Bhat Sandhya (2020). Essentials of Medical Microbiology, Jaypee brothers, Medica publishers
2. Patrick R Murray , Ken S, Rosenthal and Michael A and PFaller (2020), Medical Microbiology, Elsevier
3. Ananthanarayan Paniker (2020). A Text book of Microbiology, University Press
4. Kenneth J Ryan, Nafees Ahmad and Andrew Alspaugh J (2018). Sherris Medical Microbiology, McGraw- Hill Education

Web References

1. https://www.cdc.gov/tb/education/corecurr/pdf/chapter2.pdf
2. http://apps.searo.who.int/PDS_DOCS/B5123.pdf3.http://loyce2008.free.fr/Microbiologie/%20Micro%20%20Gillespie%20Hawkey%20%20Principles%20And%20Practice%20Of%20Clinical%20Bacteriology%202Nd%20Ed.pdf

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

Course Designer

Dr.P.Bhuvaneswari

Semester V	Internal Marks: 25	ExternalMarks:75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB5CC7	**AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY**	**CORE**	**6**	5

Course Objective:

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

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive level
CO1	Define the basic view of soil Microorganisms.	K1
CO2	Explain the Microbial association in water.	K2
CO3	Understand the production of Biofertilizer	K3
CO4	Discuss about Plant diseases and Control measures	K4,K5
CO5	Discuss about Water pollution and water quality.	K6

Mapping of CO with PO and PSO

COs	PO1	PO2	PO3	PO4	PO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	2	3	2	2	3	2	2
CO3	3	3	1	2	3	3	3	3	3	1
CO4	3	3	2	3	2	2	3	2	2	2
CO5	2	3	3	2	3	1	3	3	3	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	Bacterial diseases of agricultural crops - pathogens, symptoms, control measures with reference to paddy, cotton, maize, tomato, citrus, mango and potato. Plant protection –Phenolics – phytoalexins and related compounds. Bioinsecticides – viral (Baculovirus, NPV)- bacterial (Bacillus thuringiensis) and fungal (Trichoderma) - a brief note.	18	CO1, CO2, CO3	K1, K2, K3, K4
II	Bio-geo chemical cycles in soil – Carbon cycle, Nitrogen cycle – Nitrogen fixation, nitrification, denitrification, sulfur, iron and phosphorus cycles. Aerobiology – a brief introduction - droplet nuclei – aerosols - air-borne transmission of microbes and diseasesand assessment of air quality.	18	CO1, CO2, CO3, CO4	K1, K2, K3, K4,
III	Diversity and distribution of microorganisms in soil; Soil Microflora- Bacteria, Fungi and Actinomycetes. Microbial interactions -mutualism, synergism, commensalism, amensalism, parasitism, predation and competition. Microbial interactions with plants– phyllosphere, mycorrhizae, rhizosphere and symbiotic association in root nodules. Biofertilizer – VAM, Rhizobium, Frankia, Azospirillum, Azotobacter, Cyanobacteria, Phosphobacteria and Azolla.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K6
IV	Types of wastes - solid and liquid wastes. Treatment of solid wastes - Thermal Treatment: Incineration, Gasification, Pyrolysis. Bioreactor Landfills-Biological Waste Treatment: Composting, Vermicomposting and vermicomposting. Treatment of liquid wastes –primary, secondary, tertiary treatment; anaerobic (methanogenesis), aerobic, Trickling, activated sludge, oxidation pond. Production of biogas from waste.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	Aquatic microbiology - factors affecting microbial growth – temperature – pressure – light – salinity - turbidity – pH -inorganic and organic constituents. Aquatic habitats - freshwater - lakes, ponds and streams; marine habitats - estuaries, deep sea, hydrothermal vents, saltpans, coral reefs and mangroves and their microbial communities; zonation – food chain and food web.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Self Study for Enrichment** **(Not to be included for End Semester Examination)** Soil microbes and fertility of soil, bioaugmentation, xenobiotics degradation, plant growth promoting Rhizobacteria (PGPR), Role of biofertilizer in integrated nutrient management.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,

Textbooks

1. Alexander M. (1997). Introduction to soil microbiology, New York: John Wiley & Sons, Inc.
2. Ec Eldowney S., Hardman, D.J. and Waite, S. (1993). Pollution Ecology and Biotreatment.
3. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). Environmental microbiology. Twelth Edition, Biology Microorganisms, New Jerry: Prentice Hall. Mark Wheelis, (2010).
4. P.D.Sharma (2005). Microbiology-Rastogi Publication, India
5. D.J.Bagyaraj,G.Rangaswami.(2007). Agricultural Microbiology. Prentice, Hall of India Pvt New Delhi.

References

1. Mehrotra, R.S. (2000). Plant Pathology, New Delhi: Tata McGraw Hill Publishing Company Ltd. Pandy,
2. B.P. (1997). Plant Pathology (Pathogen & Plant Disease), New Delhi: S.Chand & Company Ltd.
3. Ray Chadhuri, S.P. (1999). A Manual of Virus Diseases of Tropical Plants, New Delhi: MacMillan Company of India Ltd.
4. Rengaswami, G. and Rajagopalan, S. (2007). Bacterial Plant Pathology. Coimbatore: Tamil Nadu Agriculture University.
5. Subba Rao, N.S. (1995). Soil Microorganisms and Plant Growth (3rd ed). New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
6. Mark Wheelis, (2010). Principles of Modern Microbiology, New Delhi: Jones & Bartlett India Pvt.

Web References

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119525899
2. https://agri-bsc.kkwagh.edu.in/uploads/department_course/plant_course.pdf
3. https://www.slideshare.net/ShanidShanu1/agricultural-microbiology
4. https://agribooks.co/agricultural-microbiology-b-sc-agriculture-icar-e-course-pdf-download/
5. https://books.google.co.in/books/about/Environmental_and_Agricultural_Microbiol.html?id=BnQ-EAAAQBAJ&redir_esc=y

Pedagogy

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

Course Designer

Dr.J.Ambika

SEMESTER VI	INTERNAL MARKS : 25		EXTERNAL MARKS : 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDIT**
23UMB5CC8	**MICROBIAL BIOTECHNOLOGY**	**CORE**	**6**	**5**

Course Objective:

The students will be able to understand the biological processes undergoing in Industries and exploit theknowledge to improve the process.

Course Outcome and Cognitive Level Mapping

COs	CO Statement	Knowledge level
CO1	Define t h e primary and secondary screening of microbes.	K1,K2
CO2	Determine the applications of microbes	K3,K4
CO3	Critique knowledge about industrial production	K4,K5
CO4	Outline views of bio control agents	K4,K6
CO5	Expand about Process of Bioremediation	K5,K6

Mapping with Programme Outcomes:

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 correlati

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Biotechnology: Definition –Milestones in History -** Scope of microbial biotechnology and its applications. Commercially important microorganisms- Bacteria (*Lactobacillus, Bacillus*), fungi (*Aspergillus, Penicillium*), Actinomyces (*Streptomyces*).Immobilization, Cryopresevation- Germplasm storage.	18	CO1, CO2, CO4, CO5	K1, K2, K3, K4, K5

II	**Microbial Production of bio fertilizers and Biocontrol agent** (*Rhizobia, Azospirillum*, BGA, *Azolla, Frankia* and VAM). Microbial production of bio-control Agents (*Pseudomonas, Trichoderma, Beaveria*). Role of micronutrient providing microbes.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Micro algal technology - SCP, bioplastic and bioploymer** - Industrial cultivation methods of Spirulina biotechnological potentials of Spirulina as: food and feed. Single cell protein (algae and yeast). Fuel (bio-diesel) production from microalgae, pharmaceutically valuable compounds from microalgae. Microbial production of bioplastics.	18	CO1, CO2, CO3, CO4	K2, K3, K4, K5
IV	**Genetic engineering bacteria / GMO's-** Insulin, hormone, enzyme production. Bioethanol, biomethane, biohydrogen, biodiesel – substrate, nutrients, inoculum, production, recovery and commercial application.	18	CO1, CO2, CO3, CO4	K2, K4, K5, K6
V	**Environmental Applications of Efficient microbes :** Bioremediation- Degradation of xenobiotics, advantages and disadvantages bioaugmentation, bioemulsifiers, biosurfactants, MEOR (Microbial enhanced oil recovery), Leaching of ores, biohazards, environmental engineering. Biotechnology Regulation – Bioethics and Biosafety.	18	CO1, CO4 , CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment** **(Not included for End Semester Examinations** Commercial production of bio-ethanol using lignocellulosic waste. Human growth hormone-Insulin.	-	CO1, CO2, CO3, CO4	K2, K3, K4, K5

Text Books

1. Faizan Ahmad, Zahra H. Mohammad (2024). Microbial Biotechnology in the Food Industry: Advances, Challenges, and Potential Solutions. Springer.
2. Mamtesh Singh, Gajendra Pratap Singh, Shivani Tyagi. (2023). Microbial Products Applications and Translational Trends, CRC Press.
3. Jayanta Kumar Patra, Pradeep Kumar, Advances in Microbial Biotechnology (2021). CRC Press.
4. Singh, J., Vyas, A., Wang, S.,Prasad, R (2020). Microbial Biotechnology:Basic Research and Applications, Springer.
5. Prakash Kumar Sarangi & Sonil Nanda (2019). Biotechnology for Sustainable

Energy andProducts. I.K. International Publishing House Pvt. Ltd.

Reference Books

1. Shivani Singh, Mamtesh (2022). Microbial Products. CRC Press.
2. S.Sivasubramanian & T. Hemalatha R. Puvanakrishnan (2021). Microbial Technology. MJP Publisher.
3. Joginder Singh, Ashish Vyas (2020). Microbial Biotechnology: Basic Research and Applications .Springer.
4. Anjana Devi Tangutur and Bhima Bhukya (2021). Microbial Biotechnology.
5. Biotechnology by R.C. Dubey. (2014). A Textbook of Biotechnology. S. Chand publishers.

Web links

1. https://enviromicro-journals.onlinelibrary.wiley.com/journal/17517915
2. https://www.nifa.usda.gov/grants/programs/biotechnology-programs/microbial-biotechnology
3. https://www.sciencedirect.com/science/article/abs/pii/B9780323904520000359
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5609265/
5. https://www.mdpi.com/journal/microorganisms/sections/microbial_biotechnology

Pedagogy

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

Course Designer

Dr.P.F.SteffI

Semester: V	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB5CC5P	**MEDICAL MICROBIOLOGY, AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY AND MICROBIAL BIOTECHNOLOGY- (P)**	**CORE PRACTICAL**	**3**	**3**

Course Objective

To impart the knowledge on isolation, identification of medically important organisms and perform water and soil analysis and isolation of chromosomal and plasmid DNA.

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement	Cognitive level
CO 1	Illustrate the isolation procedures	K2
CO 2	Explain the symptoms of diseases	K2
CO 3	Sketch out the water borne microbes	K3
CO 4	Demonstration of auxotrophic mutants	K3
CO 5	Analyze agarose gel electrophoresis	K4

Mapping of CO with PO and PSO

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

MEDICAL MICROBIOLOGY (25 Hours)

1. Isolation of bacterial flora of skin by swab method.
2. Isolation of bacteria from urine, stool and sputum.
3. Identification of Gram-positive organisms (using laboratory strains): *Streptococcus pneumoniae,Staphylococcus aureus* and *Bacillus sp.* and Gram-negative organisms (using laboratory strains): *Escherichia coli, Proteus sp*. and *Klebsiella pneumoniae* on the basis of microbiological, culturaland biochemical characteristics.
4. Saline and iodine wet mount to demonstrate protozoan parasites
5. Giemsa staining for the demonstration of blood parasites
6. KOH and Lactophenol cotton blue mount to demonstrate fungi.
7. Antibacterial sensitivity test – Kirby- Bauer method.

AGRICULTURAL MICROBIOLOGY (10 Hours)

8. Water analysis by MPN technique – presumptive coliform test – confirmed coliform test and completed coliform test.
9. Microbial assessments of air quality – open plate method and air sampler technique.
10. Isolation and counting of faecal bacteria from water.
11. Soil Analysis -pH, chlorides, nitrate, calcium, magnesium and total phosphorus.
12. Isolation of cyanobacteria from water.
13. Isolation of *Rhizobium* form legume nodule.
14. Isolation of phosphobacteria from soil.
15. Observation of VAM from plant root.

MICROBIAL BIOTECHNOLOGY (10 Hours)

16. Antibacterial Sensitivity Assay
17. Immobilization of yeast cell by alginate beads
18. Production of alcohol by yeast
19. Production of bacterial enzymes
20. Production of organic acids – citric acid production

Reference Books

1. Ananthanarayan, Paniker (2020), Textbook of Microbiology, Universities Press.
2. SubbaRao NS(2020), Soil Microbiology**,** Oxford Publishing.
3. Mangesh Y Dudhe , (2020), Agriculture- Microbiology, New VishalPublications.
4. Michael J Leboffe and Burton EPierce (2019). Microbiology: LaboratoryTheory &
5. Application, Morton PublishingCompany..
6. Ashwani Kumar,Gakhar S K andMonika Miglani (2019), Molecular Biology: A Laboratory Manual, Dreamtech Press

Web References

1. https://www.mlsu.ac.in/econtents/159_Experiment.%204_Isolation%20bacteria%20from%20skin.pdf
2. https://microbenotes.com/water-quality-analysis-by-most-probable-number-mpn/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5577976/
4. https://www.cdc.gov/dpdx/diagnosticprocedures/stool/microexam.html
5. https://www.youtube.com/watch?v=k2xx7jIW3E8

Pedagogy

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

Course Designer

Dr.V.Aruna

Semester V	Internal Marks : 25		External Marks : 75	
Course Code	**Course Title**	**Category**	**HRS/WEEK**	**CREDIT**
23UMB5DSE1A	**ORGANIC FARMING**	**DISCIPLINE SPECIFIC ELECTIVE (DSE)**	5	3

Course Objectives

This course focuses on the need and generating knowledge and skill on various organic farming practices, so as to carry out organic agricultural production and management system that sustains the health of soils and ecosystems.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Knowledge level
CO1	Determine the origin and importance of organic farming	K1,K2,K4
CO2	Explain the scope of organic farming	K2,K3,K4
CO3	Evaluate the methodology practiced in organic farming	K4,K5,K6
CO4	Generalize the management strategies in crop protection	K3,K4,K6
CO5	Compile the strategies for the commercialization of organic products	K5,K6

Mapping of CO with PO and PSO

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

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Introduction- concept, Principles and development of organic farming. Types - Natural farming- Biodynamic farming. Conventional farming v/s Organic farming.	16	CO1, CO2, CO3 CO4, CO5	K1, K2, K3, K4, K5
II	Scope of organic farming - requirements for organic farming. Organic nutrients resources and their management, organic ecosystems and their concepts- Bioinoculants.	14	CO1, CO2, CO3 CO4, CO5	K1, K2, K3, K4, K5
III	Composting - principles – stages - types and factors. Composting methods – Vermicomposting. Biofertilizers - methods of application, advantages and limitations.	13	CO1, CO2, CO3 CO4, CO5	K1, K2, K3, K4, K5
IV	Plant protection- Insect Pest and disease management in organic farming- biopesticides, - biocontrol agents, Weed management in organic farming- preventive practices, biological control of weeds- mechanical control.	16	CO1, CO2, CO3 CO4, CO5	K1, K2, K3, K4, K5
V	Organic crop production, certification process and standards of organic farming in India, economic viability of organic farming, marketing and export potential of organic products.	16	CO1, CO2, CO3 CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment (Not to be included for End Semester Examination)** Plant Nutrients-Micro and Macro, Importance and deficiency syndrome, crop rotation : need and benefits		CO1, CO2, CO3 CO4, CO5	K1, K2, K3, K4, K5

Text books

1. Maliwal P L (2020). Principles of OrganicFarming, Scientific Publisher
2. Joanne M Willey, Kathleen M Sandman and Dorothy H Wood (2019). PrescottsMicrobiology, McGraw-Hill Education
3. Joanne M Willey,Kathleen M Sandman and Dorothy H Wood (2019). Prescottsmicrobiology, McGraw-Hill Education
4. Unni M R and Sabu Thomas (2018).Organic Farming Global Perspectives andMethods, Woodhead publishing
5. Amitava Rakshit and H B Singh (2018).ABC of Organic Farming, Jain Brothers

Reference books

1. Bansal M (2020). Basics of Organic Farming, CBS publishers and Distributors Pvt. Ltd.
2. Janet Wilson (2020). Composting: Sustainable and Low- Cost Techniques for Beginners, Drip Digital Publisher
3. Debabrata Biswas, Shirley A. Micallef (2019). Safety and Practice for Organic Food Academic press, Elsevier Science.
4. Rhonda Sherman (2018). The Worm Farmer's Handbook Chelsea Green Publishing Company
5. Vinaya KumarSethi (2018). Organic farming andbio-fertilizers, Discovery publishing house Pvt. Ltd.

Web References

1. http://agrimoon.com/organic-farming-pdf-book/
2. https://www.britannica.com/topic/organic-farming
3. https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
4. https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
5. https://agritech.tnau.ac.in/org_farm/IPM%20Booklet%20for%20OF-Dr.P.D.pdf
6. https://agritech.tnau.ac.in/org_farm/orgfarm_oc%20guidelines.html

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity

Course Designer

Dr.B.Thamilmaraiselvi

Semester: V	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS./WEEK**	**Credits**
23UMB5DSE1B	**MEDICAL PARASITOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE (DSE)**	**5**	**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.

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 – Protozoa and helminthic infection. Laboratory Diagnostic Techniques in Parasites – Direct Identification and Indirect Identification. Concentration methods - flotation techniques and sedimentation techniques	15	CO1, CO2, CO3	K1, K2, K3, K4
II	Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Entamoeba histolytica, Acanthamoeba* spp. *Cryptosporidium*.	15	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Giardia intestinalis, Leishmania donovani, Trypanosoma* spp.	15	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5,
IV	Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Toxoplasma gondii, Plasmodium* spp and *Ascaris lumbricoides.*	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6,
V	Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention – *Taenia solium, Ancylostoma duodenale* and *Wuchereria bancrofti.*	15	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.

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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: V	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS./WEEK**	**Credits**
23UMB5DSE1C	**FUNDAMENTALS OF BOTANY AND ZOOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE**	**5**	**3**

Course Objective

To gain the basic knowledge about plants and animals. To impart knowledge on botanical nomenclature, classifications, merits and demerits of various systems of classifications. To understand the systematic of the selected families of the flowering plants with their economic importance. To help our students to distinguish various animal kingdoms to know the evolutionary sequence of them.

Course Outcome and Cognitive Level Mapping:

CO Number	CO Statement	Cognitive level
CO 1	State the Basic knowledge of Plant Nomenclature	K1,K2
CO 2	Describe the Salient features and Economic importance of Monocot and Dicot Plants	K2,K4
CO 3	Illustrate the views of Plant Physiology and Reproduction	K2,K3
CO 4	Prepare Animal Kingdom and Reproduction	K3,K
CO 5	Prepare the Process of Animal Cell reproduction	K3,K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	2	3	3	3	2
CO2	2	3	3	3	3	3	3	2	2	3
CO3	3	3	3	3	2	2	2	3	3	2
CO4	3	3	3	2	2	3	3	3	2	3
CO5	3	3	2	2	3	2	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	Binomial Nomenclature – ICBN rules – taxonomic types, systems of Classification – Phylogenetic Artificial and Natural. Bentham and Hooker classification - merits and demerits. Plant taxonomy, Plant Nomenclature - Forms of Scientific names. Technical description of flower and floral diagram.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	General characteristics and economic importance of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Plant Physiology – Photosynthesis, Respiration and Transpiration. Reproduction of plants in Angiosperms - Vegetative, Asexual and Sexual.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Introduction to principles of taxonomy and outline classification of Animal Kingdom – Invertebrates - Prolifera, Cnidaria, Worms, Echinoderms, Molluscs and Arthropods. Vertebrates - Mammals, Birds, Reptiles, Fish and Amphibians. Darwin's and Lamarck's theory of evolution.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,
V	Animal Physiology – Digestive, Respiratory, Circulatory, Excretion and Nervous system. Cell division – Mitosis and Meiosis.	15	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5,
VI	**Self Study for Enrichment (Not included for End Semester Examination)** Darwin's and Lamarck's theory of evolution.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5,

Text Books

1. Kishore R Pawar and Ashok E Desai (2020) An Introduction to Zoology, Nirali Prakashan Press.
2. Sunidhi Miglani (2016) Text Book of Economic Botany, ABS Publications.
3. Kotpal R L (2016) Modern text book of Zoology, Rastogi Publications.
4. AfrozAlam (2015) Textbook of Botany, I K International Publishing House Pvt. Ltd.
5. Nanda A K (2015) Text Book of Botany, Kitab Mahal – Cuttack.

Reference Books

1. James Bidlack and Shelley Jansky (2020) Plant Biology, McGraw-Hill Education.
2. James D Mauseth (2019) An introduction to plant biology, Jones & Bartlett Learning.
3. Smithsonian (2019) Zoology, DK; Illustrated edition.
4. Stephen Miller and Todd A. Tupper (2018) Zoology, McGraw-Hill Education.

Web References

1. https://www.biologydiscussion.com/plant-taxonomy/quick-notes-on-plant-taxonomy/47582
2. https://www.studyandscore.com/studymaterial-detail/international-code-of-botanical-nomenclature-icbn-history-principles-and-aim
3. https://byjus.com/biology/plant-physiology/
4. https://www.slideshare.net/mjnepa/cell-reproduction-notes
5. **https://biologywise.com/vertebrates-invertebrates**

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

Course Designer

Dr. E.Priya

Semester: V	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS./WEEK**	**CREDITS**
22UMB5SEC2P	**BIOFERTILIZER TECHNOLOGY (P)**	**SKILL ENHANCEMENT COURSE**	**2**	**2**

Course Objectives

To enable the students to understand the importance of biofertilizers in agriculture and production technologies.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand Biofertilizers and Production technology	K1, K2
CO2	Analyze and explain mass production methods of Symbiotic Biofertilizers	K3, K4
CO3	Determine and apply Non- Symbiotic Biofertilizers cultivation methods	K3, K4
CO4	Evaluate and categorize Phosphate solubilizing bacteria cultivation methods	K4, K5
CO5	Criticize and manage Mycorrhizae and Carrier based inoculum production methods	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

BIOFERTILIZER TECHNOLOGY (P)

1. Isolation, identification and cultivation of *Rhizobium* from leguminous plant roots
2. Isolation, identification and cultivation of *Azospirillum*
3. Isolation, identification and cultivation of *Azotobacter*
4. Isolation, identification and cultivation of Cyanobacteria from paddy field soil and water.
5. Isolation, identification and cultivation of *Azolla.*
6. Isolation, identification and cultivation of Phosphate solubilizing bacteria from soil.
7. Isolation, identification and cultivation of Mycorrhizae (VAM)
8. Preparation of carrier based and liquid based inoculums.

Text Books:

1. Krishnendu Acharya, Surjit Sen & Manjula Rai. (2019). Biofertilizer and Biopesticide. 1st Edition. Techno World.
2. S. Rajan & R. Selvi Christy. (2018). Experimental Procedures in Life Sciences. CBS Publications
3. Reeta Khosla. (2017). Biofertilizers and Biocontrol Agents for Organic Farming. 1st Edition. Kojo Press
4. Hyma. (2017). Biofertilizers: Commercial Production Technology and Quality Contrtol. 1st Edition. Random Publications.
5. Anil K Thakur, Susheel K Bassi, Kamajit Singh, Dinesh. (2020). Biofertilizers (Skill Enhancement course). 1st Edition. S Dinesh & Co.

Reference Books:

1. Rao B.N.S. (2019). Biofertilizers in Agriculture and Forestry. 3rd Edition. Oxford & IBH Publishing House.
2. Sharma R.A. (2019). Biofertilizer Technology. 1st Edition. Agro tech Publishing Academy.
3. Ameta O.P and Sharma U.S. (2018). Biopesticides for Sustainable Agriculture. 1st Edition. Agro tech Publishing Academy.
4. Somani L. (2018). Biofertilizers: Commercial Production Technology and Quality control. 1st Edition. Agrotech Publishing Academy.
5. Subha Rao N.S. Biofertilizers in Agriculture and Forestry. 4th Edition. Medtech scientific International Pvt Ltd.

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1. https://agritech.tnau.ac.in/ta/org_farm/orgfarm_biofertilizers.html
2. https://agritech.tnau.ac.in/org_farm/orgfarm_biofertilizertechnology.html
3. http://www.techno-preneur.net/technology/new-technologies/food-agro/vam-fungi.html
4. http://14.139.187.9/ta/org_farm/orgfarm_faq's.html
5. https://www.iihr.res.in/large-scale-production-vesicular-arbuscular-mycorrhizal-fungi-finger-millet
6. https://agriinfo.in/large-scale-production-of-biofertilizers-1932/
7. https://www.fnca.mext.go.jp/english/bf/bfm/pdf/3_Carriers_for_Biofertilizer0331final.pdf

Pedagogy

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

Course Designer: Dr. S. Jenny

Semester : VI	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB6CC9	**FERMENTATION TECHNOLOGY**	**CORE**	**6**	**5**

Course Objective

Fermentation technology gives the knowledge about Industrial developments with respect to Microorganisms and find out the suitable technology for cultivating them under Industrial scale so as to develop them for employment in bioprocess industry. To learn the screening of industrial strains, fermenters, media, fermentation process and downstream process.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Outline view of Concept and History of Strain development	K1, K2
CO2	State the types of Fermentor and Fermentation process	K1, K3
CO3	Explain the components of Fermentation media	K2, K3
CO4	Prepare the Production and Purification Industrial Important Microbial Products.	K4, K5
CO5	Describe the Production of Pharmaceutical Products	K1, K6

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	2	**3**	2	2	**3**	**3**	**3**	**2**	**3**
CO3	3	2	2	2	2	**3**	**3**	**3**	**2**	**2**
CO4	2	3	3	3	**3**	**3**	**3**	**3**	**3**	**3**
CO5	2	2	3	2	2	**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 Fermentation technology**: History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms − primary and secondary screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology.	18	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.
II	**Upstream Processing:** Fermentor design: Basic designs of Fermentor; Type of fermenters- Waldhof, Tower, Deep jet, Cyclone column, Packed tower and airlift fermenter. Types of fermentation process - Batch, Fed batch and continuous. Fermentation media: Natural and Synthetic media; Basic components of media (Carbon sources; Nitrogen sources; Vitamins; Minerals) Role of Anti-foaming agents and buffers in media.	18	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.
III	**Downstream processing**: The recovery and purification of fermentations products (intracellular and extracellular), cell disruption, precipitation (Ammonium sulphate and Solvents), filtration, centrifugation, solvent recovery, chromatography (TLC), ultra filtration, drying, cell immobilizations and its applications.	18	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.
IV	**Mass Production of Microbial Products**: Production of alcohol; Organic acid − Citric acid, Lactic acid and Vinegar; Antibiotic − Penicillin, Tetracycline, Amino acid − Glutamic acid; Vitamin − B12, Enzymes- Amylase, Protease, Antibiotics- Penicillin, tetracycline, Biopolymers, Recombinant vaccine (Hep B vaccine).	18	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.
V	**Safe disposal of effluents and Industrial Standards and Assays:** Recycling and Safe disposal of industrial wastes by Trickling filter, Activated sludge and Oxidation ponds,	18	CO1, CO2, CO3, CO4, CO5.	K1, K2, K3, K4, K5.

	Industrial standards- National and International. Assays: Amino acids- Ninhydrin assay, Vitamins- Riboflavin assay, Antibiotics- dilution and diffusion assays, Harmons- chemiluminescence assay.			
VI	**Self Study for Enrichment (Not to be included for External Examination)** Strain Preservation, Bubble column fermenter, Prosthetic group, Lysine, Rabies recombinant vaccine and SCP.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5.

Text Books

1. Ema Sushan Minj (2024). Handbook on Fermentation Technology: Industrial Microbiology. Astitva Prakashan publishers, Chhattisgarh.
2. Patel, A.H (2022). Industrial microbiology. Published by Mac Millan India Ltd., Chennai.
3. Devarajan Thangadurai, Jeyabalan Sangeetha (2021). Industrial Biotechnology. Apple Academic Press Inc. India
4. Casida, L.E.J.R (2019). Industrial Microbiology. New Age International Private Limited, India
5. Prescott L.M, Harley J.P, Helin D.A, (2018). Microbiology, 5th edition, McGraw Hill, New Delhi.
6. Peter F Stanbury, Allan Whitaker, Stephen J Hall (2017). Principles of Fermentation Technology. Butterworth-Heinemann Press. UK.
7. Crueger W, Crueger A (2017). Biotechnology: A Test Book of Industrial Microbiology, 3rd edition. Panima Publishing corporation, New Delhi.

Reference Books

1. Dhakane R Zate A Masalkar S Upadhye V Hirani D Adhao A Upadhyay U Patil N Barua S Ambawade M Chahal K Taware A (2022). Fermentation Technology I and Agricultural Microbiology: Practical Handbook of Microbiology. International Journal of Microbial Science publishers, India.
2. Aydin Berenjian (2020), Essentials in Fermentation technology. Springer Verlag
3. H. J. Peppler, D. Perlman (2014). Microbial Technology: Fermentation Technology. Academic Press.
4. Hongzhang Chen (2013). Modern Solid State Fermentation: Theory and Practice. Springer Press, Germany.
5. Sivakumar, P.K., Joe, M.M., Sukesh, K., 2010. An introduction to Industrial Microbiology. 1st edition, S. Chand and Company Ltd, New Delhi.

Web Links:

1. https://www.shahucollegelatur.org.in/NAAC/CRII/ictppttool/Microbiology/Maske Madam5.pdf
2. https://www.slideshare.net/MDCrules/basic-design-of-a-fermenter-53452713

3. https://www.brainkart.com/article/Fermentors_41001/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7232202/
5. https://www.slideshare.net/AmanChauhan8/organic-acids-production-copy
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7121293/

Pedagogy:

Power point presentation, Group Discussion, Seminar, Quiz, Assignment, Animations.

Course Designer

Dr. S.Jeyabharathi

Semester: VI	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS./WEEK**	**Credits**
23UMB6CC10	**FOOD AND DAIRY MICROBIOLOGY**	**CORE COURSE**	**5**	**4**

Course Objective

To enable the students to acquire knowledge in key concepts of food and dairy microbiology and to know various methods of food fermentation, types of food borne diseases and their prevention.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Define and understand food microbes and methods of fermentation	K1, K2
CO2	Analyze and explain food borne infections and intoxications	K3, K4
CO3	Determine and apply Asepsis techniques in food preservation	K3, K4
CO4	Evaluate and categorize properties of milk and its assessment	K4, K5
CO5	Criticize and manage fermented dairy products.	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	2	3	3	2
CO2	2	2	2	2	2	3	2	3	2	2
CO3	2	3	2	2	3	3	2	3	2	2
CO4	3	2	3	2	2	3	2	3	2	1
CO5	3	3	3	3	2	3	2	3	3	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

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

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Food Microbes and Fermentation**: Microorganisms in food- Bacteria, molds, yeast. Factors influencing microbial growth in food- pH, moisture, oxidation – Reduction potential, Nutrient content and Inhibitory substances. Methods of fermentations and organisms used - bread, wine, beer. Fermented vegetables- pickled cucumber, sauerkraut – soy sauce. Prebiotics, Probiotics, Synbiotics - Advantages.	15	CO1, CO2, CO3	K1, K2, K3, K4
II	**Food Borne infections and intoxications**: Food borne infections and food poisoning. Food spoilage and contamination – *Staphylococcus, Clostridium, Escherichia coli* and *Salmonella* infections, *Hepatitis, Amoebiosis* and Mycotoxins.	15	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	**Food preservations**: General principles- Physical and chemical methods. Canning of food items, Asepsis - Techniques of removal – use of temperature (low & high). Drying, radiation and chemical preservatives. Preservation of cereals, vegetables, fruits, meat, Fish, poultry and dairy products. Food sanitation and control measures, Food standards- HACCP, FDA, FSSAI, WHO.	15	CO1, CO2, CO3, CO4,	K1, K2, K3, K4, K5
IV	**Dairy Microbiology**: Introduction - Composition - Physical and chemical properties of milk. Microbes in milk, Starter cultures, sources of contamination. Processing of milk - homogenization, Pasteurization, storage, and transportation. Microbiological analysis of milk- Direct Microscopic count, standard plate count, MBRT, Resazurin test, Alkaline phosphatase test.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Fermented Dairy products**- Fluid milk products and dried milk Products. Skimmed milk powder, other dairy products: Ice Cream, Butter, Whey. Milk Fermentation – Yoghurt, cheese, butter milk and Kefir.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study for Enrichment** **(Not included for End Semester Examinations)** Spoilage in canned foods, frozen dairy products, Detection of food-borne pathogens.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Frazier. W.C and D.C Westhoff (2017). Food Microbiology. 5th Edition. Tata Mc Graw Hill publishing Co.
2. Aneja. K.R. (2018). Modern Food Microbiology. 1st Edition. Med tech. Scientific International.
3. Virendra Kumar Pandey. (2021). Text book of Food Microbiology. 1st Edition. INSC International Publishers.
4. Foster. W.M. (2020). Food Microbiology. 1st Edition. CBS Publishers & Distributors Pvt. Ltd.
5. Adam M. and Dick M. (2023). Food Microbiology: An Introduction. 3rd Edition. Scientific International Pvt. Ltd.
6. Vijaya Ramesh. R. (2021). Food Microbiology. 1st Edition. Mjp Publishers.

Reference Books

7. Rajan, S. and Selvi Christy, R. (2018). Essentials of Microbiology. 4th Edition. CBS Publishers and Distributors Pvt. Ltd.
8. Joanne M. Willey, Kathleen M. Sandman and Dorothy H. Wood (2022). Prescott's Microbiology. 12th Edition. McGraw-Hill Education.
9. Neelima Garg, Garg, K.L. and Mukerji, K.G. (2020). Laboratory Manual of Food Microbiology. 1st Edition. Dream tech Press.
10. Suresh Chandra, Ratnesh Kumar, Ruchi Verma. (2022). Food Technology: Objective Food Microbiology. 1st Edition. New India Publishing Agency (NIPA), New Delhi.
11. Joshi, R. D., Kulkarni, R. V., Mule, P. R. (2018). Dairy Microbiology & Technology. 1st Edition. Oxford Book Company.
12. Getachew Osei (2018). Food and Dairy Microbiology. 1st Edition. Bio-Green Publishers.

Web References

1. https://www.wikilectures.eu/w/Micro-organisms_in_Foods
2. https://byjus.com/biology/role-of-microbes-in-food-processing/
3. https://www.healthline.com/nutrition/probiotics-and-prebiotics
4. https://byjus.com/biology/food-preservation-methods-food-poisoning/
5. https://www.britannica.com/topic/food-preservation
6. https://www.onlinebiologynotes.com/food-borne-disease-food-poisoning-and-food-infection-with-example/
7. https://microbenotes.com/spoilage-of-milk-and-milk-products/

Pedagogy

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

Course Designer

Dr. S. Jenny

Semester : VI	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22UMB6CC6P	**FERMENTATION TECHNOLOGY AND FOOD AND DAIRY MICROBIOLOGY(P)**	**CORE PRACTICAL**	**3**	**3**

Course Objective

Fermentation technology is used to produce both primary and derived metabolites from microorganisms. Food and dairy microbiology learn various methods of isolation, detection and Identification of spoilage microorganisms in food. Understand the application of principle of effect of temperature on spoilage of food products.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Recall the safety practice in food microbiology laboratory	K1,K2
CO2	Explain Bacterial growth curve studies	K2
CO3	Identify the microorganism in various food	K3
CO4	Determine the antibiotic producing microorganisms	K4
CO5	Discuss the TDP and TDT of microorganisms	K6

Mapping of CO with PO and PSO

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

1- Slight (Low) correlation
2- Moderate (Medium) correlation
3- Substantial (High) correlation
"-" indicates there is no correlation

Syllabus

Fermentation Technology

1. Production of Media preparation and Sterilization.
2. Bacterial growth curve of industrial important microorganisms – Batch and continuous culture
3. Isolation of Antibiotic producing organism.
4. Production of Citric Acid using *Aspergillus niger.*
5. Microbial enzyme production of amylase, lipase and protease.

6. Visit to fermentation industry/ Science Institute/ Research laboratory.

Food and Dairy Microbiology

1. Microscopic observation of microorganisms commonly found in food: Gram smear preparation and Tease mount preparation of fungi.
2. Isolation of spoilage microorganisms from bread, cheese and butter milk, vegetables and fruits.
3. Microbial Examinations of Foods: Isolation of Bacteria Standard Plate Count Method.
4. Determination of Thermal Death Point (TDP) of Microorganisms.
5. Determination of Thermal Death Time (TDT) of Microorganisms.
6. Water Examination: Multiple Tubes Method – MPN Techniques : Presumptive, Confirmative and Completed
7. Milk Examination: Methylene Blue Reduction Test and Alkaline Phosphatase Test

Reference Books

1. Saha, R (2022).Microbiology Practical Manual (2nd edition) CBS Publishers & Distributors Pvt. Ltd.India.
2. Das, S (2020).Microbiology Practical Manual (1st edition) CBS Publishers & Distributors Pvt. Ltd.India.
3. Gunasekaran, P. (2018). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
4. R C Dubey and D K Maheswari (2010). Practical Microbiology. S. Chand Publishing.
5. James G Cappucino and N. Sherman MB(2013). A lab manual Benjamin Cummins, New York.

Web References

1. https://www.ifsc.usp.br/~ilanacamargo/FFI0740/4.pdf
2. http://www.lucp.net/books-pdf/Lab%20Manual%20Dr.%20Idris%20Adewale%20Ahmed/18.%20FERMENTATION%20TECHNOLOGY.pdf
3. https://content.kopykitab.com/ebooks/2016/06/7633/sample/sample_7633.pdf
4. https://sacmicro.files.wordpress.com/2016/09/food-safety-lab-manual.pdf
5. file:///C:/Users/HP/Desktop/FMS-122%20food%20microiology%20practical.pdf

Pedagogy

Chalk and talk, Power Point Presentation and Group Discussions

Course Designer

Dr. E.Priya

Semester: VI	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB6DSE2A	**MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE – II (DSE)**	**5**	**3**

Course Objective

The paper Microbial Genetics is the field of biology that studies the composition, structure and interactions of cellular molecules encompasses the basic study and understanding the central dogma. It helps in understanding the basic organization of the genome of prokaryotes and eukaryotes. It is followed by prokaryotic and eukaryotic replication, transcription, translation processes and regulation. This knowledge can be employed in determining the function of various genes and proteins for better understanding of cellular life processes.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	State the Basic concept of Microbial Genetics	K1
CO2	Define the Concept of gene	K1
CO3	Explain about Gene transfer Mechanism	K2
CO4	Apply the view of Recombinant DNA Technology	K3
CO5	Expose the students on the methods to construct the gene libraries	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3	2	3	2	3	2
CO2	3	2	2	2	2	3	3	2	3	3
CO3	3	2	2	2	2	3	2	3	2	2
CO4	2	3	3	3	2	3	3	2	2	3
CO5	2	2	3	2	2	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	**UNIT I: Introduction to Microbial Genetics** Introduction and Basic history in Microbial Genetics. Fundamentals of genetics- Mendelian laws, alleles, crossing over and linkage. Structure of DNA-Watson and Crick model. Plasmids and types in bacteria. Bacteriophages, Lytic phages – T7 and T4. Lysogenic phages I and Pl. M13 and f x 174 Life cycle	15	CO1, CO2, CO4, CO5	K1, K2, K3, K4,
II	**UNIT II: Concept of gene** Concept of gene- Cistron, Muton and recon. One gene -one enzyme, one gene – one polypeptide, one gene -one product hypothesis. Types of RNA and their functions. Outlines of RNA biosynthesis in prokaryotes. Genetic code. Structure of ribosomes and a brief account of protein synthesis.	15	CO1, CO2, CO3, CO4,	K1, K2, K3, K4,
III	**UNIT III:** **Gene transfer and genetic recombination mechanisms:** Transformation – competence cells, regulation, general process and Efficiency. Transduction – general and specialized; Mechanisms and applications. Conjugation: Discovery, F+, F- and Hfr cells; F+ & F and Hfr & F genetic crosses. Mechanism of conjugation. conjugational transfer of colicin genic and resistance transfer factors. Genetic mapping of T4 phage.	15	CO1, CO2, CO3, CO4	K2, K3, K4, K5
IV	**Unit IV: *Recombinant DNA Technology*** Introduction-Isolation of DNA and recombinant DNA construction. Core techniques used in rDNA technology. Enzymes useful in molecular cloning- Cloning Vectors- Labeling nucleic acids and blotting techniques (Southern, Northern, Western, Zoo blot) Polymerase Chain Reaction and its applications. Applications of recombinant DNA technologies- Agriculture, Medicine.	15	CO1, CO2, CO3, CO4	K2, K4 K5, K6
V	**UNIT-V: Cloning vectors and Gene libraries** Cloning vectors - plasmids, phages and	15	CO1, CO2, CO4,	K1, K2, K3,

	cosmids. Cloning strategies. Cloning and selection of individual genes, Gene libraries: cDNA and genomic libraries.		CO5	K4, K5
VI	**Self-Study for Enrichment (Not included for End Semester Examinations** X–ray diffraction analysis of DNA, Forces stabilizes DNA structure, Conformational variants of double helical DNA.	-	CO1, CO2, CO3, CO4 CO5	K1, K2, K3, K4, K5

Text Books

1. Larry R. Snyder, Joseph E. Peters, Tina M. Henkin (2013) Molecular Genetics of Bacteria, ASM Press.
2. Clark David (2019) Molecular Biology, Academic Cell.
3. Gerald Karp, Janet Iwasa and Wallace Marshall(2016)Karp's Cell and Molecular Biology, Wiley.
4. Joanne Willey, Linda Sherwood (2016) Prescott's Microbiology, Mc-Graw– Hill Publishing company Ltd.
5. Veer Bala Rastogi (2015) Principles of Molecular Biology Med tech.
6. Verma P S and Agarwal V K (2015) Cell biology, Genetics, Molecular Biology Evolution and Ecology, S. Chand and Company Ltd.

Reference Books

7. Chaudhuri. K. (2012) Microbial Genetics. The Energy and Resources Institute, TERI.
8. Tania A. Baker, Stephen P. Bell, Michael Levine and Richard Losick. (2013) Molecular Biology of the Gene. 7th Edition. Benjamin/Cummings Publ. Co., Inc., California.
9. Geoffrey M Cooper (2016) Cell: A Molecular Approach, Sinauer Associates Inc.
10. Bernard R Glick and Cheryl L Patten (2017) Molecular Biotechnology: Principles and Applications of Recombinant DNA, ASM Press.

Web Links

1. https://www.uomustansiriyah.edu.iq/media/lectures/6/6_2019_10_25!03_16_45_PM.pdf
2. https://pages.jh.edu/rschlei1/Random_stuff/publications/molbiogene.pdf
3. https://www.fmed.uniba.sk/uploads/media/Introduction_to_Medical_and_Molecular_Biology.pdf
4. https://www.aacb.asn.au/documents/item/3400
5. https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental_molecular_biology.pdf
6. https://users.ugent.be/~avierstr/pdf/principles.pdf
7. https://pages.jh.edu/rschlei1/Random_stuff/publications/molbiogene.pdf

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

Course Designer

Ms.S. Sathya

semester: VI	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB6DSE2B	**MICROBIAL ECOLOGY**	**DISCIPLINE SPECIFIC ELECTIVE-II (DSE)**	**5**	**3**

Course Objective

To create awareness on evolutionary relationship of ecosystem and its interactions. To understand the

Prerequisites

To obtain concepts of community ecology and strategies for biodiversity conservation.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Explain the basic concept of ecosystem	K2,K3
CO2	Illustrate the microorganisms and their natural habitats	K3,K4
CO3	Summarize the environmental pollution	K4,K5
CO4	Interpret waste management system	K5,K6
CO5	Discuss about biodiversity and its conservation	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	History, significance, principle, scope and developmen of microbial ecology. Population ecology Characteristics of a population; population growth curves; population regulation; life history strategies (and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Biological Interactions: Microbe–Microbe Interactions, Microbe–Plant Interactions, Microbe–Animal Interactions.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4,K5
II	Ecosystem – structure and functions. Abiotic and biotic components. Energy flow, food chain, food web, ecological pyramids and types. Terrestrial Environment: Soil characteristics, Soil profile, Soil formation, Soil as a natural habitat of microbes, Soil microflora. Aquatic Environment: Stratification & Microflora of Freshwater & Marine habitats. Atmosphere: Stratification of the Atmosphere, Aeromicroflora, dispersal of Microbes. Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Environmental pollution-Air pollution: Sources and classification of major air pollutants; Noise pollution-concept and effects. Soil pollution: sources and types of soil and water pollutants; effect of pollutants on soil health and productivity; Radioactive pollutants, their lifetime and disposal; Water pollution: major sources and types of water pollutants; pollution in fresh and marine water bodies. Climate change: Global warming and green house effects, sources and sinks of green house gases, Acid rain.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Waste management- Solid and liquid wastes. Physical, chemical and biological properties of wastes; Effluent treatment- sewage and other agro-industrial wastes; Biomagnification and its impact on loss of biodiversity. Biodegradation and Bioconversion of organic wastes; Microbiological and public health aspects of waste disposal; heavy metal contamination of environments, source and sinks of heavy metals.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

V	Biodiversity- concepts, levels and types; strategies for biodiversity conservation. Biodiversity-status monitoring and documentation; major drivers of biodiversity change; biodiversity managemen approaches. Principles of conservation- in-situ and ex-situ. National and global conservation measures Biodiversity hot spots in India and world	15	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6
VI	**Self Study for Enrichment** **(Not included for End Semester Examination)** Ecological succession: Types; mechanisms; changes involved in succession; concept of climax.	-	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4, K5, K6

Text Books

1. Pelczar, M.J., Schan,E.C. and Kreig, N.R (2010) Microbiology – An application based approach, Fifth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Saha, T.K (2010) Ecology and Environmental Biology. Books and Allied Pvt. Ltd. Kolkata.
3. Dubey,R.C.and Maheswari, D.K.(2013), A text book of Microbiology Revised, S. Chand and Company Ltd, New Delhi.
4. Nduka Okafor(2011), Environmental Microbiology of Aquatic and Waste Systems. Springer Dordrecht Heidelberg London New York.

Reference Books

1. Ian Pepper Charles Gerba Terry Gentry.(2014) *Environmental Microbiology*.3rd Edition Academic press. USA.
2. Prescott, L.M.,Harley, J.P. and Helin,D.A. (2017) *Microbiology*, 10thEdition**,** McGraw Hill,New York.
3. Bal Ram Singh, Raj Kumar,(2022)Practical Techniques in Molecular Biotechnology, Cambridge University Press.
4. Tortora G.J., Funke,B.R. and Case, C.L.(2009) *Microbiology*, 9th Edition, Dorling Kindersely (India) Pvt. Ltd., Noida

Web References

1. https://www.onlinebiologynotes.com/microbial-ecology-and-role-of-microorganism-in-ecosystem/ 2.https://www.slideshare.net/WilliamElly/microbial-ecology-58311201
3. https://www.slideshare.net/cezsham/microbiology-microbial-ecology
4. https://byjus.com/biology/define-microbial-diversity/
5. https://byjus.com/biology/ecology/

Pedagogy

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

Course Designer: Dr. S. Jeyabharathi

semester: VI	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
23UMB6DSE2C	**BIOLOGICAL TECHNIQUES**	**DISCIPLINE SPECIFIC ELECTIVE-II (DSE)**	**5**	**3**

Course Objective

This course will give an understanding about the working principles, construction and applications of the instruments often used in the studies related to various disciplines of Biological Sciences.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO 1	Understand the basic instrumentation protocols of biological sciences.	K1, K2
CO 2	Illustrate the principles of biological techniques.	K2, K3
CO 3	Examine the results of bioinstrumentation techniques.	K3, K4
CO 4	Organize the advantages of assorted techniques.	K4, K5
CO 5	Interpret the application of instrumentation biology.	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	3	3	3	3	2	3
CO2	3	2	3	3	3	2	3	3	3	3
CO3	3	3	3	2	3	3	2	2	3	3
CO4	2	3	3	3	2	3	3	3	3	3
CO5	3	3	2	3	3	3	3	3	3	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

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

Syllabus

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
I	**Microscopy:** Basic principles, mechanisms and application of Bright Field, Dark field, Phase contrast, Fluorescence, Transmission Electron microscope (TEM), Scanning Electron microscope (SEM) and Confocal microscope.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
II	**Spectroscopy**: Concepts and applications of UV-Visible spectrophotometry, Fourier-transform infrared spectroscopy (FTIR), Nuclear Magnetic Resonance spectroscopy (NMR) and Mass spectroscopy.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Centrifugation:** Working Principles, Steps and uses of Analytical, Density gradient, Differential, Isopycnic, Rate zonal density gradient, Continuous and Ultra-centrifugation.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Chromatographic Techniques:** Instrumentation, principles and application of Thin-layer chromatography, Paper chromatography, Gel filtration chromatography, Ion- exchange chromatography, Affinity chromatography, Gas chromatography and High Performance Liquid chromatography.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Electrophoretic Techniques**: Operating procedure and uses of Agarose gel, Polyacrylamide gel, SDS-PAGE, Isoelectric focusing, 2D-electrophoresis, Immuno-electrophoresis and Pulse field electrophoresis. Brief outline about Polymerase Chain Reaction, Blotting techniques and DNA sequencing.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment (Not to be included for End Semester Examination)** Outline the concept, types and importance of Radiographic and Molecular techniques used in biological sciences.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text books

1. Kothari C.R. and Gaurav Garg M.K. (2024). Research Methodology Methods and Techniques.5th Edition. New Age International Publishers.
2. Dev Brat Mishra, Shailendra Kumar Singh and Vijeta Chaturvedi. (2022). Tools and Techniques in Biological Science. Xoffencer, Gwalior. M.P.
3. Ankita Jain, Haresh Kalasariya, Varsha Tailor, Nikunj Patel. (2020). Bioinstrumentation techniques- Basics and applications.1st Edition. Notion Press.
4. Bhawana Pandey M.H. Fulekar. (2019). Bioinstrumentation. 5th Edition. Dream tech Press.
5. Gurdeep R. Chatwal. (2019). Instrumental Methods of Chemical Analysis. 3rd Edition. Himalaya publishing house.

Reference Books

6. Satish Chandra and Gyanendra Kumar. (2023). Bioinstrumentation and Biological Technique. P.K. Publishers & Distributors.
7. Rao, D. M. (2020). Instrumental Methods of Analysis. 1st Edition. CBS publishers and distributors Pvt. ltd.
8. Gakhar, Monika Miglani, Ashwani Kumar. (2019). Molecular Biology: A Laboratory
9. Manual.1st Edition. Dreamtech Press.
10. Almroth E., Wright. (2018). Principles of Microscopy: Being a Handbook to the Microscope.1st Edition. Forgotten Books.
11. Andreas Hofmann and Samuel Clokie. (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.8th Edition. Cambridge University Press.

Web References

1. https://www.brunelmicroscopessecure.co.uk/acatalog/books.html
2. https://www.freebookcentre.net/chemistry-books-download/Introduction-to-Spectroscopy.html
3. https://archive.org/details/centrifugation-biotechgirl
4. https://www.pdfdrive.com/chromatography-sixth-edition-fundamentals-and-applications-of-chromatography-and-related-differential-migration-methods-part-b-applications-e157059666.html
5. https://www.freebookcentre.net/chemistry-books-download/Electrophoresis.html

Pedagogy

Power Point Presentation, Group Discussion, Assignment, Seminar and Brain Stroming Activity.

Course Designer

Dr. N. Jeenathunisa