Dhanalakshmi Srinivasan College of Arts & Science for Women (Autonomous)

(Affiliated to Bharathidasan University, Tiruchirappalli)

Nationally Re-accredited with 'A++' Grade by NAAC)

Perambalur- 621 212

(For the candidates admitted from the academic year 2024-2025 onwards)

B.Sc., MICROBIOLOGY COURSE STRUCTURE UNDER CBCS

Sem	Part	Course	Course Title	Sub. Code	periods/ Week	Credit	Internal	External	Total
I	I	Language course I	Cheyull (IkkalaIlakiyam), Sirukathai, Ilakiyavaralaru, Hindi, French	24U1LT1/ 24U1LH1/24U1LF1	5	3	25	75	100
	II	English Language course I	English for Communication-I	24U1EL1	5	3	25	75	100
	III	Core Course-I (CC)	Fundamentals of Microbiology	24UMB1C1	6	5	25	75	100
		Core Course-II (CC)	Practicals –I Fundamentals of Microbiology	24UMB1C2P	4	4	40	60	100
		Allied Course-I	Biochemistry -I	24UMB1A1	5	4	25	75	100
			Biochemistry –I Practical		3	**	**	**	**
	IV	Value education	Value education	24U1VED	2	2	25	75	100
			TOTAL		**30**	**21**			**600**
II	I	Language course II	Cheyull (IddikalaIlakiyam), Puthinumum, Hindi, French	24U2LT2/24U2LH2/ 24U2LF2	5	3	25	75	100
	II	English Language course II	English for Communication-II	24U2EL2	5	3	25	75	100
	III	Core Course-III (CC)	Microbial Physiology	24UMB2C3	6	5	25	75	100
		Core Course-IV (CC)	Practicals II- Microbial physiology	24UMB2C4P	4	4	40	60	100
		Allied Course-II	Biochemistry -II	24UMB2A2	5	4	25	75	100
		Allied Course-II	Biochemistry -I &II	24UMB1A1P	3	2	40	60	100
	IV	Environmental studies	Environmental studies	24U2EVS	2	2	25	75	100
			TOTAL		**30**	**23**			**700**
III	I	Language course III	Cheyyul (Kappiyangal), Vurainadai, AluvalmuraiMadalgal, Ilakkiyavaralaru Hindi, French,	24U3LT3/24U3LH3/ 24U3LF3	5	3	25	75	100

	II	English Language Course III	English - III	24U3EL3	5	3	25	75	100
	III	Core Course – V	Virology & Parasitology	24UMB3C5	5	5	25	75	100
		Core Course – VI	Practical-III Virology & Parasitology	24UMB3C6P	4	4	40	60	100
		Allied Course-III	Bio-statistics -III	21UMB3A3	5	4	25	75	100
			Bio-statistics –III Practical		3	**	**	**	**
	IV	Non-major Elective-I	A) Bioinstrumentation	24UMB3N1A	2	2	25	75	100
			B) Clinical Lab Technology	24UMB3N1B					
			C) Food processing Technology	24UMB3N1C					
			TOTAL		**30**	**21**			**600**
IV	I	Language course – IV	Tamil, Hindi, French	24U4LT4/24U4LH4/ 24U4LF4	5	3	25	75	100
	II	English Language Course – IV	English IV	24U4EL4	5	3	25	75	100
	III	Core Course – VII	Immunology & Immunotechnology	24UMB4C7	6	5	25	75	100
		Core course – VIII	Practical-IV Immunology & Immunotechnology	24UMB4C8P	4	4	40	60	100
		Allied Course- IV	Bio-statistics -IV	24UMB4A4	5	4	25	75	100
			Bio-statistics - III & IV	24UMB3A2P	3	2	40	60	100
	IV	Non-major Elective-II	A) Antimicrobial Agents	24UMB4N2A	2	2	25	75	100
			B) Social and preventive medicine	24UMB4N2B					
			C) Mushroom technology	24UMB4N2C					
			TOTAL		**30**	**23**			**700**
	III	Core Course – IX	Bacteriology & Mycology	24UMB5C9	5	5	25	75	100
		Core Course – X	Molecular Biology & Microbial Genetics	24UMB5C10	6	5	25	75	100
		Core Course – XI	Industrial Microbiology	24UMB5C11	5	5	25	75	100
		Core Course – XII	Practical-V Bacteriology & Mycology, Molecular Biology & Microbial Genetics,, Industrial Microbiology	24UMB5C12P	6	4	40	60	100
			A) Biosafety & Bioethics	24UMB5MBE1A					

V	III	Major Based Elective-I	B) Microbial Quality Control & Testing	24UMB5MBE1B	4	3	25	75	100
			C) Entrepreneurship & Bio business	24UMB5MBE1C					
	III		Internship/ field study/ industrial visit	24UMB51S1	-	1			100
	IV	Skill Based Elective-I	A) Sericulture	24UMB5SBE1A	3	2	25	75	100
			B) Nutrition & Health hygiene	24UMB5SBE1B					
			C) Organic Farming & Bio fertilizer technology	24UMB5SBE1C					
		Soft Skills	Soft Skills	24U5SS	2	2	25	75	100
			Self-Paced learning	24UMB5SP	-	2*			
			TOTAL		**30**	**27**			**800**
VI	III	Core course – XIII	Environmental & Agricultural Microbiology	24UMB6C13	6	5	25	75	100
		Core course – XIV	Food, Dairy & Probiotic Microbiology	24UMB6C14	5	5	25	75	100
		Core Course- XV	Practical –VI Environmental & Agricultural Microbiology, Food, Dairy & Probiotic Microbiology	24UMB6C15P	6	4	40	60	100
		Major Based Elective-II	Marine Microbiology	24UMB6MBE2A	5	4	25	75	100
			Microbial Biotechnology & Bioethics	24UMB6MBE2B					
			Microbes in Human Welfare	24UMB6MBE2C					
			Project work	24UMB5PW	4	3	40	60	100
	IV	Skill Based Elective- II	Microbial diseases in human	24UMB6SBE2A	3	2	25	75	100
			Vaccine technology	24UMB6 SBE2B					
			Genetic Engineering	24UMB6 SBE2C					
	IV	Gender Studies	Gender Studies	24U6GS	1	1	25	75	100
			Comprehensive examination	24UMB6CE	-	2*			
			TOTAL		**30**	**24**			**700**
I-VI	V		Extension Activities		**-**	**1**			
				Grand Total	**180**	**140**			**4100**

PROGRAMME OUTCOMES

1. Enable students to acquire expertise in the use and application of various methods used in microbiology
2. Provide learning opportunity to be reflective about their role as are searcher
3. Handle and independently work on lab protocols involving molecular techniques
4. Awareness of ethical issues in Microbiology research and career options.
5. Production of substantial original research of significance and quality sufficient for publications.

The course is reasoning and application based, making the students eligible for higher studies, jobs in various sectors and Entrepreneurship abilities. Applied papers are advanced, making the students updated in the field. More number of practical is there in the course making the students well worse with the subject

CORE COURSE: I

FUNDAMENTALS OF MICROBIOLOGY

Semester :I **Max Marks: 75**

Course Code :24UMB1C1 **Credit :6***

Total Period : 75h

Objectives

Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.

UNIT I Introduction to Microbiology (15 Period)

History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity- ecological niche. Basic concepts of Eubacteria, Archaebacteria and Eucarya. Conservation of Biodiversity.

UNIT II General Characteristics of microorganisms (15 Period)

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, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae.

UNIT III Culture Media (15 Period)

Culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques.

UNIT IV Microscopy (15 Period)

Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.

UNIT V Sterilization Techniques (15 Period)

Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.

REFERENCES

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition., McGraw – Hill, New York.
2. Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition.
3. Tortora, G.J., Funke, B.R., Case, C.L. (2013). Microbiology. An Introduction 11thEdition., A La Carte Pearson.
4. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9thEdition). Jones &Bartlett learning 2010.
5. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5thEdition., MacMillan Press Ltd
6. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11thEdition., Benjamin Cummings.
7. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5thEdition., McGraw Hill Publications.

Web resources

1. https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology
2. https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4. https://bio.libretexts.org/@go/page/9188
5. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.	K1
CO 2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.	K2
CO 3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	K3
CO 4	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application.	K4
CO 5	Understand the concept of asepsis and modes of sterilization and disinfectants**.**	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

CORE COURSE II

PRACTICAL I – FUNDAMENTALS OF MICROBIOLOGY

Semester :I **Max Marks: 60**

Course Code :24UMB1C2P **Credit :4***

Total Period : 75h

Objectives

Acquire knowledge on Cleaning of glass wares, GLP and sterilization. To impart hands on training on fundamentals of microbiology.

1. Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration**.** **(Periods 10)**
2. Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates. **(Periods 10)**
3. Various media preparation- quality control of media, growth supporting properties, sterility check of media **(Periods 12)**
4. Pure culture techniques: streak plate, pour plate, Serial dilution. **(Periods 12)**
5. Culture characteristics of microorganisms (**Periods 9)**
6. Microscopy light microscopy and bright field microscopy. **(Periods 10)**
7. Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining. **(Periods 12)**

REFERENCES

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 Bartlett Publication
5. James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.
6. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
7. R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
8. Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi

Web resources

1. https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology
2. https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4. https://bio.libretexts.org/@go/page/9188
5. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Practice sterilization methods; learn to prepare media and their quality control.	K1
CO 2	Learn streak plate, pour plate and serial dilution and pigment production of microbes.	K2
CO 3	Understand Microscopy methods, different Staining techniques and motility test.	K3
CO 4	Observe culture characteristics of microorganisms.	K4
CO 5	Study on Microbial Diversity using Hay Infusion Broth-Wet mount	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	S	M	M	S	S
CO 2	M	S	S	M	S
CO 3	S	S	S	M	S
CO 4	S	S	M	S	S
CO 5	S	S	S	M	S

S- Strong, M- Medium, L- Low

ALLIED COURSE: I

FOOD MICROBIOLOGY

Semester :I **Max Marks: 75**

Course Code :24UND1A1 **Credit :4***

Total Period : 75h

Objective

To enable the students to gain knowledge about the role of microorganism in health and disease.

UNIT I Food factors and Microbes (15 Period)

Growth and multiplication - Factor influencing the growth - Intrinsic factors, nutrient content, pH, redox potential, antimicrobial barrier and water activity. Extrinsic factors - Relative humidity, temperature and gaseous atmosphere.

UNIT II Microbiology of Perishable Food (15 Period)

Outline of contamination - Spoilage and intoxication. Preservation of vegetables and fruits, milk and milk products and canned food, meat and meat Products, egg and poultry. HACCP and Food regulations

UNIT III Microbiology of Non -Perishable Food (10 Period)

Outlines of contamination – spoilage and preservation of cereal and cereal, Pulses and Pulses product, sugar and sugar products.

UNIT IV Food Borne Diseases (10 Period)

Food poisoning and intoxication. Causes and symptoms of the following food borne diseases - *Salmonellosis, Botulism*, Cholera and Typhoid. Water borne disease - Gastro enteritis, Diarrhea: Campylobacter and Gardialamblia.

UNIT V Fermented Food from Microorganisms (10 Period)

Fermented food - curd, cheese, sauerkraut, meat, soy based foods, alcoholic beverages, vinegar and organic acids.

REFERENCES

1. Adams , M.R. and Moss, M.O. 2005. Food Microbiology, *New age International (P) Ltd.* New Delhi.
2. Vijaya Ramesh, K. 2007. Food Microbiology. *MJP Publishers*, Chennai. JamesG. Cappuccino and Natalie Sherman. 2008. Microbiology–A Laboratory manual, *Pearson education publishers*, USA.
3. James M. Jay. 2005. Modern Food Microbiology, 4th Edition, *CBS Publishers and Distributors*, New Delhi.
4. Adams Tamine. 2005. Probiotic Dairy Products, *Blackwell Publishing*, US

Course Outcomes:

On the Successful completion of the course the student would be able to

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Understand the Food factors and Microbes	K3
CO 2	Outline of contamination	K2
CO 3	Understand the Microbiology of Non -Perishable Food	K4
CO 4	Understand the Food poisoning and intoxication	K3
CO 5	Understand the Fermented food	K4

Mapping with Programme Outcomes:

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**S**
CO 2	**S**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**S**	**S**	**S**	**S**	**S**

S- Strong, M- Medium, L- Low

ALLIED COURSE: II

FOOD MICROBIOLOGY PRACTICALS

Semester I **Max Marks :60**

Course Code :24UND1A2P **Credit :3***

Total Period : 45h

To gain knowledge on food spoilage and quality control aspects

1. Isolation of pathogens from spoiled food **(06 Periods)**
2. Identification of fungi from spoiled bread by LPC **(03 Periods)**
3. A differential stain: Gram's staining method using spoiled vegetable **(06 Periods)**
4. Methylene blue reduction test **(06 Periods)**
5. Water quality by MPN technique **(09 Periods)**
6. Preparation of wine using yeast **(09 Periods)**
7. Preparation of Paneer and cheese **(06 Periods)**

REFERENCES

1. Adams, M.R. and Moss M.O. 1995. Food Microbiology. *The Royal Society of Chemistry*. Cambridge. Banwart, G.J. 1989. Basic Food Microbiology. *Chapman & Hall*, New York.
2. Basic Practical Microbiology Published by the Society for General Microbiology, Marlborough House, Basingstoke Road, Spencers Wood, Reading RG7 1AG, UK
3. Frazier, W.C, Westhoff, D.C. 1988. Food Microbiology, *TATA McGrawHill*.

Course Outcomes:

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Isolate of pathogens from spoiled food	K5
CO 2	Perform the Methylene blue reduction test	K4
CO 3	Perform Water quality by MPN technique	K3
CO 4	Preparation of wine using yeast	K4
CO 5	Preparation of paneer and cheese	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**S**	**S**	**S**
CO 2	**S**	**S**	**S**	**M**	**M**
CO 3	**S**	**S**	**S**	**S**	**S**
CO 4	**S**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**S**	**S**	**S**

S- Strong, M- Medium, L- Low

CORE COURSE-III
MICROBIAL PHYSIOLOGY

Semester :II	**Max Marks: 75**
Course Code :24UMB2C3	**Credit :5***
Total Period : 75h	

Objectives

Understand the basic concepts of aerobic and anaerobic metabolic pathways.

UNIT I Physiology of microbial growth (Periods 15)

Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.

UNIT II Nutrition requirements (Periods 15)

Nutrition requirements - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Factors affecting microbial growth.

UNIT III Overview of Metabolism (Periods 15)

Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.

UNIT IV Photosynthesis (Periods 15)

An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle.

UNIT V Reproduction of Bacteria (Periods 15)

Bacterial reproduction - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Microalgae reproduction. Asexual and sexual reproduction of protozoa.

REFERENCES

1. Schlegal, H.G. (1993). General Microbiology.,7th Edition.
2. RajapandianK. (2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
3. MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.
4. Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
5. Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
6. Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
7. Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, Wiley & Sons. Inc. Publications.
8. Bhan Shrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

WEB RESOURSES

1. https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
2. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4. http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
5. https://www..frontiersin.org.microbial-physiology-and-metabolism

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Describe microorganisms based on nutrition.	K1
CO 2	Know the concept of microbial growth and identify the factors affecting bacterial growth.	K2
CO 3	Explain the methods of nutrient uptake.	K3
CO 4	Describe anaerobic and aerobic energy production.	K4
CO 5	Elaborate on the process of bacterial photosynthesis and reproduction.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

CORE COURSE-IV
PRACTICAL –II MICROBIAL PHYSIOLOGY

Semester :II **Max Marks: 75**

Course Code :24UMB2C4P **Credit :4***

Total Period : 75h

Objectives

1. Motility demonstration: hanging drop, wet mount preparation. **(Periods 08)**

2**.** Staining techniques: Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining **(Periods 12)**

3. Direct counts – Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Viable count –pour plate, spread plate. Bacterial growth curve. **(Periods 16)**

4. Anaerobic culture methods. Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains. **(Periods 08)**

5. Morphological variations in algae, fungi and protozoa. Micrometry: Demonstration of the size of yeast, fungal filaments and protozoa. **(Periods 06)**

6. Methods of bacterial identification- morphological, physiological, and biochemical methods - IMViC test, H2S, TSI, Oxidase, catalase, urease test, and Carbohydrate fermentation test. **(Periods 16)**

7. Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture. **(Periods 09)**

REFERENCES

1. David White., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
2. Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
3. Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
4. Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications.
5. Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publicatio

WEB RESOURSES

1. https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
2. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4. http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
5. https://www..frontiersin.org.microbial-physiology-and-metabolism

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Describe hanging drop, wet mount preparation.	K1
CO 2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	K2
CO 3	Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	K3
CO 4	Describe demonstration of the size of yeast, fungal filaments and protozoa.	K4
CO 5	Elaborate on the bacterial identification- morphological, physiological, and biochemical methods.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

CORE COURSE: V
VIROLOGY & PARASITOLOGY

Semester :III **Max Marks: 75**

Course Code :24UMB3C5 **Credit :5***

Total Period : 75h

Objectives

To gain knowledge on properties and classification of viruses and collection of relevant clinical samples for diagnosing viral infections.

UNIT I **(Periods 15)**

General Properties, replication and Classification of viruses (Baltimore classification), Cultivation of viruses- in animals, embryonated eggs and tissue culture, Virus purification assays - collection and transport of clinical specimens for viral infections.

UNIT II **(Periods 15)**

Viral diseases with reference to symptoms, pathogenesis, transmission, prophylaxis and control – Polio virus and Rhinovirus, Hepatitis viruses (HAV, HBV, HCV, HDV, HEV), Rabies virus, Orthomyoviruses (Influenza virus) and Paramyxoviruses (Mumps and Measles virus), Pox viruses (Variola, Vaccinia), Herpes viruses (Herpes simplex, Varicella zoster), Adeno viruses, Rota viruses and HIV viruses. Oncogenic viruses (Human Papilloma virus)

UNIT III **(Periods 15)**

Emerging and reemerging viral infections (SARS, Swine flu, Ebola, Dengue, Chikungunya- and Corona) – causes, spread and preventive measures. Detection of viruses in clinical specimens – Serological and Molecular diagnosis of virus infections – Antiviral agents, Interferons and Viral Vaccines, Immunization schedules.

UNIT IV **(Periods 15)**

General introduction to Medical Parasitology, Classification of medically important parasites. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases caused by the following organisms: *Entameoba histolytica*, flagellates (*Giardia lamblia, Leishmania donovani*), Sporozoa- *Plasmodium* spps.

UNIT V **(Periods 15)**

Introduction to Helminthes, Platyhelminthes – *Taenia* – *Fasciola* – *Paragonimus* – *Schistosoma* spps.. Nemathelminthes – Ascaris– *Ankylostoma* – *Enterobius* – *Trichuris* – *Trichinella* – *Wuchereria* – *Dracanculus.* Collection, transport and examination of specimen Laboratory techniques in parasitology Examination of faeces for ova and cyst by direct wet mount and iodine wet mount, Concentration methods (Floatation and Sedimentation techniques), Examination of blood for parasites. Cultivation of parasites.

REFERENCES

1. S., Rajan (2007). Medical microbiology, MJP publisher.
2. Jeyaram Paniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers, NewDelhi.
3. Arora D.R. and Arora B. (2002). Medical Parasitology, 1st Edition CBS Publishers & Distributors, New Delhi.
4. Chatterjee (1986). Medical Parasitology. Tata McGraw Hill, Calcutta.
5. Jawetz, E., Melnick, J.L. and Adelberg, E.A. (2000). Review of Medical Microbiology, 19th Edition. Lange Medical Publications, U.S.A.
6. Ananthanarayan, R. and Jeyaram Paniker, C.K. (2009). Text Book of Microbiology, 8th Edition. Orient Longman, Chennai .
7. Topley& Wilsons's (1990). Principles of Bacteriology, Virology and Immunity, 8th Edition, Vol. III Bacterial Diseases, Edward Arnold, London.

Web Resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/
2. https://www.ncbi.nlm.nih.gov/pubmed/21722309
3. https://www.sciencedirect.com/science/article/pii/S2211753919300193
4. https://cmr.asm.org/content/30/3/811
5. https://www.nejm.org/doi/full/10.1056/NEJMoa1811400

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Understand the structure and properties of viruses, cultivation methods and diagnosis of viral diseases.	K1
CO2	Knowledge of basic and general concepts of causation of disease by the pathogenic microorganisms and various parameters of assessment of their severity and the methods of diagnosis.	K2
CO3	Insights to treatment options of viral diseases.	K3
CO4	Knowledge about the importance of protozoans in the intestine.	K4
CO5	Knowledge of Nematodes as infectious agent	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong, M-Medium, L-Low

CORE COURSE: VI
PRACTICAL-III VIROLOGY & PARASITOLOGY

Semester :III **Max Marks: 75**

Course Code :24UMB3C6P **Credit :6***

Total Period : 75h

1. Isolation of Bacteriophages from Sewage and other natural sources. **(Periods 15)**
2. Cultivation of Viruses in Embryonated eggs – Amniotic, Allantoic, Yolk sac routes and Chorio-allantoic membrane **(Periods 12)**
3. Concentration techniques of stool specimen – Floatation and Sedimentation methods. **(Periods 12)**
4. Examine the stool specimens for parasitic ova, cyst, and trophozoites by saline wet mount. **(Periods 12)**
5. Examination of Intestinal parasites by Iodine wet mount **(Periods 12)**
6. Perform Giemsa stain & Leishman's stain to differentiate blood parasites. (**Periods 12)**

REFERENCES

1. Jeyaram Paniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers, NewDelhi.

2. Arora D.R. and Arora B. (2002). Medical Parasitology, 1st Edition CBS Publishers & Distributors, New Delhi.

3. Chatterjee (1986). Medical Parasitology. Tata McGraw Hill, Calcutta

4. Ananthanarayan, R. and Jeyaram Paniker, C.K. (2009). Text Book of Microbiology, 8th Edition. Orient Longman, Chennai .

5. Topley& Wilsons's (1990). Principles of Bacteriology, Virology and Immunity, 8th Edition, Vol. III Bacterial Diseases, Edward Arnold, London.

Web Resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/
6. https://www.ncbi.nlm.nih.gov/pubmed/21722309
7. https://www.sciencedirect.com/science/article/pii/S2211753919300193
8. https://cmr.asm.org/content/30/3/811
9. https://www.nejm.org/doi/full/10.1056/NEJMoa1811400

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Understand cultivation methods of viral diseases.	K1
CO2	Assessment of their severity and the methods of diagnosis of viruses	K2
CO3	Insights to treatment options of viral diseases.	K3
CO4	Knowledge about the importance of protozoans in the intestine.	K4
CO5	Knowledge of Nematodes as infectious agent	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	M	S	S	M	S
CO3	S	S	S	M	S
CO4	S	S	M	S	S
CO5	S	S	S	M	S

S-Strong, M-Medium, L-Low

NON MAJOR ELECTIVE: I
BIOINSTRUMENTATION

Semester :III **Max Marks: 75**

Course Code :24UMB3N1A **Credit :2***

Total Period : 24h

Objectives

Understand the analytical instruments and study the basic principles in the field of sciences

UNIT I Bioinstrumentation (Periods 5)

Basic instruments: pH meter, Buffer of biological importance, Centrifuge-Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave**,** Hot Air Oven and Incubator. Biochemical calculations-preparations of Molar solutions - Buffers-Phosphate, Acetate, TE, TAE- calculation of Normality , PPM- Ammonium sulphate precipitation.

UNIT II Spectroscopic Techniques (Periods 5)

Spectroscopic Techniques: Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra-red and Mass Spectroscopy.

UNIT III Chromatographic and Electrophoresis Techniques (Periods 4)

Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.

UNIT IV Imaging techniques (Periods 5)

Imaging techniques: Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.

UNIT V Fluorescence and radiation based techniques (Periods 5)

Fluorescence and radiation-based techniques: Spectrofluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.

REFERENCES:

1. Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi.

2. Ponmurugan. P and Gangathara PB (2012). Biotechniques.1stEdition. MJP publishers

3. Veerakumari, L (2009).Bioinstrumentation- 5 thEdition -.MJP publishers.

4. Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home.

5. Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7thEdition. Cambridge University Press.

6. Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.

7. Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt. Ltd, Singapore.

Web Resources

1. http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction-types- uses-and-other-details-with-diagram/12489

2. https://www.watelectrical.com/biosensors-types-its-working-andapplications/

3. http://www.wikiscales.com/articles/electronic-analytical-balance/ Page 24 of 75

4. https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html

5. http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Gain knowledge about the basics of instrumentation.	K1
CO 2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.	K2
CO 3	Evaluate by separating and purifying the components.	K3
CO 4	Understand the need and applications of imaging techniques.	K4
CO 5	Categorize the working principle and applications of fluorescence	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

NME: I
CLINICAL LABORATORY TECHNOLOGY

Semester :III	**Max Marks: 75**
Course Code :24UMB3N1B	**Credit :2***
Total Period : 24h	

Objectives

Demonstrate ethical and professional conduct with patients, laboratory personnel, health- care professionals, and the public.

UNIT I Introduction to Clinical Laboratory Science (Periods 05)

Introduction to Clinical Laboratory Science: Basic laboratory principles - Code of conduct for medical laboratory personnel -Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Assessment of a patient and brief history of collection. Maintenance of Hygiene & Infection Control Practices

UNIT II Specimen collection and processing (Periods 05)

Specimen collection and processing - Blood, urine, stool, sputum CSF, amniotic fluid and bile. Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens and factors affecting the clinical results.

UNIT III Introduction to histopathology (Periods 05)

Introduction to histopathology-Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing - Collection of specimens, Labeling and fixation, Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting, Microtomes – types and mounting of sections.

UNIT IV Introduction to Haematology (Periods 05)

Introduction to Haematology- Laboratory methods used in the investigation of coagulation disorders - coagulation tests , Routine coagulation tests, (prothrombin time , plasma recalcification time,partial thromboplastin time , activated partial thromboplastin time, thrombin time), Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors.

UNIT V Quality Standards in Health Laboratories (Periods 04)

Quality Standards in Health Laboratories – Development and implementation of standards, Accreditation Boards –NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing.

REFERENCES:

1. Mukharji,K.L. (2000).Medical Laboratory Techniques, Vol - I, II & III, 5th Edition. Tata McGrawHill, Delhi.

2. Ochei,A., Kolhatkar.A. (2000).Medical Laboratory Science: Theory and Practice, McGraw Hill Education**.**

3. Ramnik Sood (2015).Concise Book of Medical Laboratory Technology:Methods and Interpretation, 2ndEdition, Jaypee Brothers Medical Publishers, NewDelhi.

4. *S. Ramakrishnan,* KN Sulochana **(**2012). Manual of Medical Laboratory Techniques**,** Jaypee Brothers Medical Publishers Pvt. Ltd

5. Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby.

6. Baker, F.J., Silverton, R.E., and Pallister,.J. (1998). An Introduction to Medical Laboratory Technology, 7thEdition, CBS Publishers and Distributors Pvt. Ltd.

7. Godkar (2021).Textbook of Medical Laboratory Technology, 3rdEdition,Bhalani Publishing House.

Web Resources

1. https://www.jaypeedigital.com › book

2. https://www.pdfdrive.com › wintrobes-clinical-hematology

3. https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5

4. https://vlab.amrita.edu/index.php?sub=3&brch=272

5. https://nptel.ac.in/courses/102105087

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Demonstrate ethical and professional conduct with patients, laboratory personnel, health- care professionals, and the public.	K1
CO 2	Explain how accurate and reliable information might be obtained about proper procurement, storage, and *handling* of laboratory *specimens*.	K2
CO 3	Develop a sound scientific knowledge foundation that prepares them to interpret, analyze and evaluate scientific knowledge in clinical practice.	K3
CO 4	Perform a full range of laboratory tests with accuracy and precision.	K4
CO 5	Establish quality assurance principles and practices to ensure the	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

NME: I
FOOD PROCESSING TECHNOLOGY

Semester :III **Max Marks: 75**

Course Code :24UMB3N1C **Credit :2***

Total Period : 24h

Objectives

To provide knowledge on objectives of food preservation.

UNIT I Introduction to food preservation (Periods 5)

Introduction to food preservation –objectives and techniques of food preservation. Preservation: principles of high temperature, low temperature, radiation, chemical preservatives and bio preservatives

UNIT II Freshness criteria and quality assessment (Periods 5)

Freshness criteria and quality assessment of meat and fish –spoilage and methods of preservation. Production of byproducts after processing waste and their utilization. Role of packaging material, types of packaging material

UNIT III Composition of milk (Periods 5)

Composition of milk; assessment of milk, thermal processing of fluid milk-pasteurization (LTH, HTST&UHT techniques). Fermented milk products-cheese, Butter milk, Yogurt, Kumis, Kefir and Acidophilus milk. Hygiene and sanitation requirement in food processing and fermentation industries.

UNIT IV Importance of fats (Periods 5)

Importance of fats and oils in Food-Extraction of fats and Oils-Rendering, pressing, solvent extraction, pressing of oil- degumming, refining, bleaching, deodorization, fractionation, pyrolysis of fats, toxicity of frying oil.

UNIT V Microbiological examination of foods (Periods 4)

Methods for the microbiological examination of foods. Food borne illness and diseases. Microbial cultures for food fermentation. Indian Factories Act on safety, HACCP, Safety from adulteration of food

REFERENCES:

1. Avantina Sharma. (2006). Text Book of Food Science and Technology, International Book Distributing Co, Lucknow, UP.

2. Sivasankar. (2005). Food Processing and Preservation, 3rd Edition.,Prentice hall of India Pvt Ltd, NewDelhi.

3. Ramaswamy H & Marcotte M. (2006). Food Processing: Principles & Applications. Taylor & Francis

4. NIIR Board of Food and Technologist. (2005). Modern Technology of Food Processing and Agrobased industries, National Institute of Industrial Research, Delhi.

5. Adams M.R. and Moss M. O (2007).Food Microbiology.New Age International.

6. Fellos PJ. (2005). Food Processing Technology: Principle &Practice 2nd Edition. CRC.

7. Peter Zeuthen and Leif Bogh-Sorenson. (2005). Food Preservation Techniques, WoodlandPublishing Ltd, Cambridge, England.

Web Resources

1. https://sites.google.com/a/uasd.in/ecourse/food-processing-technology

2. https://nptel.ac.in/courses/126105015

3. https://engineeringinterviewquestions.com/biology-notes-on-food-adulteration/

4. Food processing | Definition, Purpose, Examples, & Facts | Britannica

5. Food Processing Technology | Food News & Views Updated Daily (foodprocessing-technology.com)

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Assess the fundamental concepts of food preservation.	K1
CO 2	Investigate the quality assessment of meat and fish.	K2
CO 3	Design the processing of milk and milk quality assessment.	K3
CO 4	Explain about the importance of fats and oils.	K4
CO 5	Plan the food safety and adulteration detection.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

CORE COURSE: VII
IMMUNOLOGY AND IMMUNOTECHNOLOGY

Semester :IV **Max Marks: 75**
Course Code :24UMB4C7 **Credit :5***
Total Period : 75h

Objectives

To gain knowledge about immune system, organs of immunity and cells involved.

UNIT I Organs and Cells in Immune System (Periods 15)

Organs and Cells in Immune System and Immune Response: Primary lymphoid organs, secondary lymphoid organs, and lymphoid tissues; T – cell and B –cell membrane bound receptors – apoptosis; T - cell processing, presentation and regulation; T –cell subpopulation, properties, functions and T – cell suppression; Physiology of immune response- innate, humoral and cell mediated immunity; Immunohematology.

UNIT II Antigen and Antibody (Periods 15)

Antigen and Antibody: Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination, complement fixation, opsonization, neutralization; Vaccines – active and passive immunization; Classification of vaccines; Other approaches to new vaccines; Types of vaccine - antibacterial, antiviral; Vaccination schedule.

UNIT III Immunoassay and Immunotechniques (Periods 15)

Immunoassay and Immunotechniques - Preparation and standardization of bacterial antigens; Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, RAST, ELISA, Immuno fluorescence techniques and Flow cytometry

UNIT IV Transplantation and Tumor Immunology (Periods 15)

Transplantation and Tumor Immunology - MHC Antigens - structure and function; HLA system - Regulation and response to immune system; Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor specific antigens; Immune response to tumors; Immune diagnosis; cancer immune therapy

UNIT V Immunological disorders and diseases (Periods 15)

Immunological disorders and diseases - Hypersensitivity reactions (Type I, II, III and IV); acquired immunodeficiency syndrome; Auto immune disorders and diseases: organ specific and non-organ specific.

REFERENCES:

1. Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5th Edition. Wiley-Blackwell, New York.

2. Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7th Edition. W. H. Freeman and Company, New York.

3. Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2021). Cellular and Molecular Immunology, 10thEdition. Elsevier.

4. Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand. (2018).Clinical Immunology: Principles and Practice, 5th Edition. Elsevier

5. Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

6. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.

7. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition.,Wiley-Blackwell

Web Resources

1. https://www.ncbi.nlm.nih.gov/books/NBK279395/

2. https://med.stanford.edu/immunol/phd-program/ebook.html

3.https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/

4. Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)

5. Immunology - an overview | ScienceDirect Topics

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses.	K1
CO 2	Investigate the structures of Ag and Ab; Immunization.	K2
CO 3	Justify the Immunoassay and Immunotechniques.	K3
CO 4	Explain about the immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation	K4
CO 5	Analyze the overreaction by our immune system leading to	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

CORE COURSE: VIII
Practical – VI IMMUNOLOGY AND IMMUNOTECHNOLOGY

Semester :IV **Max Marks:60**

Course Code :24UMB4C8P **Credit :5***

Total Period : 75h

Objectives

To gain hands-on knowledge to identify Blood group and typing.

1. Identification of blood group and typing. **(Periods 12)**
2. Latex Agglutination reactions- RF, ASO, CRP **(Periods 12)**
3. Ouchterlony's Double Diffusion Method (antigen pattern). **(Periods 12)**
4. Single Radial Immuno Diffusion Method. **(Periods 12)**
5. Electrophoresis - Serum, Counter and Immuno. **(Periods 12)**
6. Separation of Lymphocytes by gradient centrifugation method. **(Periods 15)**

ELISA: Hepatitis/ HIV

REFERENCES:

1. Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.

2. Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications.

3. Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5th Edition., Wiley-Blackwell, New York.

4. Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7th Edition., W. H. Freeman and Company, New York.

5. Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

6. Frank C. Hay, Olwyn M. R. Westwood. (2008).Practical Immunology, 4th Edition, Wiley-Blackwell.

7. Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.

Web Resources

1. https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual

2. https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf

3. https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf

4. Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)

5. Immunology - an overview | ScienceDirect Topics

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Assess the blood groups and types	K1
CO 2	Competently perform serological diagnostic tests such as RF, ASO, CRP	K2
CO 3	Illustrate the antigen antibody reactions in gel.	K3
CO 4	Compare & contrast antigens and antibodies in electrophoresis	K4
CO 5	Examine the concept of ELISA.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

NON MAJOR ELECTIVE: II

ANTIMICROBIAL AGENTS

Semester :IV **Max Marks: 75**

Course Code :24UMB4N2A **Credit :2***

Total Period : 24h

Objectives

To educate clinically significant antimicrobial agents and their mechanisms of drug resistance.

UNIT I Introduction of Antimicrobial Agents: (Periods 5)

Definition – disinfection – antiseptics – antibiotics – chemical agents (antibacterial, antifungal, antiviral and antiparasitic) – non pharmaceutical agents (essential oils) –physical agent (Ozone, heat, radiation).

UNIT – II Antibacterial Agents: (Periods 5)

Antibacterial agent - mechanism of action- cell wall synthesis inhibitor (penicillin, arabinoglycan), protein synthesis inhibitor (Tetracycline, Chloramphenicol), nucleic acid synthesis inhibitor (metronidazole, rifampin), alteration of cell membranes (gramicidin, polymyxin, antimetabolite (sulfanilamide).

UNIT – III Antiviral Agents: (Periods 5)

Antiviral agents - interferon – types- mechanism of action - amantadine, rimantadine, zanamivir, and oseltamivir - viral vaccines.

UNIT – IV Antifungal Agents: (Periods 5)

The mode of action- amphotericin, nystatin and fluorocytosin

Antiprotozoalagents mechanism of action – (Metronidazole – chloroquine, Paromomycin sulfate,– quinolines).

UNIT – V Drug Resistance: (Periods 4)

Emergence of drug resistance – bacteria, fungi and viruses. Alternative drugs antimicrobial peptides.

REFERENCES:

1. Alan R Hauser. Antibiotics basics for clinicians: choosing the right antibacterial agent. Wolter Kluwer / Lipponcott Williams and Wilkins Publisher, New York. 2018, 3rd edition.
2. Anthony J Trevor, Bertram G Katzung, Susan B Masters. Katzung and Trevor's. Pharmacology: examination and board review. McGraw-Hill Professional, New York. 2021, 13th edition.
3. Cohen MR. Medication errors, American pharmaceutical association, Washington, DC. 2007.
4. Erika J Ernst. Antifungal agent (methods in molecular medicine). Humana Press, New York. 2015, 2005th edition.
5. Gale EF, Cundliffe E and Reynolds PE. The Molecular Basis of Antibiotic Action. 2nd edition. John Wiley and Sons, New York. 1981.
6. Hellen Geiband, Molly Miller, Petrie, Suraj Pant, Sumanth Gandra, Jordan lewinson, Devra Barter, Andrea White and Ramanan Laxminarayanan. The state of the Worlds antibiotic. CDDEP publisher, Washington, DC. 2021.
7. Jeffries DJ and De Clercq E. Antiviral Chemotherapy. John Wiley and Sons, Ltd., Chichester, Sussex, England. 1995.

Web Resources

1. https://www.mdpi.com/topics/anti_agent
2. https://www.frontiersin.org/articles/10.3389/fmicb.2020.01669/full

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Explain the mechanism of antimicrobial agent.	K1
CO 2	Understand the production of antimicrobial drug from various sources.	K2
CO 3	Investigate interesting biological problems.	K3
CO 4	Have an insight of current topics in microbial genetics and related fields.	K4
CO 5	Relate pharmaceutical microbiology to biotechnology.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	S	M	M	S	S
CO 2	M	S	S	M	S
CO 3	S	S	S	M	S
CO 4	S	S	M	S	S
CO 5	S	S	S	M	S

S- Strong, M- Medium, L- Low

NON MAJOR ELECTIVE: II
SOCIAL AND PREVENTIVE MEDICINE

Semester :IV **Max Marks: 75**

Course Code :24UMB4N2B **Credit :2***

Total Period : 24h

Objectives

Describe the concepts of health and disease and their social determinants

UNIT I Introduction to social medicine: (Periods 5)

Introduction to social medicine: History of social medicine-concepts of health and disease-social determinants of health and disease-Health and quality of life-Health information system- measures of population health-health policies.

UNIT II Health management: (Periods 5)

Health management: Applications of behavioral sciences and psychology in health management- nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.

UNIT III Health care and services: (Periods 5)

Health care of the community-information, education, communication and training in health-maternal & child health-school health services- Geriatrics-care and welfare of the aged-mental health-health services through general practitioners.

UNIT IV Preventive medicine: (Periods 5)

Preventive medicine: Introduction- role of preventive medicine- levels of prevention-Risk assessment in communities and vulnerable population –surveillance, monitoring and reporting of disease outbreaks - forecasting and control measures in community setting – early detection methods.

UNIT V Prevention through alternate medicine: (Periods 4)

Prevention through alternate medicine: Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.

REFERENCES:

1. Park. K (2021). Textbook of preventive and social medicine, 26th edition. Banarsidas Bhanot publishers.

2. Mahajan& Gupta (2013). Text book of preventive and social medicine, 4thedition. Jaypee brothers medical publishers.

3. Chun-Su Yuan, Eric J. Bieber, Brent Bauer (2006). Textbook of Complementary and Alternative Medicine. Second Edition. Routledge publishers.

4. Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatics. 12th edition, Jaypee Brothers Medical Publishers.

5. Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher.

6. GN Prabhakara (2010). Short Textbook of Preventive and Social Medicine. Second Edition. Jaypee publishers.

7. Jerry M. Suls, Karina W. Davidson, Robert M. Kaplan (2010).Handbook of Health Psychology and Behavioral Medicine. Guilford Press

Web Resources

1.https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php

2. https://www.teacheron.com/online-md_preventive_and_social_medicine-tutors

3. https://www.futurelearn.com

4. https://www.healthcare-management-degree.net

5. https://www.conestogac.on.health-care-administration-and-service-management

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Identify the health information system	K1
CO 2	Associate various factors with health management system	K2
CO 3	Choose the appropriate health care services	K3
CO 4	Appraise the role of preventive medicine in community setting	K4
CO 5	Recommend the usage of alternate medicine during outbreaks	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

NON MAJOR ELECTIVE: II
MUSHROOM TECHNOLOGY

Semester :IV	**Max Marks: 75**
Course Code :24UMB4N2C	**Credit :2***
Total Period : 24h	**Exam Hrs:3**

Objectives

To provide knowledge on application of mushroom and to promote the students to become an entrepreneur.

UNIT I Scope and development of Mushroom (4 Periods)

Classification of Edible Mushrooms- Medicinal Value of Mushrooms- Edible mushroom cultivation – Types of edible mushroom available in India – *Calacybeindica, Volvariella Volvacea, Pleurotus sp ., Agaricus bisporus*

UNIT II Nutritive value and spawn (5 Periods)

Protein, Vitamins, Minerals, Carbohydrates, Fibre, Fat pure Culture- Preparation of media (PDA and Oatmeal agar media) Sterilization – Preparation of test tube Slants to store Mother Culture – Culturing of Pleuretus mycelium on Petriplates – Preparation of mother Spawn in Saline Bottle and Polypropylene Bags and their Multiplication .

UNIT III Cultivation (5 Periods)

Infra-structure, Substrates (locally available) polythene bag, vessels, Inoculation hood –low cost stove – sieves – Cultural rack mushroom unit (Thatched house) – Mushroom bed preparation – Paddy straw, sugarcane trash, maize straw, banana leaves- post harvest technique- packing- transport- storage- short term storage- long term storage Cultivation of button mushroom.

UNIT IV Pests and Diseases of Edible Mushrooms (5 Periods)

Fungal diseases- dry bubble, wet bubble, cob web disease, green moulds, competitor moulds- bacterial diseases- bacterial blotch- viral diseases insect- sciarid flies, phorid flies, cecid files- mushroom mites- beetles nematodes.

UNIT V Economics (5 Periods)

Fixed assets, recurring expenditure, Labour, Economics of Cultivation throughout the year and seasonal growing formulation of Project report for getting finance from funding agencies). Precautions in mushroom cultivation. Mushroom recipes western and Indian recipes, Pickles, Powders, Jams

REFERENCES

1. Arvind kumar. Vermitechnology, Aph publishing Corporation, 2005.

2. Marimuthu. Oyster Mushrooms, Dept. of Plant pathology, TNAU, Coimbatore, 1991. 3. Mary violet Christy .A .Vermitechnology, Mjp publishers, 2008.

4. Nita Bahl. Hand book of Mushrooms, II edition, Vol. I & II, 1988.

5. Paul Stamets, J.S. and Chilton, J.S. Mushroom Cultivator: A practical guide to growing mushrooms at home, Agarikon Press, 2004.

6. Swaminathan M. Food and Nutrition, Bappco. The Bangalore Printing and Publishing Co. Ltd., Bangalore, 1990.

7. Tewari and Pankaj Kapoor S.C. Mushroom cultivation, Mittal Publications, Delhi, 1988.

Course Outcomes:

On the Successful completion of the course the student would be able to

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Differentiate edible and Poisonous mushrooms	K5
CO 2	Create an nutrient profile of mushroom	K4
CO 3	Examine cultivation system of mushroom	K5
CO 4	Formulation of mushroom food preparation	K6
CO 5	Determine health benefits of mushroom	K4

Mapping with Programme Outcomes:

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO 1	**M**	**M**	**M**	**M**	**S**
CO 2	**M**	**M**	**S**	**M**	**S**
CO 3	**M**	**M**	**M**	**S**	**M**
CO 4	**S**	**S**	**S**	**S**	**S**
CO 5	**S**	**S**	**M**	**S**	**S**

S- Strong, M- Medium, L- Low

CORE COURSE: IX
BACTERIOLOGY & MYCOLOGY

Semester :V	**MaxMarks:75**
Course Code :24UMB5C9	**Credit:***
Total Period : 75h	

Objectives
Understand the role of normal flora and pathogenic microbes of various diseases and clinical microbiological techniques.

UNIT I Classification of Medically important Microbes (Periods 15)

History, Classification of Medically Important Microbes, Koch's, and River's postulates- A brief account on the normal microbial flora of the healthy human body – Host-pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, endemic, epidemic, pandemic diseases and epidemiology – putative virulence factors of human pathogens –infectious disease cycle. Collection and transport of clinical specimens for bacterial and fungal infections.

UNIT II Medically important Gram Positive infection (Periods 15)

Medically important Gram Positive infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (b) Staphylococcal infections (*Staphylococcus aureus*), (c) Tetanus (*Clostridium tetani*)(d) Diphtheria (*Corynebacterium diphtheriae*) (e) Anthrax (*Bacillus anthracis*) (f) Tuberculosis (*Mycobacterium tuberculosis*), (g) Leprosy (*Mycobacterium leprae*).

UNIT III Medically important Gram-Negative infections (Periods 15)

Medically important Gram-Negative infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (a) Meningitis (*Streptococcus pneumoniae, Neisseria meningitidis*) (b) typhoid (*Salmonella typhi,*) (c) cholera (*Vibrio cholerae*) (d) bacillary dysentery (*Shigella dysenteriae*); Sexually Transmitted disease (*Treponema pallidum. Neisserigonorrhoeae*); Nosocomial infections – definition, importance, and their control (*Pseudomonas aeruginosa*).

UNIT IV Medically important Fungi (Periods 15)

Medically important Fungi - Classification of medically important fungi; Superficial mycoses: Pityriasis Versicolor; Tinea Nigra; Piedra. Cutaneous mycoses: *Microsporum* spps. ,*Trichophyton* spps., and *Epidermophyton floccosum*. Subcutaneous mycoses: Chromoblastomycosis; Sporotrichosis; Systemic Mycoses - Blastomycosis;

Histoplasmosis; Opportunistic Infections -Candidiasis; Cryptococcosis; Zygomycosis; Mycotoxins: Aflatoxin

UNIT V Antimicrobial Agents (Periods 15)

Antimicrobial agents -General characteristics and mode of action of Antibacterial agents: Modes of action with an example for each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin.

REFERENCES

1. Tom Parker, M. Leslie H. Collier. (1990). Topley&Wilson's Principles of Bacteriology, Virology and Immunity,8th Edition. London: Edward Arnold.
2. Greenwood, D., Slack, R.B. and Peutherer, J.F. (2012) Medical Microbiology, 18thEdition. Churchill Livingstone, London.
3. Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis.
4. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
5. Kevin Kavanagh, (2018). Fungi Biology and Applications 3rd Edition. Wiley Blackwell publishers.
6. C.J. Alexopoulos, C.W. Mims, M. Blackwell, (2007). Introductory Mycology, 4th edition. Wiley publishers.
7. Christopher C. Kibbler ,RichardBarton,Neil A. R. Gow, Susan Howell,Donna M. MacCallum, Rohini J. Manuel (2017). Oxford Textbook of Medical Mycology. Oxford University Press.

Web Resources

1. http://textbookofbacteriology.net/nd
2. https://microbiologysociety.org/members-outreach-resources/links.html
3. http://mycology.cornell.edu/fteach.html
4. https://www.adelaide.edu.au/mycology/

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Understand the importance of normal flora of human body and acquire knowledge on the process of infectious disease.	K1
CO2	Explain the various bacterial pathological events during the progression of an infectious disease, and apply the underlying mechanisms of spread of disease and its control.	K2
CO3	Compile a list of disease-causing bacteria and compare their modes of infection, symptoms, diagnosis and treatment.	K3
CO4	Comprehend human-fungal interaction, which can be applied to obtain in-depth knowledge on fungal diseases and the mechanism behind the disease process.	K4
CO5	Explain the types of mycoses caused in humans and categorize the modes of infection, pathogenesis, and treatment with introduction to mycotoxins.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong, M-Medium, L-Low

CORE COURSE: X

MOLECULAR BIOLOGY & MICROBIAL GENETICS

Semester :V **MaxMarks:75**

Course Code :24UMB5C10 **Credit:***

Total Period : 75h

Objectives

Explain the cause and types of DNA mutation and DNA repair mechanisms.

UNIT I Structure of DNA (Periods 15)

DNA Structure - Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA topology – Supercoiling, linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes. Replication of DNA in prokaryotes and eukaryotes - Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase, primase. DNA replication modes - rolling circle, D-loop modes.

UNIT II Transcription in Prokaryotes (Periods 15)

Concept of transcription. RNA Polymerases - prokaryotic and eukaryotic. General transcription factors in eukaryotes. Distinction between transcription processes in prokaryotes versus eukaryotes. Translation in prokaryotes and eukaryotes - Translational machinery - ribosome structure in prokaryotes and eukaryotes, tRNA structure and processing. Inhibitors of protein synthesis in prokaryotes and eukaryotes. Overview of regulation of gene expression - *lac*, *trp* and *ara* operons as examples. Regulation of gene expression by DNA methylation.

UNIT III Mutation (Periods 15)

Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair.

UNIT IV Plasmids (Periods 15)

Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Ti plasmid, linear

plasmids, yeast 2µ plasmid. Bacteriophage-T4, Virulent Phage – Structure and lifecycle. Lambda phage-Structure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics.

UNIT V Gene Transfer Mechanism

(Periods 15)

Gene Transfer Mechanisms- Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence and Transformation. Transposition and Types of Transposition reactions. Mechanism of transposition: Replicative and non- replicative transposition. Transposable elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Uses of transposons.

REFERENCES

1. Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. 4th Edition. Narosa Publishing House, New Delhi.
2. Gardner E. J. Simmons M. J. and SnustedD.P.(2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd.
3. Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
4. Russell P.J. (2010). I Genetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
5. Nelson, D.L. and Cox, M.M. Lehninger (2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
6. Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th Edition, ASM Press Washington-D.C. ASM Press.
7. Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing

Web Resources

1. [PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in
2. https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/
3. https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/
4. Molecular Biology Notes - Microbe Notes
5. Molecular Biology Lecture Notes & Study Materials | Easy Biology Class

Course Outcomes

CO Number	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Analyze the significance of DNA and elucidate the replication mechanism.	K1
CO 2	Illustrate the types of RNA and protein synthesis machinery.	K2
CO 3	Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.	K3
CO 4	Evaluate the importance of plasmids and phages in genetics.	K4
CO 5	Analyze gene transfer and recombination methods.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**M**	**M**	**S**	**S**
CO 2	**M**	**S**	**S**	**M**	**S**
CO 3	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**M**	**S**	**S**
CO 5	**S**	**S**	**S**	**M**	**S**

S- Strong, M- Medium, L- Low

CORE COURSE: XI

INDUSTRIAL MICROBIOLOGY

Semester :V **MaxMarks:75**

Course Code :24UMB5C11 **Credit:5***

Total Period : 75h

Objectives

To know the industrial importance of microorganisms about design of fermenters and its types.

UNITI: Screening and Strain Improvement I (Periods 15)

General concepts of industrial microbiology - Industrially important microorganisms - Primary and secondary screening and preservation of industrially important strains - Major classes of products and processes. Strain improvement.

UNIT II : Fermenter and its types (Periods 15)

Fermenter - Design and basic functions. Types of fermenters- Stirred tank, Packed bed Bioreactor, Fluidized bed reactors, Trickle flow reactors and Airlift bioreactors.

UNIT III : Media formulation and process (Periods 15)

Fermentation media - formulation strategies, Sources of carbon, nitrogen, vitamin and mineral, Oxygen requirements, role of buffers, precursors, inhibitors, inducers and antifoams. Sterilization of fermentation equipment, air and media. Types of Fermentation.

UNIT IV : Downstream processing (Periods 15)

Downstream processing- recovery and purification of fermentation products (intracellular and extracellular), cell disruption, precipitation, filtration, centrifugation, solvent recovery, chromatography, Ultrafiltration and drying, Immobilization of cell and enzymes.

UNIT V : Industrially important microbial products (Periods 15)

Microbiological production of alcohols – Ethanol, Glycerol, Alcoholic beverages – Wine, Beer, Antibiotics - Penicillin, Streptomycin, Vitamins - C, B_{12}, Organic acids – Citric acid, Lactic acid, Amino acids – Lysine, glutamic acid, Enzymes – Amylase, Protease. Recycling and disposal of industrial wastes.

REFERENCES

1. Patel, A.H. (2005). *Industrial Microbiology*. Laxmi Publications, New Delhi.

2. Maheswari, D.K., Dubey, R.C., & Kang, S.C. (2006). *Biotechnological applications of microorganisms – A Techno-Commercial Approach*. I.K. International Publishing House Pvt. Ltd., New Delhi.
3. Sivakumar, P.K., Joe, M.M., and Sukesh, K. (2010). *An introduction to Industrial Microbiology* (1st ed.). S. Chand and Company Ltd., New Delhi.
4. Stanbury, P.F., Whitaker. A., and Hall. S.J. (1999). *Principles of Fermentation Technology* (2nd ed.). Aditya Book (p) Ltd., New Delhi.
5. Casida, L.E. Jr. 1993. *Industrial Microbiology* (5th ed.). Wiley Eastern Ltd., New Delhi.
10. Prescott, L.M., Harley, J.P., and Helin D.A.2002. *Microbiology* (5th ed.). McGraw Hill, New Delhi.

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Screen, isolate and improve the beneficial microorganisms from the environment for improved yield.	K1
CO2	Understand the fermenter and its types.	K2
CO3	Gain knowledge on Media formulation	K3
CO4	Understand the downstream and purification processes.	K4
CO5	Describe the production of commercially important microbial products	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong, M-Medium, L-Low

CORE COURSE: XII

PRACTICAL –V BACTERIOLOGY &MYCOLOGY, MOLECULAR BIOLOGY & MICROBIAL GENETICS, INDUSTRIAL MICROBIOLOGY

Semester :V **MaxMarks:60**

Course Code :24UMB5C12P **Credit:4***

Total Period : 75h

Objectives

To familiarize students with medical microbiology techniques and technical knowledge on collection and processing of clinical samples.

1. Collection and Transport of Clinical specimens**.** **(Periods 6)**
2. Simple, Differential and Special staining of Clinical materials. **(Periods 6)**
3. Culture techniques used to isolate microorganisms. **(Periods 6)**
4. Identification of bacterial pathogens by their biochemical reactions. **(Periods 6)**
5. Antimicrobial susceptibility testing by disc-diffusion technique and determination of Minimum Inhibitory Concentration. **(Periods 6)**
6. Isolation of Genomic and Plasmid DNA from *E. coli* and Analysis by Agarose gel electrophoresis **(Periods 6)**
7. Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – Demonstration **(Periods 6)**
8. UV induced auxotrophic mutant production and isolation of mutants by replica plating technique **(Periods 6)**
9. Isolation of antibiotic resistant mutants by gradient plate method **(Periods 6)**
10. Screening and isolation of phages from sewage. Perform RNA isolation. **(Periods 6)**

REFERENCES

1. Dubey, R.C. and Maheswari, D.K. (2020). S. Chand Publishers. ISBN-13: 978-8121921534, ISBN-10: 8121921538.
2. K.R. Aneja (2017). Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology. 5th Edition. New Age International Publishers. ISBN-10: 9386418304, ISBN-13: 978-9386418302.
3. Prince CP (2009). Practical Manual of Medical Microbiology, Ist edition, Jaypeedigital publishing.
4. Patricia M. Tille (2021). Bailey & Scott's Diagnostic Microbiology, 15th Edition. Elsevier. ISBN-10: 0323681050, ISBN-13: 978-0323681056.

5. Monica Cheesbrough (2006). District Laboratory Practice in Tropical Countries. Part 1. 2nd Edition. Cambridge University Press. ISBN-10: 0521171571, ISBN-13: 978-0521171571.
6. Michael A. Pfaller (ed.) (2015). Manual of Clinical Microbiology. Vol. 1 and 2. 11th Edition. ASM Press. ISBN-10: 9781555817374, ISBN-13: 978-1555817374.
7. Rowland, S.S., Walsh, S.R., Teel, L.D. and Carnahan, A.M. ((1994). Pathogenic and Clinical Microbiology: A Laboratory Manual. Lippincott Williams & Wilkins. ISBN-10: 0316760498, ISBN-13: 9780316760492.

Web Resources

1. https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf
2. http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf
3. https://www.academia.edu/11977315/Basic_Laboratory_Procedures_in_Clinical_Bacterioloy
4. https://cmr.asm.org/content/31/3/e00062-17.full.pdf
5. https://www.molbiotools.com/usefullinks.html
6. (PDF) Molecular Biology Laboratory manual (researchgate.net)
7. https://www.molbiotools.com/usefullinks.html
8. https://geneticgenie.org3.
9. https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Demonstrate methods to observe and measure microorganisms by standard microbiological techniques	K1
CO2	Identify pathogenic microorganisms in the laboratory set-up and interpret their sensitivity towards commonly administered antibiotics.	K2
CO3	Understand experimental tools used to cultivate and characterize clinically important viruses and bacteriophages	K3
CO4	Elucidate clinically important fungi.	K4
CO5	Investigate Parasites of medical importance and identify them from clinical specimens.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**M**	**S**	**S**

CO5	**S**	**S**	**S**	**M**	**S**

S-Strong,M-Medium,L-Low

MAJOR BASED ELECTIVE:I
BIOSAFETY&BIOETHICS

Semester :V **MaxMarks:75**

Course Code :24UMB5MBE1A **Credit:3***

Total Period : 75h

Objectives

To create a research environment - encourage investigation, analysis and studying the bioethical principles, values, concepts, and social and juridical implications contained in the Universal Declaration on Bioethics and Human

UNIT I Basics of Biosafety (Periods 15)

Basics of Biosafety - Laboratory Hazards and Hazard symbols. Definitions on Biohazard, Biosafety and Biosecurity- Biohazard- LAI, BP. Biohazard Classification. Biological Risk Groups. Need and application of biosafety. Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP).

UNIT II Hazardous materials in Biotechnology (Periods 15)

Hazardous materials in Biotechnology - Categories of Waste in the Biotechnology Laboratories, Biohazardous waste and their disposal and treatments- issues in use of GMO's, risk for animal/human/ agriculture and environment owing to GMO. Hazardous materials, Emergency response/ first aids in Laboratories.

UNIT III Biological Safety (Periods 15)

Biological Safety Containment in Laboratory - Primary and secondary containments - Physical and biological containment. Types of biosafety containments (level I, II, III), PPE, Biosafety guidelines in India - Roles of Institutional Biosafety Committee, RCGM, GEAC.

UNIT IV Bioethics (Periods 15)

Introduction and need of Bioethics - its relationship with other branches, Ethical implications of biotechnological products and techniques. Ethical Issues involving human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, Social and ethical implications of biological weapons.

UNIT V Patent laws (Periods 15)

IPR, Patents and Patent laws - Intellectual property rights-TRIP- GATT International conventions patents, Methods of application of patents, Legal implications. Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions, and patent law. Legal

development-Patentable subjects and protection in biotechnology. The patenting of living organisms.

REFERENCES

1. Usharani .B, S Anbazhagi, C K Vidya, (2019). Biosafety in Microbiological Laboratories- 1st Edition, Notion Press, ISBN-101645878856
2. Satheesh.M.K.,(2009). Bioethics and Biosafety- 1st Edition, J. K International Publishing House Pvt. Ltd: Delhi, ISBN :9788190675703
3. DeepaGoel and ShominiParashar, (2013). IPR, Biosaftey and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700
4. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited, ISBN-10: 9386668572
5. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited, ISBN : 9788120349896
6. Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis, ISBN-10: 8131251659.
7. Edited by Sylvia Uzochukwu, Nwadiuto (Diuto) Esiobu, Arinze Stanley Okoli, Emeka Godfrey Nwoba, EzebuiroNwagboChristpeace, Charles OluwaseunAdetunji, Abdulrazak B. Ibrahim, Benjamin EwaUbi (2022). Biosafety and Bioethics in Biotechnology-Policy, Advocacy, and Capacity Building,1st edition. CRC Press
8. Sree Krishna. V (2007). Bioethics and Biosafety in Biotechnology. New age international publishers.

Web Resources

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf.
2. World Intellectual Property Organisation. (2004). WIPO Intellectual propertyHandbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf.
3. https://www..niehs.nih.gov/bioethics
4. https://www.sist.sathyabama.ac.in
5. https://www.longdom.org/bioethics-and-biosafety

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Understand the control measures of laboratory hazards (chemical, biological and physical) and to practice safety strategies and personal protective equipment	K1
CO2	Develop stratagems for the use of genetically modified organisms and Hazardous materials	K2
CO3	Develop skills of critical ethical analysis of contemporary moral problems in medicine and health care.	K3
CO4	Analyze and respond to the comments of other students regarding philosophical issues.	K4
CO5	Pave the way for the students to catch up Intellectual Property(IP) as a career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong, M-Medium, L-Low

MAJOR BASED ELECTIVE:I
MICROBIAL QUALITY CONTROL AND TESTING

Semester :V **MaxMarks:75**

Course Code :24UMB5MBE1B **Credit:3***

Total Period : 75h

Objectives

To understand the use of various advanced techniques for application in the field of quality control and quality assurance.

UNIT I Microbial quality control (Periods 15)

Microbial quality control: definition, history and introduction. Standard Methods involved in assessment of microbial quality control. Q.A and Q.C definitions and importance. Traditional Microbiological Quality Controlling methods: Sampling methods, TVC, APC and serial dilution techniques. Good laboratory practices, Good microbiological practices.

UNIT II Instruments association (Periods 15)

Instruments associated in QC & QA**:** Principle involved, working conditions, uses and precautions of Laminar Air Flow (LAF), Autoclave, Incubator, pH meter, Colony counter, Hot air oven, Centrifuges, colorimeter/ spectrophotometer, ELISA and storage devices. Methodology of Disinfection, Autoclaving & Incineration.

UNIT III Culture media (Periods 15)

Culture media used in QC and QA**:** Design of specialized media for identification of pathogens. Good laboratory practices in culture media preparation: raw material, water, pH. Uses of media. Enrichment culture technique, Detection of specific microorganisms - on XLD agar, *Salmonella Shigella* Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Agar.

UNIT IV Microbes in Pharmaceutical Samples (Periods 15)

Determining Microbes in Pharmaceutical Samples**:** Sterility testing for pharmaceutical products, Bioburden, pyrogen test, inprocess and final process control, safety and sterility test.

UNIT V Microbial Standards (Periods 15)

HACCP for Food Safety and Microbial Standards: Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centers.

REFERENCES

1. W.B.Hugo & A.D.Russell. (1998). Pharmaceutical Microbiology.6thEdition. Blackwell scientific Publications.
2. Kulkarni A. K. Bewoor V. A. ()Quality Control, Wiley India Pvt. Ltd,
3. ChandrakantKokare (2016). Pharmaceutical Microbiology, 1st Edition, Nirali Publication.
4. Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyer. (2000). Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices. 1st Edition, CRC Press
5. Konieczka, (2012). Quality Assurance and Quality Control in the Analytical Chemical Laboratory A Practical Approach (Hb), Routledge, Taylor and Francis group.
6. Singh Gajjar, Budhrani, Usman. (2021). Quality Control And Quality Assurance (M.Pharm)SVikas And Company.
7. Amihud Kramer Bernard A. Twigg(2017). Quality Control For The Food Industry Fundamentals & Applications (Vol.1) 3rd Edition, MEDTEC publication.

MAJOR BASED ELECTIVE: I
ENTREPRENEURSHIP AND BIO-BUSINESS

Semester :V	**MaxMarks:75**
Course Code :24UMB5MBE1C	**Credit:3***
Total Period : 75h	

Objectives

Understanding basic concepts in the area of entrepreneurship, the role and importance of entrepreneurship for economic development

UNIT I Entrepreneurship (Periods 15)

Bio Entrepreneurship: Introduction to bio-business, SWOT analysis of bio-business. Ownership, Development of Entrepreneurship; Stages in entrepreneurial process; Government schemes and funding. Small scale industries: Definition; Characteristics; Need and rationale.

UNIT II Agricultural Biotechnology (Periods 15)

Entrepreneurship Opportunity in Agricultural Biotechnology: Business opportunity, Essential requirement, marketing, strategies, schemes, challenges and scope-with case study on Plant cell and tissue culture technique, polyhouse culture. Herbal bulk drug production, Nutraceuticals, value added herbal products. Bioethanol production using Agricultural waste, Algal source. Integration of system biology for agricultural applications. Biosensor development in Agriculture management.

UNIT III Industrial Biotechnology (Periods 15)

Entrepreneurship Opportunity in Industrial Biotechnology**:** Business opportunity, Essential requirement, marketing strategies, schemes, challenges, and scope- Pollution monitoring and Bioremediation for Industrial pollutants. Integrated compost production- microbe enriched compost. Bio pesticide/ insecticide production. Biofertilizer. Single cell protein.

UNIT IV Fermented products (Periods 15)

Therapeutic and Fermented products: Stem cell production, stem cell bank, production of monoclonal/polyclonal antibodies, secondary metabolite production – antibiotics, probiotic and prebiotics.

UNIT V Management and Startup Schemes (Periods 15)

Project Management, Technology Management and Startup Schemes: Building Biotech business challenges in Indian context-biotech partners (BIRAC, DBT, Incubation centers. etc.,), operational biotech parks in India. Indian Company act for Bio business-schemes and subsidies. Project proposal preparation, Successful start-ups-case study.

REFERENCES

1. Craig Shimasaki. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press.
2. Ashton Acton, O. (2012). Biological Pigments– Advances in Research and Application Scholorly Editions: Atlanta, Georgia.
3. Jennifer Merritt, Jason Feifer (2018). Start Your Own Business, 7th edition, Entrepreneur Press publisher.
4. Crueger, W, and Crueger. A.(2000). Biotechnology: A Text Book of Industrialmicrobiology, 2nd Edition, Sinauer Associates: Sunderland.Mass.
5. Paul S Teng. (2008). Bioscience Entrepreneurship in AsiaWorld Scientific Publishing Company.
6. Yali Friedman (2014). Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science 4th Edition, Logos press publication.
7. Stephanie A. Wisner (2022). Building Backwards to Biotech: The Power of Entrepreneurship to Drive Cutting-Edge Science to Market, International Kindle paperwhite.

Web Resources

1. https://www.bio-rad.com/webroot/web/pdf/lse/literature/Biobusiness.pdf
2. https://www.crg.eu/biobusiness-entrepreneurship
3. https://www.entrepreneur.com
4. https://www.birac.nic.in
5. https://www.springer.com

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Describe and apply several entrepreneurial ideas and business theories in practical framework.	K1
CO2	Analyse the business environment in order to identify business opportunities, identify the elements of success of entrepreneurial ventures, evaluate the effectiveness of different entrepreneurial strategies and interpret their own business plan.	K2
CO3	Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides in response with field application and crop response.	K3
CO4	Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits.	K4
CO5	Integrate and apply knowledge of the regulation of biotechnology industries, utilize effective team work skills within an effective management team with a common objective, and gain effective team work skills, with an awareness of cultural diversity and social inclusiveness.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong,M-Medium,

SKILL BASED ELECTIVE:I

SERICULTURE

Semester :V **MaxMarks:75**

Course Code :24UMB5SBE1A **Credit:2***

Total Period : 24h

Objectives

Acquire knowledge on the concepts of origin, growth and study of Sericulture as science and scientific approach of mulberry plant

UNIT I Introduction to Sericulture (Periods 5)

General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.

UNIT II Silkworm (Periods 5)

Silkworm- biology-morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth.

UNIT III Silkworm pathology (Periods 5)

Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.

UNIT IV Rearing of silkworm (Periods 5)

Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.

UNIT V Sericulture (Periods 4)

Entrepreneurship and rural development in sericulture: Planning for EDP, Project formulation, Marketing, Insectary facilities and Equipment: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.

REFERENCES

1. VijayaKhader (2000) Food, nutrition & health, Kalyan Publishers, New Delhi
2. Srilakshmi, B., (2010) Food Science, (5th Edition) New Age International Ltd., New Delhi
3. Arvind Kumar Goel (2005). A College Textbook of Health & Hygiene,ABD Publishers
4. Sharma D. (2015).Textbook on Food Science and Human Nutrition.Daya Publishing House.
5. Revilla M. K. F., Titchenal A. and Draper J. (2020). Human Nutrition. University of Hawaii, Mānoa
6. Bamji, M.S., K. Krishnaswamy& G.N.V. Brahmam (2009) Textbook of Human Nutrition(3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

Web Resources

1. https://egyankosh.ac.in › bitstream
2. https://archive.org › details › SericultureHandbook
3. https://www.academic.oup.com
4. https://www.sericulture.karnataka.gov.in
5. https://www.silks.csb.gov.in

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant.Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions.	K1
CO2	Familiarize with the lifecycle of silk worm.	K2
CO3	Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	K3
CO4	Attain thorough knowledge about the cultivation of mulberry,	K4

	maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products.	
CO5	Plan the facilities required for establishment of insectary. Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong, M-Medium,

SKILL BASED ELECTIVE: I
NUTRITION &HEALTH HYGINE

Semester :V	**MaxMarks:75**
Course Code :24UMB5SBE1B	**Credit:2***
Total Period : 24h	

Objectives

Learn about nutrition and their importance, Make student understand the nutritional facts fora better life.

UNIT I Nutrition (Periods 5)

Nutrition – definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins –functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water– functions, sources, requirements and effects of deficiency

UNIT II Nutrition for Life Cycle **(Periods 5)**

Nutrition for Life Cycle: Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods

UNIT III Improper diets (Periods 5)

Improper diets: Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder
- hypertension, diabetes, anemia, osteomalacia, cardiovascular disease.

UNIT IV Health-Education (Periods 5)

Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.

UNIT V Hygiene **(Periods 4)**

Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places

R**EFERENCES**

1. Bamji, M.S., K. Krishnaswamy& G.N.V. Brahmam (2009) Textbook of Human Nutrition(3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2. Swaminathan (1995)Food &Nutrition(Vol I, Second Edition) The Bangalore Printing &Publishing Co Ltd., , Bangalore
3. VijayaKhader (2000)Food, nutrition & health, Kalyan Publishers, New Delhi
4. Srilakshmi, B., (2010)Food Science, (5^{th} Edition) New Age International Ltd., New Delhi
5. Arvind Kumar Goel (2005). A College Textbook of Health &Hygiene,ABD Publishers
6. Sharma D. (2015).Textbook on Food Science and Human Nutrition.Daya Publishing House.

Web Resources

1. National Rural Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49
2. National Urban Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137
3. Village health sanitation & Nutritional committee https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225
4. Health Impact Assessment - https://www.who.int/hia/about/faq/en/
5. Healthy Living https://www.nhp.gov.in/healthylivingViewall

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant.Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions.	K1
CO2	Familiarize with the lifecycle of silk worm.	K2
CO3	Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	K3
CO4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products.	K4
CO5	Plan the facilities required for establishment of insectary. Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**

S-Strong, M-Medium, L- Low

SKILL BASED ELECTIVE: I
ORGANIC FARMING &BIO FERTILIZER TECHNOLOGY

Semester :V **MaxMarks:75**

Course Code :24UMB5SBE1C **Credit:2***

Total Period : 24h

Objectives

Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment.

UNIT I Organic farming (Periods 5)

Principle of organic farming: principles of health, fairness, ecological balance, and care. Environmental benefits of organic farming: sustainability- reduces non-renewable energy by decreasing agrochemical need. Biodiversity-crop rotation, inter-cropping. Ecological services – biological control, soil formation and nutrient cycling.

UNIT II Organic Garden (Periods 5)

Organic farming for urban space; Create a Sustainable Organic Garden (Backyard- Square Foot Gardening, Small Space Gardening, Mini Farming) Composting, Vermicomposting

UNIT III Biofertilizer (Periods 5)

Biofertilizers: Introduction, advantages and future perspective. Structure and characteristic features of bacterial biofertilizers- *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium* and *Frankia*

UNIT IV Cyanobacteria biofertilizers (Periods 5)

Structure and characteristic features of Cyanobacterial biofertilizers- *Anabaena, Nostoc ;*Structure and characteristic features of fungal biofertilizers- AM mycorrhiza

UNIT V Biofertilizers **(Periods 4)**

Production of *Rhizobium, Azotobacter, Anabena*; Biofertilizers -Storage, shelf life, quality control and marketing.

REFERENCES

1. A.C.Gaur (2017). Hand book of Organic Farming and Biofertilizers
2. A.K. Sharma (2006). Hand book of Organic Farming
3. N.S. Subbarao (2017). Bio-fertilizers in Agriculture and Forestry (4th Edition) Med tech publisher
4. SubbaRao, N. S. (2002). Soil Microbiology. Soil Microorganisms and Plant Growth. (4th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Singh and Purohit (2008). Biofertilizer technology. Agrobios, India.
6. Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One-Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics.
7. Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.

Web Resources

1. https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
2. **https://www.fao.org/organicag/oa-faq/oa-faq6/en**
3. https://www.india.gov.in/topics/agriculture/organic-farming
4. https://agriculture.nagaland.gov.in/bio-fertilizer/
5. https://vlab.amrita.edu/index.php?sub=3&brch=272

Course Outcomes

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Become an Entrepreneur with wide knowledge about farming and sustainable resources.	K1
CO2	Implement organic farming in urban areas with knowledge on compost.	K2
CO3	Gain knowledge about the bacterial biofertilizers and its advantages	K3
CO4	Understand the significance about Cyanobacterial and fungal biofertilizers	K4
CO5	Understand and implement the use of bio fertilizers.	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	M	S	S	M	S
CO3	S	S	S	M	S
CO4	S	S	M	S	S
CO5	S	S	S	M	S

S-Strong, M-Medium, L-Low

CORE COURSE : XIII

ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Semester : VI **Max Marks : 75**

Course Code : 24UMB6C13 **Credit : 5***

Total Period : 75

Objectives

To discuss the distribution and association of microorganism in various ecosystems and to know about the role of microorganism in water pollution and water quality.

UNIT I Microorganisms and their Habitats (Periods 15)

Microorganisms and their Habitats: Structure and function of ecosystems Terrestrial Environment: Soil profile and soil micro flora, Microbial succession in decomposition of soil organic matter. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen. Aquatic Environment: Micro flora of fresh water and marine habitats, factors influencing microbial growth in the aquatic environments.

UNIT II Water portability: (Periods 15)

Water portability: Sources and types of water surface, ground, stored, distilled, mineral and de-mineralized water and their pollution, biological indicators of water Pollution, Eutrophication. Conventional Bacteriological standards of Water Quality, MPN index, coliform test, Membrane filtration. BOD, COD. Advanced molecular methods for water analysis. Water borne diseases. Central Pollution Control Board (CPCB) standards**.**

UNIT III Microbial Interactions: (Periods 15)

Microbial Interactions: Rhizosphere micro flora. Concepts of Nitrogen fixation – Symbiotic and a symbiotic nitrogen fixers. Brief account of microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation. General account and Significance of Biofertilizer and biocontrol agents – Bacterial, cyanobacterial, VAM. Mass production of Rhizobial biofertilizer. Biocontrol agents – Bacterial, viral, fungal.

UNIT IV Waste treatment and bioremediation: (Periods 15)

Waste treatment and bioremediation**:** Solid waste management: Sources and types of solid waste, composting, vermin composting, production of biogas. Liquid waste management: Primary, secondary, and tertiary sewage treatment. Bioremediation and waste management: Need and scope of bioremediation. Degradation of hydrocarbons, oil spills, heavy metals – Chromium, lead, and xenobiotics – PCB.

UNIT V Plant pathology: (Periods 15)

Plant pathology: Mode of entry of pathogens, Microbial enzymes, toxins, growth regulators and suppressor of plant defense in plant diseases. Plant defense mechanisms. Bacterial diseases – Citrus canker, Blight of paddy. Viral disease – TMV, CMV. Fungal disease- red rot of sugarcane, Tikka disease. Plant disease management.

References Books

1.Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. Bright Sun Publications.

2.Pradipta. K.M. (2008). Textbook of Environmental Microbiology. I.K.Publishing. House.

3.Ramanathan, and Muthukaruppan SM. (2005). Environmental Microbiology.OmSakthiPathipagam, Annamalai Nagar.

4.Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.

5.EcEldowney S, Hardman D.J., Waite D.J., Waite S.(1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.

6.Mitchel, R.(1992). Environmental Microbiology. Wiley –John Wiley and Sons. Inc. Publications, New York.

7.Clescri, L.S., Greenberg, A.E. and Eaton, A.D.(1998). Standard Methods for Examination of Water and Wastewater, 20thEdition. American Public Health Association.

Web Resources

1. https://nptel.ac.in/courses/126105016
2. https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236
3. https://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm
4. https://plantpath.cornell.edu/labs/enelson/PDFs/Hill_et_al_2000.pdf
5. https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2389.2005.00781.x

Course Outcomes:

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Describe about the structure and function of ecosystems and understand the role of microbes in various environments	K5
CO2	Identify the cause of water pollution, and perform methods to assess the quality of water.	K4
CO3	Explain the production of biofertilizers and bio pesticides.	K5
CO4	Explain about waste treatment process and microbial decomposition and bio-remediation process.	K6
CO5	Describe about plant diseases caused by microbes and acquire a clear idea on plant pathogenic interaction	K4

Mapping with Programme Outcomes:

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**S**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

CORE COURSE : XIV

FOOD, DAIRY AND PROBIOTIC MICROBIOLOGY

Semester : VI **Max Marks : 75**

Course Code : 24UMB6C14 **Credit : 5***

Total Period :75h

Objectives

To impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety.

UNIT I Food as a substrate for microorganisms (Periods 15)

Food as a substrate for microorganisms-.Microorganisms important in food microbiology; Molds, yeasts and bacteria -General Characteristics - Classification and importance. Principles of food preservation - Asepsis - Removal of microorganisms, - High temperature - Low temperature - Drying - Food additives. Nano science in food preservation; microencapsulation.

UNIT II Contamination and spoilage of food products (Periods 15)

Contamination and spoilage of food products -Food borne infections (*Bacillus cereus,* ,*Salmonellosis, Shigellosis,* ,*Listeria monocytogenes* and *Campylobacter jejuni*) and intoxications – (*Staphylococcus aureus, Clostridium botulinum* ,*Clostridium perfringens* and mycotoxins) Food borne disease outbreaks - newly emerging pathogens. Conventional and Novel technology in control of food borne pathogens and preventive measures - Food sanitation - plant sanitation - Employees' health standards. Regulatory Agencies &criteria for food safety.

UNIT III Micro flora of raw milk (Periods 15)

Micro flora of raw milk - sources of contamination. Spoilage and preservation of milk and milk products. -antimicrobial systems in raw milk. Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies.

UNIT IV Food fermentations (Periods 15)

Food fermentations: Indian Pickles Bread, vinegar, fermented vegetables (sauerkraut), fermented dairy products (yoghurt, cheese, Acidophilus Milk, Kefir, Koumiss). Oriental fermented foods- Miso –Tempeh Ontjom. Natto, Idli Spoilage and defects of fermented dairy products -. Functional fermented foods and nutraceuticals, bioactive proteins and bioactive peptides, genetically modified foods.

UNIT V Probiotic microorganisms (Periods 15)

Probiotic microorganisms, concept, definition safety of probiotic microorganisms, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic microorganisms. Role of probiotics in health and disease: Mechanism of probiotics. Application of bacteriocins in foods. Food fermentations Bio preservation. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut micro flora - Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods.

References Books

1. Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology. 7th Edition CBS Publishers and Distributors, Delhi, India.

2.Prescott, Harley and Klein Wim.(2008). Microbiology, 7th Edition McGraw Hill Publications.

3.Robinson, R. K.(2002). Dairy Microbiology Handbook - The Microbiology of Milk and Milk Products (Third Edition), A John Wiley & Sons, Inc., New York.

4.Yuankunlee,Sepposalminen. (2008). Handbook of probiotics and prebiotics Second Edition. A John Wiley & Sons publication Inc.

5.DharumauraiDhansekaran, Alwarappan Sankaranarayanan. (2021). Advances in Probiotics Microorganisms in Food and Health 1st Edition. eBook ISBN:9780128230916.

WEB RESOURCES

1.https://www.researchgate.net/publication/15326559_A_Dynamic_Approach_to_Predicting_BacterialGrowth_in_Food/link/5a1d2e02aca2726120 b28eba/download

2.https://www.fda.gov/food/laboratory-methods-food/bam-foodsamplingpreparation-sample-homogenate

3.https://www.researchgate.net/publication/243462186_Foodborne_diseases_in_India_-_A_review

3.https://www.researchgate.net/publication/228662659_Fermented_Dairy_Products_Starter_Cultures_and_Potential_Nutritional_Benefits/link/000084160cf23f86393d5764/ download

4.https://www.fda.gov/food

Course Outcomes:

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Gain knowledge about food as a substrate for various microbes, Understand about the principles and application of different types of food spoilage and preservation technique,	K5
CO2	Acquire a thorough understanding of food borne diseases, testing methods, and preventive technique	K4
CO3	Gain information about spoilage of milk and its products and its antimicrobial properties	K5
CO4	Learn about the various fermented product and its various stage spoilage	K6
CO5	Impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits	K4

Mapping with Programme Outcomes

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**S**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

CORE COURSE -XV

PRACTICAL–VI ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY, FOOD, DAIRY & PROBIOTIC MICROBIOLOGY

Semester : VI **Max Marks : 75**

Course Code : 24UMB6C15P **Credit : 4***

Total Period :75h

Objectives

To investigate various extracellular enzyme producers in soil and to gain knowledge on preparation of bio fertilizers

1. Physical, chemical, and microbiological assessment of water and potability test **(Periods 8)**
2. Study of air micro flora by settle plate method. **(Periods 7)**
3. Isolation and identification of bacteria and fungi from fruits and vegetables **(Periods7)**
4. Direct microscopic count of milk. **(Periods 8)**
5. Methylene blue reductase test and Resazurin test **(Periods 7)**
6. Microbiological examination of milk by SPC. **(Periods 8)**
7. Isolation of extracellular enzyme producers –Amylase, protease, lipase **(Periods 7)**
8. Microbiological assay of antibiotics by cup plate method and other methods **(Periods 8)**
9. Isolation of *Rhizobium*/ *Azotobacter*/ phosphate solubilizing organisms **(Periods 7)**
10. Preparation of biofertilizers – Demonstration **(Periods 8)**

REFERENCES

1. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th Edition. Pearson Education Limited.

2. Kannan. N. (1996). Laboratory manual in General Microbiology. Palani Publications.

3. R C Dubey and D K Maheswari. (2002). Practical Microbiology. S. Chand Publishing.

4. Neelima Garg, K.L. Garg, K.G. Mukerji (2010). Laboratory Manual of Food Microbiology,

Wiley publication

5. Christon J. Hurst Editor in Chief, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, Linda D. Stetzenbach (2007). Manual of Environmental Microbiology, Third Edition, Wiley publication.

6. James G Cappucino and Natalie Sherman. (2016). Microbiology – A laboratory manual. 4thEdition. The Benjamin publishing company, New York.

7. Marylynn V. Yates, Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai 2016). Manual of Environmental Microbiology, 4th Edition, ASM press.

8. Burns, Richard G (2005). Environmental Microbiology A Laboratory Manual, 2nd Edition .Lippincott Williams & Wilkins, Inc

Web Resources

1.https://micobenotes.com/fields-of-microbiology/

2.https://bio.libretexts.org

3.https://www.google.com

4.https://www.sfamjournals.onlinelibrary.wiley.com

5.https://www.degruyter.com

Course Outcomes:

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Assess the microbial quality of water and relate the experimental results to the prescribed standards by the statutory bodies	K5
CO2	Evaluate the quality of milk and enumerate bacteria in milk by standard plate count method	K4
CO3	Identify extracellular enzyme producing and nitrogen fixing microorganism form soil and to prepare a biofertilizer.	K5
CO4	Identify various plant pathogenic bacteria	K6
CO5	Synthesize probiotic fermented milks using microorganisms	K4

Mapping with Programme Outcomes

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**S**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

MAJOR BASED ELECTIVE: II

MARINE MICROBIOLOGY

Semester : VI **Max Marks : 75**

Course Code : 24UMB6MBE2A **Credit : 4**

Total Period :75h

Objectives

Understand Microbial Diversity and significance

UNIT I Marine Biology (Periods 12)

Introduction to marine biology, General classification and taxonomy of marine microorganisms. Distribution of microorganisms in the marine habitats. Role of microbes in nutrient cycling in the Ocean. Microbes of extreme environment -Hydrothermal vents, polar regions and Deep Sea.

UNIT II Characteristics of Marine Microorganisms (Periods 12)

Methods of studying microorganisms-sample collection -isolation and identification: Cultural, morphological, physiological, chemical and molecular characteristics-Preservation methods of marine microbes. Role of microorganisms in carbon, nitrogen, phosphorus and sulphur cycles in the sea under different environments and Mangroves.

UNIT III Marine Planktons (Periods 12)

Environmental factors affecting life in the oceans-Salinity, temperature, light, currents, waves, tides, oxygen and carbon di oxide. Vertical migration of zooplankton, phytoplankton-plankton and fisheries.

UNIT IV Sea Foods (Periods 12)

Pathogenic microorganisms, distribution, indicator organisms, prevention and control of water pollution, quality standards. Microbiology of shellfish products. Rapid diagnosis of contamination in sea foods and aquaculture products.

UNIT V Marine Microbial Products (Periods 12)

Marine microbial products-agar-agar, weed fertilizers-Astaxanthin, Beta carotene -enzyme – antibiotics - antitumor agents - polysaccharides – bio surfactants and pigments. Preservation method of sea foods. Quality control and regulations for Microbial quality of fishes, shellfish. Marine living resources used for food and drugs.

REFERENCES

1. Belkin.s .,&Colwell RR., Ocean and Health: Pathogens in the Marine Environment, Springer .2005.
2. Bhakuni DS& Rawat DS. Bioactive marine natural products. Anamaya publishers, New Delhi,2005.
3. Elay AR. Microbial food poisoning . Chapman and Hall, London.1992.
4. Hunter-Cevera J.,Karl D & Buckley M.Marine Microbial Diversity : the key to earth's habitability, American Academy of Microbiology.2005.
5. Munn C. Marine Microbiology: Ecology and applications, Garland science, Taylor and Francis group,NY.2011.
6. Scheper T.Advances in biochemical Engineering / Biotechnology- Marine Biotechnology I/.Springer 2005.

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Understanding the role of microorganisms in the Ocean.	K5
CO2	Obtain knowledge about marine microbial products.	K4
CO3	Gain knowledge about the cultivation of marine microorganisms	K5
CO4	Obtain knowledge about seafoods and their contamination by microorganisms.	K6
CO5	Obtain knowledge about marine microbial products.	K4

Mapping with Programme Outcomes

Cos/Pos	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**S**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

MAJOR BASED ELECTIVE: II

MICROBIAL BIOTECHNOLOGY AND BIOETHICS

Semester : VI **Max Marks : 75**

Course Code : 24UMB6MBE2B **Credit : 4***

Total Period : 75h

Objectives

To introduce the role of micro-organisms in biotechnology.

UNIT – I Microbial Production of Therapeutic Agents and Vaccines (Periods 15)

Biotechnology: Definition – Milestones in History - Scope of microbial biotechnology and its applications - Microbial production of pharmaceuticals – antibiotics, hormones (insulin), enzymes (streptokinase), recombinant vaccines (Hepatitis B vaccine) - Edible vaccine, Monoclonal antibodies

UNIT - II Production of Biofertilizer, Biopesticides , Bioplastics (Periods 15)

Microbial production of biofertilizers – (Rhizobia, Azospirillum, Frankia and VAM). Microbial production of bio-pesticides (*Bacillus thuriengiensis*). Microbial production of bioplastics. Microorganisms in bioremediation: Degradation of xenobiotics.

UNIT – III Algal Biotechnology (Periods 15)

Single cell protein (algae and yeast). Microalgal technology – Industrial cultivation methods of Spirulina – biotechnological potentials of Spirulina as: food and feed – fuel production from microalgae – pharmaceutically valuable compounds from microalgae. Commercial production of bio-ethanol and bio-diesel using lignocellulosic waste.

UNIT – IV Genetic Engineering of Plant ts and Animals (Periods 15)

Genetic engineering of plants: Ti plasmid vectors and gene transfer in plants – Development of insect, virus and herbicide resistant plants. Transgenic animals: methods of creating transgenic mice and sheep. Human gene therapy – in vivo and ex vivo gene therapy.

UNIT – V IPR and Bioethics (Periods 15)

Intellectual Property Rights (IPR) - different types of IPRs - Principles of Bioethics (IB) - Definition of Ethics and Bioethics. - Ethics committee - Brief account on risks and ethics of modern biotechnology - Ethical concerns in human gene therapy - Ethical limits of animal use.

Ethical issues at the beginning of life (abortion) – Ethical issues at the end of life (with holding and with drawing medical treatment and euthanasia)

REFERENCES:

1. Desmond, S.T Nicholl. 2002. An Introduction to Genetic Engineering, 2nd edition, Cambridge university press.

2. Das, H.K. 2017.Textbook of Biotechnology,5th edition, Wiley Press.

3. Sivaji Mathivanan. 2020. Advances in Microbial Biotechnology, LAP Lambert Academic Publishing.

4. Chawla, H.S. 2020. Introduction to Plant Biotechnology, 3rd edition, Oxford &IBH Publishing.

5. Glick, B.R., Pasternak, J.J., Patten, C.L. 2010. Molecular Biotechnology 4th edition, ASM Press.

6. Mukesh Pasupuleti. 2006. Molecular Biotechnology. MJP Publishers, Chennai.

7. Ratledge C., Kristiansen, B. 2001. Basic Biotechnology, 2nd edition, Cambridge University Press.

8. Willey, J.M., Sherwood, L.M., Woolverton, C.J. 2014. Prescott, Harley and Klein's Microbiology, 9th edition, Mc Graw Hill Publishers.

Web resources

1. https://www.onlinebiologynotes.com/human-insulin-production-by-geneticengineering/ 14.

2.https://www.biotechnologynotes.com/transgenic-plants/edible-vaccinesapplications-advantages-and-limitations/627 15.

3. https://www.biologydiscussion.com/microbiology-2/bioremediation/ xenobiotic - compounds-meaning-hazards-and-biodegradation/

Course Outcome

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Gather the basics of producing pharmaceutically valuable products from microbiota	K5
CO2	Enrich themselves with knowledge of producing biofertilizers and biocontrol agents	K4
CO3	Attain the knowledge on the exploitation and applications of microalgae	K5
CO4	Posses the concepts of genetic engineering in plants and animals.	K6
CO5	Get a comprehensive idea about IPR and Bioethics	K4

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**S**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

MAJOR BASED ELECTIVE: II

MICROBIAL DISEASES IN HUMAN

Semester : VI **Max Marks : 75**

Course Code : 24UMB6MBE2B **Credit : 4***

Total Period :75h

Objectives

To understand the diseases, infections, transmission

UNIT I Diseases (Periods 15)

Introduction to Diseases, History of Diseases, Types of infection, Sources of infection, Mode of Transmission, Communicable disease, Noncommunicable disease, Types of Pathogenic microorganisms Bacteria, Viruses, Protozoans, Metazoans, Fungi).

UNIT II Diarrheal Diseases (Periods 15)

Diarrheal Diseases, Diarrhoea caused by Bacteria, Protozoan and viruses. Amoebic dysentery, Giardiasis, Balantidiasis. Cryptosporodiasis, Cholera, Rota viral Diarrhoea.

UNIT III Vector borne diseases (Periods 15)

Vector borne diseases, Malaria, Filariasis, Dengue, Zika fever, ARBO viral infections, Trypanosomiasis, Leishmaniasis.

UNIT IV Airborne infections (Periods 15)

Airborne infections, Tuberculosis, Corona viral infections, Common cold, Pneumonia, Adenoviral infections.

UNIT V Sexually transmitted diseases (Periods 15)

Sexually transmitted diseases - HIV/AIDS, *Trichomoniasis, Syphilis, Neisseria gonorrhoeae*, Hepatitis-B infections, HPV infections. Prevention of sexually transmitted infections.

REFERENCES

1. Anathanarayanan, R. & Paniker, C.K. (2009). *Text Book of Microbiology* (8th ed.). Orient and Longman, New Delhi.
2. 2. Parija, S.C. (2012). *Text Book of Microbiology and Immunology* (2nd ed.). Elsevier India, New Delhi.

3. 3. Parija, S.C. (2013). *Text Book of Medical Parasitology*. (4th ed.). All India Publishers and Distributors, Chennai

4. L Collier and J. Oxford. (2000) *Human Virology.* (2nd ed.). Oxford University Press, Oxford.

5. Murray, P.R., Rosenthal, K.S. & Pfaller, M.A. (2008). *Medical Microbiology*. (6th ed.). Mosby - Elsevier.

7. Greenwood, D., Slack, R., Barer M. & Irving, W. L. (2012). *Medical Microbiology*. (18th ed.). Churchill Livingstone

Course Outcome

CO Number	**COSTATEMENT**	**KNOWLEDGE LEVEL**
CO1	Understand the types of diseases.	K5
CO2	Understand the transmission and control of Diarrhoeal Diseases.	K4
CO3	Understand the transmission and control of Vector borne Diseases.	K5
CO4	Understand the transmission and prevention of Airborne Diseases.	K6
CO5	Understand the transmission and control of Sexually transmitted Diseases	K4

Mapping with Programme Outcomes

Cos/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**S**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

SKILL BASED ELECTIVE: II

HEMATOLOGY AND BLOOD BANKING

Semester : VI **Max Marks : 75**

Course Code : 24UMB6SBE2A **Credit : 6***

Total Period :24h

Objectives

UNIT I Blood **(Periods 5)**

Blood: definition, characters, composition. Collection of blood – capillary blood: from adults and infants, examinations employed. Venous blood: from adults and infants, examinations employed – Anticoagulants: definition – type: Wintrobes, EDTA, heparin, citrate, concentration, examinations, advantages and disadvantages.

UNIT II Blood cells **(Periods 5)**

Counting of blood cells: Neuberger counting chamber – total RBC count: diluting fluids, normal values – total WBC count: diluting fluids, normal values differential leucocyte count: granulocyte and a granulocytes, morphology and function, staining technique – Platelet count: morphological characters and functions, hemoglobin: composition and normal values, hemoglobin estimation.

UNIT – III Coagulation mechanism **(Periods 5)**

Coagulation mechanism: factors, bleeding time, clotting time. Haematological indices: packed cell volume. Erythrocyte sedimentation: principle – determination: introbes, Westegren method – advantages and disadvantages – factors affecting the process.

UNIT– IV **Staining techniques** **(Periods 5)**

Preparation of stains and staining techniques: Wright stain, Leishman’s stain, Giemsa's stain , Fields stain, peroxidase stain. Examination of blood smear – peripheral smear report – size, colour and shape. Blood parasites: malarial parasite and microfilaria.

UNIT – V ABO Grouping **(Periods 4)**

ABO Grouping: History, slide and tube technique, Rh typing: slide and tube technique, Coombs test: direct and indirect method, donor screening – cross matching, collection of blood, preservation and storage.

REFERENCES

1. Maheswari N. (2008) Clinical Pathology, Haematology and Blood Banking (for DMLT students), 2nd Edn. Jaypee Brothers Medical Publishers.
2. Hoffbrand A.V. and Moss P.A.H. (2015) Hoffbrand's Essential Haematology, 7th Edn. Wiley.
3. Greer J.P., Foerster J., Lukens J.N., Rodgers G.M., Paraskevas F. and Glader B.E. (Ed.) (2013). Wintrobe's Clinical Hematology, 13th Edn. Wolters Kluwer.
4. HIllyer C., Silberstein L., Ness P., Anderson K. and Roback J. (2006) Blood banking and Transfusion medicine, 2nd Edn. Elsevier Press.
5. Godkar P.B. and Godkar D.P. (2013) Textbook Medical Laboratory Technology Vol-I and II, Bhalani Publishing House.

Course Outcome

CO Number	COST STATEMENT	KNOWLEDGE LEVEL
CO1	Understand the principles of blood banking and its importance in patient care.	K5
CO2	Analyze the characteristics and management of sickle cell disease and thalassemias.	K4
CO3	Evaluate emerging trends and innovations in transfusion medicine.	K5
CO4	Application of an understanding of hemostasis and coagulation disorders.	K6
CO5	Master the pathobiology of hematological disorders encountering in hospital practice.	K4

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	M	S
CO2	M	M	S	M	S
CO3	M	M	M	S	M
CO4	S	S	S	S	S
CO5	S	S	M	S	S

SKILL BASED ELECTIVE: II

VACCINE TECHNOLOGY

Semester : VI **Max Marks : 75**

Course Code : 24UMB6SBE2B **Credit : 2***

Total Period :24h

Objectives

To provide knowledge on the basics of immunization and induction of immunity.

UNIT I History of vaccine (Periods 5)

History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterization and location of APC, MHC and immunogenicity.

UNIT II Vaccine preparation (Periods 5)

Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, sub unit vaccines; Licensed vaccines, Viral Vaccine - Poliovirus vaccine-inactivated & Live, Rabies vaccines, Hepatitis A & B vaccines, Bacterial Vaccine - Anthrax vaccines, Cholera vaccines, Diphtheria toxoid, Parasitic vaccine - Malaria Vaccine.

UNIT III Vaccine technology (Periods 5)

Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV.

UNIT IV Vaccine Design (Periods 5)

Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens, Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies.

UNIT V Vaccine additives (Periods 4)

Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Quality control and regulations in vaccine research, Animal testing, Rational design to clinical trials, Large scale production, Commercialization. Vaccine safety ethics and Legal issues.

REFERENCES

1. Ronald W. Ellis.(2001). New Vaccine Technologies. Landes Bioscience.
2. Cheryl Barton. (2009). Advances in Vaccine Technology and Delivery. Espicom Business Intelligence.
3. Male, David. Ed. (2007). Immu Stanley A. Plotkin, Walter Orenstein& Paul A. Offit.(2013). Vaccines, 6th Edition. BMA Medical Book Awards Highly Commended in Public Health. Elsevier Publication.nology. 7th Edition. Mosby Publication.
4. Coico, R. etal. (2003). Immunology: A Short Course. 5th Edition, Wiley – Liss.
5. Abbas, A.K. etal. (2007). The Cellular and Molecular Immunology. 6th Edition, Sanders / Elsevier.

Web Resources

1. https://www.slideshare.net/adammbbs/pathogenesis-3-rd-internal-updated-43458567
2. https://www.bio.fiocruz.br/en/images/stories/pdfs/mpti/2013/selecao/vaccine-processtechnology.pdf
3. https://www.dcvmn.org/IMG/pdf/ge_healthcare_dcvmn_introduction_to_pd_for_vaccine_production_29256323aa_10mar2017.pdf
4. https://www.sciencedirect.com/science/article/pii/B9780128021743000059
5. https://www.researchgate.net/publication/313470959_Vaccine_Scaleup_and_Manufacturing

CO Number	COST SATEMENT	KNOWLEDGE LEVEL
CO1	Understand the systematic position and life history of honey bee.	K5
CO2	Reveal the different stages and types of bees and discuss about the care and management of apiculture.	K4
CO3	Describe the practice of bee rearing process and analyze instruments employed in apiary.	K5
CO4	Compare and contrast the composition of honey and bee wax and interpret the yield in National and International markets.	K6
CO5	Clarify the proposal for financial assistance and funding agencies and reveal the modern methods employed in artificial bee hives.	K4

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**S**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

SKILL BASED ELECTIVE: II

GENETIC ENGINEERING

Semester : VI **Max Marks : 75**

Course Code : 24UMB6SBE2C **Credit : 2***

Total Period :24h

Objectives

To get introduced about the concept of recombinant DNA.

To appreciate the types and role of vectors in r DNA technology.

UNIT I: Recombinant Technology (Periods 5)

Introduction to recombinant DNA technology- tolls for rDNA technology- DNA manipulative enzymes- Restriction enzymes, ligase, polynucleotide kinase, phosphatase, cutting of DNA molecules, joining of DNA molecules- Homopolymer tails, Linkers, Adapters

UNIT II: Cloning Vectors (Periods 5)

Gene cloning vectors- salient features, plasmid-based vectors, natural vectors (PSC101, PSF2124, PMBI). Artificial vectors (PBR322, PUC). Phage based vectors- lambda phage vector- hybrid vectors- phage mid, cosmid. BAC, YAC- expression systems- *E. coli*.

UNIT III: Gene Cloning (Periods 5)

Cloning strategies- Isolation, purification of DNA (Chromosomal, plasmid), RNA and Protein. Construction of gene libraries (genomic, cDNA), polymerase chain reaction and its applications.

UNIT IV: Gene Transfer Methods (Periods 5)

Gene/DNA transfer techniques – calcium chloride mediated gene transfer, Agrobacterium mediated DNA transfer, Electroporation, Microinjection, Liposome fusion, particle gun bombardment. Screening of recombinants.

UNIT V: APPLICATION of rDNA TECHNOLOGY (Periods 4)

Blotting techniques – Southern, Northen, Western, RFLP, RAPD and their application. Application of genetic engineering in Agriculture, Health and Industry. Social impact of rDNA technology.

REFERENCES

1. Brown, T. A. (2016). Gene Cloning and DNA analysis. 7th Edn. American Society for Microbiology Press.
2. Primrose, S. B & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics. 7th Edn. Wiley Blackwell.
3. Winnecker, E.D. (1987). From Gene to clones. Introduction to Gene Technology, VCH Publication, FRG.
4. Glick B. R & Patten, C.L. (2017). *Molecular Biotechnology. Principles and Application of Recombinant DNA.* 5th Edn. ASM press, Washington..
5. Watson, J.D., Gann, A., Baker, T.A., Levine, M., Bell, S.P and Losick, R. (2014). *Molecular biology of Gene.* 7th Edn. Pearson Publishers
6. Winnacker, E. L.(1987). *From genes to clones: Introduction to gene technology.* VCH Publications, Federal Republic of Germany.

CO Number	COSTATEMENT	KNOWLEDGE LEVEL
CO1	Get acquainted with the basic tools used in recombinant DNA technology.	K5
CO2	Understand the different gene cloning vectors	K4
CO3	Understand the construction of gene libraries and genome isolation methods	K5
CO4	Have learnt the techniques in transformation of recombinant DNA into target host organism.	K6
CO5	Understand the various applications of recombinant DNA technology in various fields.	K4

Mapping with Programme Outcomes

Cos/POs	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**S**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**