

Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621 220

Bachelor of Microbiology - UG Course Structure under CBCS-LOCF

(For the candidates admitted from the academic year 2023-2024 onwards)

Semester	Part	Course Code	Title of the Course	Ins. Hours/ Weeks	Credits	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
1	I	23UT1/H1/F1	Language-I	6	3	3	25	75	100
1	II	23UE1	English-I	6	3	3	25	75	100
1	III	23UMB1CC1	Fundamentals of Microbiology and Microbial Diversity	5	5	3	25	75	100
1	III	23UMB1CC2P	Fundamentals of Microbiology and Microbial Diversity - Practical	3	3	3	40	60	100
1	III	23UMB1AC1	Basic and Clinical Biochemistry	5	4	3	25	75	100
1	III	23UMB2AP1	Basic and Clinical Biochemistry & Bioinstrumentation-Practical	3	--	--	--	--	--
1	IV	23UMB1SE1	Skill Enhancement Course- 1(NME-1)	2	2	3	25	75	100
			Value Added Course		2*	2	50	50	100*
Total				30	20	-	-	-	600
2	I	23UT2/H2/F2	Language - II	6	3	3	25	75	100
2	II	23UE2	English-II	6	3	3	25	75	100
2	III	23UMB2CC3	Microbial Physiology and Metabolism	5	5	3	25	75	100
2	III	23UMB2CC4P	Microbial Physiology and Metabolism -Practical	3	3	3	40	60	100
2	III	23UMB2AC2	Bioinstrumentation	3	3	3	25	75	100
2	III	23UMB2AP1	Basic and Clinical Biochemistry & Bioinstrumentation-Practical	3	2	3	40	60	100
2	IV	23UMB2SE2	Skill Enhancement Course-2 (NME-2)	2	2	3	25	75	100
2	IV	23UMB2SE3	Mushroom Technology	2	2	3	25	75	100
			Value Added Course		2*	2	50	50	100*
Total				30	23	-	-	-	800
3	I	23UT3/H3/F3	Language -III	6	3	3	25	75	100

3	II	23UE3	English-III	6	3	3	25	75	100
3	III	23UMB3CC5	Molecular Biology and Microbial Genetics	4	4	3	25	75	100
3	III	23UMB3CC6P	Molecular Biology and Microbial Genetics -Practical	3	3	3	40	60	100
3	III	23UMB3AC3	Clinical Laboratory Technology	4	3	3	25	75	100
3	III	23UMB4AP2	Clinical Laboratory Technology & Food Processing Technology - Practical	2	--	--	--	--	--
3	IV	23UMB3SE4	Organic Farming & Biofertilizer Technology	2	2	3	25	75	100
3	IV	23UMB3SE5	Microbiological analysis of air and water	2	2	3	25	75	100
3	IV	23UGS	Gender Studies	1	1	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
Total				30	21	-	-	-	800
4	I	23UT4/H4/F4	Language -IV	6	3	3	25	75	100
4	II	23UE4	English-IV	6	3	3	25	75	100
4	III	23UMB4CC7	Immunology and Immunotechnology	5	5	3	25	75	100
4	III	23UMB4CC8P	Immunology and Immunotechnology - Practical	3	3	3	40	60	100
4	III	23UMB4AC4	Food Processing Technology	4	4	3	25	75	100
4	III	23UMB4AP2	Clinical Laboratory Technology & Food Processing Technology - Practical	2	2	3	40	60	100
4	IV	23UMB4SE6	Soft skill Development	2	2	3	25	75	100
4	IV	23UES	E.V.S	2	2	-	25	75	100
			Value Added Course*		2*	2	50	50	100*
Total				30	24	-	-	-	800
5	III	23UMB5CC9	Bacteriology and Mycology	5	5	3	25	75	100
5	III	23UMB5CC10	Virology and Parasitology	5	5	3	25	75	100
5	III	23UMB5CC11P	Bacteriology and Mycology & Virology and Parasitology – Practical	5	5	3	40	60	100
5	III	23UMB5CC12	Project with viva- voce	5	3	3	Evaluation 80	Viva voce 20	100
5	III	23UMB5DE1	Recombinant DNA Technology	4	4	3	25	75	100

5	IV	23UMB5DE2	Biosafety & Bioethics	4	4	3	25	75	100
5	IV	23UVE	Value Education	2	2	3	25	75	100
5	IV		Internship/ Industrial visit/ Field visit	-	2*	-	-	-	-
5			Value Added Course*		2*	2	50	50	100*
Total				30	28	-	-	-	700
6	III	23UMB6CC13	Environmental and Agriculture Microbiology	6	5	3	25	75	100
6	III	23UMB6CC14	Food, Dairy and Probiotic Microbiology	6	5	3	25	75	100
6	III	23UMB6CC15P	Environmental and Agriculture Microbiology & Food, Dairy and Probiotic Microbiology – Practical	6	5	3	40	60	100
6	III	23UMB6DE3	Pharmaceutical Microbiology	6	4	3	25	75	100
6	III	23UMB6DE4	Entrepreneurship and Bio-Business	6	4	3	25	75	100
6	V		Extension activity	-	1	-	-	-	-
6			Value Added Course*		2*	2	50	50	100*
Total				30	24	-	-	-	500
Grand Total				180	140				4200

Credit Distribution for UG MICROBIOLOGY

S.No	Part	Course Details	Credit
1	I&II	Language & English (Lang - 4x3=12 Eng - 4x3=12)	24
2	III	Core, Allied & Elective Course	94
3	IV	NME(2x2)	4
4		EVS(1x2)	2
5		Value Education(1x2)	2
6		Extension Activity(1x1) Gender Studies	1 1
7		• Skill Enhancement (5x2=10)	10
		• Foundation course	2
			140

LIST OF CORE COURSES OFFERED

Core Course I: Fundamentals of Microbiology and Microbial Diversity
 Core Course II: Practical I Fundamentals of Microbiology and Microbial Diversity
 Core Course III: Microbial Physiology and Metabolism
 Core Course IV: Core Practical II- Microbial Physiology and Metabolism
 Core Course V: Molecular Biology and Microbial Genetics
 Core Course VI: Practical III Molecular Biology and Microbial Genetics
 Core Course VII: Immunology and Immunotechnology
 Core Course VIII: Practical IV Immunology and Immunotechnology
 Core Course IX: Bacteriology and Mycology
 Core Course X: Virology and Parasitology
 Core course XI: Practical V CC IX & CC X
 Core Course XII: Project with Viva-Voce - Group Project
 Core Course XIII: Environmental and Agriculture Microbiology
 Core Course XIV: Food, Dairy and Probiotic Microbiology
 Core Course XV: Practical VI CC XIII & CCXIV

LIST OF ALLIED COURSES OFFERED

Allied Course-I: Basic and Clinical Biochemistry
 Allied Course II: Bioinstrumentation
 Allied Course III: Clinical Laboratory Technology
 Allied Course IV: Food Processing Technology
 Allied Practical-I: Basic and Clinical Biochemistry & Bioinstrumentation
 Allied Practical-II: Clinical Laboratory Technology & Food Processing Technology

LIST OF SKILL ENHANCEMENT COURSES OFFERED

Skill enhancement Course SEC - 1 (NME): Cosmetics Microbiology

Skill Enhancement Course SEC-2 (NME): Nutrition & Health Hygiene

Skill Enhancement Course SEC-3: Mushroom technology

Skill Enhancement Course SEC -4 (Entrepreneurial Skill): Organic Farming & Biofertiliser Technology

Skill Enhancement Course -5: Microbiological analysis of air and water

Skill Enhancement Course SEC -6: Softskill Development

LIST OF ELECTIVE COURSES OFFERED

Discipline Specific Elective- I: Recombinant DNA Technology

Discipline Specific Elective II: Biosafety & Bioethics

Discipline Specific Elective III: Pharmaceutical Microbiology

Discipline Specific Elective IV: Entrepreneurship and Bio-Business

Note:

	Internal Marks	External Marks
1. Theory	25	75
2. Practical	40	60
3. Separate passing minimum is prescribed for Internal and External marks		

FOR THEORY

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for Semester Examinations shall be 40% out of 75 marks [i.e. 30 marks]

FOR PRACTICAL

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16 marks]

The passing minimum for Semester Examinations shall be 40% out of 60 marks [i.e. 24 marks]

- Project : 100 Marks (The Project will be evaluated by an Internal and an External Examiner)

List of Value Added Courses

Course Code	Course Title
23UMBVA1	Hematology
23UMBVA2	Forensic Microbiology
23UMBVA3	Cancer cell Biology
23UMBVA4	First Aid and Emergency Care
23UMBVA5	Herbal Cosmetics
23UMBVA6	Spirulina Cultivation

Question Paper Pattern

UG Programme		
Maximum Marks : 75		Duration: 3 Hours
Section - A	i) a- (5 Questions for Multiple Choice) One question from each unit	5 x 1 = 5 Marks
	b- (5 Questions for Fill in the Blanks) One question from each unit	5 x 1 = 5 Marks
	ii) (5 short answer questions) One question from each unit	5 x 2 = 10 Marks
Section - B	5 Questions (Internal Choice: Either or) One set of questions from each unit	5 x 5 = 25 Marks
Section - C	3 Questions (Answer any 3 out of 5 Questions) One question from each unit	3 x 10 = 30 Marks

SEMESTER-I

Course Code: 23UMB1CC1

Instruction Hours: 6

Credits: 6

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE - 1

FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY

Objectives:

- Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
- Describe the structural organization, morphology and reproduction of microbes.
- Explain the methods of cultivation of microbes and measurement of growth.
- Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.
- Compare and contrast the different methods of sterilization.

Course outcomes:

- CO1: Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.
- CO2: Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.
- CO3: Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms..
- CO4: Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application.
- CO5: Understand the concept of asepsis and modes of sterilization and disinfectants.

Unit I

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, Archaeobacteria and Eucarya. Conservation of Biodiversity.

Unit II

General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae.

Unit III

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

Unit IV

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

Text Books

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,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 11th Edition., A La Carte Pearson.
4. Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc.New York
5. Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby CollegePublishing, St Louis.

References Books

1. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones & Bartlett learning 2010
2. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd.
3. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition., Benjamin Cummings.
4. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition., McGraw Hill Publications
5. Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co

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/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course				Hours	Credits			
I	23UMB1CC1	Fundamentals Of Microbiology And Microbial Diversity				6	6			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓	✓		✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓		✓	✓	
Number of Matches(✓) = 43 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

Course Code: 23UMB1CC2P

Instruction Hours: 3

Credits: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE COURSE - II

PRACTICAL I - FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY

Objectives:

- Acquire knowledge on Cleaning of glass wares, GLP and sterilization.
- Gain knowledge on media preparation and cultural characteristics.
- Explain Learn the pure culture technique.
- Learn the microscopic techniques and staining methods.
- Acquire knowledge on stain and staining methods.

Course outcomes:

CO1: Practice sterilization methods; learn to prepare media and their quality control.

CO2: Learn streak plate, pour plate and serial dilution and pigment production of microbes.

CO3: Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms..

CO4: Observe culture characteristics of microorganism.

CO5: Study on Microbial Diversity using Hay Infusion Broth-Wet mount.

Unit I

Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.

Unit II

Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.

Unit III

Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation- quality control of media, growth supporting properties, sterility check of media.

Pure culture techniques: streak plate, pour plate, decimal dilution.

Unit IV

Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production.

Microscopy: light microscopy and bright field microscopy.

Unit V

Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining.

Study on Microbial Diversity using Hay Infusion Broth-Wet mount to show different types of microbes, hanging drop

Text Books

1. James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.

- Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
- Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
- Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi
- R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing

References Books

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

Web Resources

- <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>
- <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635>
- https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
- <https://microbiologyinfo.com/top-and-best-microbiology-books/>
- <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UMB1CC2P	CORE COURSE-II Practical I					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

Course Code: 23UMB1AC1
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ALLIED COURSE I – BASIC AND CLINICAL BIOCHEMISTRY

Objectives:

- Attain thorough knowledge on carbohydrates and lipids, their characteristic properties and organization in carrying out all the living functions which constitute the life.
- Explain the biological activity of amino acids and proteins.
- Identify the metabolic errors in enzymes of carbohydrates and lipids.
- Describe the disorders in amino acid metabolism.
- Interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day today life.

Course outcomes:

- CO1: Explain the structure, classification, biochemical functions and significance of carbohydrates and lipids
- CO2: Differentiate essential and non-essential amino acids, biologically important modified amino acids and their functions, Illustrate the role, classification of Proteins and recognize the structural level organization of proteins, its functions and denaturation.
- CO3: Assess defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism.
- CO4: Discuss and evaluate the pathology of amino acid metabolic disorders.
- CO5: Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.

Unit I

Biomolecules -Carbohydrate – General properties, function, structure, classification– monosaccharides (Glucose, Fructose, Galactose), Oligoaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance. Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL – biological significance.

Unit II

Biomolecules - Amino acids – General properties, functions, structure, classification and biological significance. Proteins– General structure, Properties, functions, classification and biological significance.

Unit III

Disorders of Metabolism: Disorders of carbohydrate metabolism: diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia, sphingolipidosis..

Unit IV

Disorders of Metabolism: Disorders of amino acid metabolism: alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias.

Unit V

Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase

Text Books

1. Satyanarayana, U. and Chakrapani, U(2014).Biochemistry,4th Edition, Made Simple Publisher
2. Jain J L, Sunjay Jain and Nitin Jain (2016).Fundamentals of Biochemistry, 7th Edition, S Chand Company.
3. AmbikaShanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8th Edition. Wolters Kluwer India Pvt Ltd
4. Vasudevan. D.M.Sreekumari.S, Kannan Vaidyanathan (2019). Textbook Of Biochemistry For Medical Students. Kindle edition, Jaypee Brothers Medical Publishers.
5. Jeremy M. Berg,LubertStryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8th edition. WH Freeman publisher.

References Books

1. AmitKessel&Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2nd Edition, Chapman and Hall.
2. David L. Nelson and Michael M. Cox (2017).Lehninger Principles of Biochemistry, 7th Edition W.H. Freeman and Co., NY.
3. LupertStyrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J (2019). Biochemistry. 9th Edition ,W.H.Freeman& Co. New York.
4. Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition, Wiley.
5. Joy PP, Surya S. and AswathyC (2015). Laboratory Manual of Biochemistry, Edition 1.,Publisher:Kerala agricultural university.

Web Resources

1. <https://www.abebooks.com> > plp
2. <https://kau.in/document/laboratory-manual-biochemistry>
3. <https://metacyc.org>
4. <https://www.medicalnewstoday.com>
5. <https://journals.indexcopernicus.com>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UMB1AC1	Allied Course – I Basic and Clinical Biochemistry					5	4			
Course Outcomes (COs)	Programme Outcomes(Pos)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓		
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓			✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 44 Relationship: High											

6.

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

7.

SEMESTER-I

Course Code: 23UMB1SE1
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SKILL ENHANCEMENT COURSE SEC - 1 (NME) COSMETICS MICROBIOLOGY

Objectives:

- Study the role of Microbiology in Cosmetic Industry
- Gain knowledge in cosmetic Products
- Study the different process and work culture in the Cosmetic Industry

Course Outcomes

CO1: Grasp the knowledge on Cosmetic Microbiology.
CO2: Explicit the various product forms in cosmetics.
CO3: Acquire the knowledge on cosmetic ingredients.
CO4: Investigate the antimicrobial preservative testing in cosmetics.
CO5: Describe the Cosmetic product regulations.

UNIT I

Introduction to Cosmetic Microbiology: Regulatory definition of Cosmetics. History of cosmetic microbiology- Microbiology as a scientific discipline, Biology of microbes. Broad classification of cosmetic products for skin, #hair and oral care#.

UNIT II

Application of Cosmetics Products: Solutions, creams, lotions, ointment, paste, gels, sticks, tablets, capsules, powders and aerosols. Product Development: Defining the product, selection & sources of ingredients, #formulaoptimization#.

UNIT III

Cosmetic Ingredients: Classification and application in cosmetics – Foaming agents, emulsifiers, and solubilizers. Antioxidants, anti UV compounds, antimicrobial and chelating agents used as preservatives. Perfume: Classification of perfumes. #Perfume ingredients listed as allergens in EU guidelines#.

UNIT IV

Antimicrobial Preservative Testing: General product and raw materials tests -CTFA, ASTM and USP method- Microbial enumeration tests, Tests for specified microorganisms,#Microbiological contamination limits for nonsterile products#, D-value methods and Capacity tests.

UNIT V

Cosmetic Product Regulation: Ingredients, Safety assessment, Efficacy data, Labeling requirements for cosmetic products. Evolution of Cosmetics to Cosmeceuticals.Environmental and safety concerns of cosmetic ingredients. Guidelines on green cosmetics and #challenges in green formulation#. # #Self-study portion

Text Books:

1. Philip A. Geis, Cosmetic Microbiology, 2nd Edition, Taylor & Francis Group, New York, London, 2006.
2. Wilkinson J.B and Moore R.J, Harry's Cosmeticology –7 th edition, Chemical Publishing,New York,2011.

3. P.P. Sharma, Cosmetics – Formulation, Manufacturing and Quality Control, 4th edition, Vandana Publications Pvt. Ltd., Delhi,2014.
4. Hilda Butler, Poucher’s Perfumes, Cosmetics and Soaps, 10th Edition, Kluwer Academic Publishers.

Reference:

1. André O. Barel, Marc Paye, Howard I. Maibach, Handbook of Cosmetic Science and Technology, 3rd Edition, Marianne Mahieu Informa Healthcare USA,Inc.
2. Zoe Diana Draelos, Lauren A.Thaman, Cosmetic formulation of skin careproducts.

Web Source:

1. <https://www.ceway.eu/cosmetic-products-definition-in-the-eu/#:~:text=>
2. <https://thebeautybrains.com/2014/05/understanding-the-basic-forms-of-cosmetics/>
- 3.<https://betaeq.com.br/index.php/en/2019/06/26/cosmetics-ii-classifications-andapplications-of-cosmetics/>
- 4.<https://www.pharmamanufacturing.com/articles/2014/usp-microbial-examinationnonsterile-products/#>
5. <http://www.opastonline.com/wp-content/uploads/2019/01/cosmetics-vsosomeceuticals>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UMB1SE1	SEC(NME)-I Cosmetics Microbiology					2	2			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓			✓	✓	
CO2	✓		✓	✓		✓		✓		✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓		✓			
CO5	✓	✓	✓	✓	✓	✓	✓		✓		
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 23UMB2CC3
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE III – MICROBIAL PHYSIOLOGY AND METABOLISM

Objectives:

- Study the basic principles of microbial growth.
- Understand the basic concepts of aerobic and anaerobic metabolic pathways.
- Analyze the role of individual components in overall cell function.
- Provide information on sources of energy and its utilization by microorganisms.
- Study the different types of metabolic strategies

Course outcomes:

- CO1: Describe microorganisms based on nutrition.
- CO2: Know the concept of microbial growth and identify the factors affecting bacterial growth
- CO3: Explain the methods of nutrient uptake.
- CO4: Describe anaerobic and aerobic energy production.
- CO5: Elaborate on the process of bacterial photosynthesis and reproduction

Unit I

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 - 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

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

Unit V

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.

Text Books

- Schlegel, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge.
- RajapandianK.(2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
- MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.
- Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
- S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.

References Books

- Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49
- Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge
- Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm.C. Brown Communications, Inc. USA
- Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
- BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

Web Resources

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

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UMB2CC3	Microbial Physiology and Metabolism					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓			✓	✓	✓	✓	✓	✓		
Number of Matches (✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 23UMB2CC4P
Instruction Hours: 3
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

PRACTICAL II – MICROBIAL PHYSIOLOGY AND METABOLISM

Objectives:

- Understand the principles of motility test.
- Understand the basic concepts of staining methods.
- Learn the bacterial count using different methods and anaerobic culture.
- Study the morphological demonstration of microorganisms and identification.
- Study the biochemical identification of the bacteria

Course outcomes:

- CO1: Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.
CO2: Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining
CO3: Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.
CO4: Describe demonstration of the size of yeast, fungal filaments and protozoa.
CO5: Elaborate on the bacterial identification- morphological, physiological, and biochemical methods

Unit I

Motility demonstration: hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method. Staining techniques: Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.

Unit II

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

Unit III

Anaerobic culture methods. Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.

Unit IV

Morphological variations in algae, fungi and protozoa. Micrometry: Demonstration of the size of yeast, fungal filaments and protozoa.

Unit V

Methods of bacterial identification- morphological, physiological, and biochemical methods - IMViC test, H₂S, TSI, Oxidase, catalase, urease test, and Carbohydrate fermentation test. Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

REFERENCES

Text Books

1. James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York.

2. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4. Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher.
5. Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference publisher.

References Books

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. Publications

Web Resources

1. <https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents>
2. <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition>
3. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4. <https://www.studocu.com/microbial-physiology-practicals>
5. <https://www.agr.hokudai.ac.jp/microbial-physiology>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UMB2CC4P	Practical II- Microbial Physiology and Metabolism					3	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓		
CO2	✓	✓		✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓		
Number of Matches (✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 23UMB2AC2
Instruction Hours: 4
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ALLIED COURSE II – BIOINSTRUMENTATION

Objectives:

- Understand the analytical instruments and study the basic principles in the field of sciences
- To gain knowledge about principles of spectroscopy
- Understand the analytical techniques of Chromatography and electrophoresis
- To understand the principle of different types of scans used in medical diagnosis
- To gain information about the principles of radioactivity and its measurements

Course outcomes:

- CO1: Able Gain knowledge about the basics of instrumentation.
- CO2: Exemplify the structure of atoms and molecules by using the principles of spectroscopy.
- CO3: Evaluate by separating and purifying the components.
- CO4: Understand the need and applications of imaging techniques.
- CO5: Categorize the working principle and applications of fluorescence and radiation.

Unit I

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

Unit III

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

Unit IV

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

Unit V

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

Text Books

1. Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi.
2. Ponmurugan. P and Gangathara PB (2012). Biotechniques.1st Edition. MJP publishers.
3. Veerakumari, L (2009).Bioinstrumentation- 5th Edition -.MJP publishers.
4. Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home.

5. Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai

References Books

1. Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication
2. SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14th Edition W.B.SaundersCo.,Philadephia
3. N.Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP Publishers
4. Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7th Edition. Cambridge University Press
5. 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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UMB2AC2	Allied Course II - Bioinstrumentation					4	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓		✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓		✓	
CO4	✓	✓	✓		✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 42 Relationship: High											

6.

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

7.

SEMESTER-II

Course Code: 23UMB2AP2

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

ALLIED PRACTICAL-I

Objectives:

- Able to analyse the given carbohydrate systematically
- Able to analyse amino acids systematically
- Able to characterize lipids

Course Outcomes:

1. Perform qualitative analysis of sugars
2. Perform qualitative analysis of Amino acids.
3. Demonstrate the amino acid quantitatively.
4. Predict the amount of proteins.
5. Demonstrate on paper and Thin Layer Chromatography

List of Practical

1. Qualitative Analysis of Carbohydrates
2. Qualitative Analysis of Protein
3. Qualitative Analysis of Lipids
4. Estimation of glucose.
5. Estimation of amino acid
6. Estimation of Protein by Lowry's method.
7. Demonstrate paper and Thin Layer Chromatography
8. Demonstrate on Agarose Gel Electrophoresis

Reference books:

1. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain. 1995.
2. Oser BL Hawks. Physiological Chemistry, TATA Mc Graw Hill. 1965.
3. Strolv BA, Makavora VC. Laboratory manual in Biochemistry. MIR Publisher, Moscow. 1989.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UMB2AP2	Allied Practical I					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓		
CO2	✓		✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓	✓	✓	✓		✓	✓		
CO4	✓	✓	✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓		✓		✓	✓		
Number of Matches(✓) = 38 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- II

Course Code: 23UMB2SE2
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SKILL ENHANCEMENT COURSE -SEC-II (NME) – NUTRITION & HEALTH HYGIENE

Course Objectives:

- Learn about nutrition and their importance.
- Make student understand the nutritional facts for a better life
- Learn information to optimize our diet
- Impart knowledge on different health care programs taken up by India
- Learn knowledge on different health indicators and types of hygiene methods

Course outcomes:

- CO1: Learn the importance of nutrition for a healthy life
CO2: Study the nutrition for life cycle.
CO3: Know the health care programmes of India.
CO4: Learn the importance of community and personal health & hygiene measures
CO5: Create awareness on community health and hygiene

Unit I

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: 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: 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 - 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 – 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.

REFERENCES

Text Books

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. SK. Haldar (2022). Occupational Health and Hygiene in Industry. CBS Publishers
4. Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices. Satish Serial Publishing House
5. Dass (2021). Public Health and Hygiene, Notion Press

References Books

1. Vijaya Khader (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

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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UMB2SE2	SEC-II (NME) Nutrition and health Hygiene					2	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓		✓		✓	✓	✓		✓	
CO4	✓		✓	✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓		✓		✓	✓		
Number of Matches (✓) = 39 Relationship: High											

1.

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code: 23UMB2SE3
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SKILL ENHANCEMENT COURSE -SEC-III MUSHROOM TECHNOLOGY

Objectives:

- Acquire knowledge on the concepts of origin, growth and study of Mushroom Technology
- Describe the morphology of Mushroom
- Discuss effective management of Mushroom Production
- Demonstrate field skills in Mushroom Cultivation and their Nutritional Benefits.
- Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises

Course outcomes:

- CO1: Discuss the overall aspects of Scope of Mushroom Cultivation.
CO2: Creates awareness among students about the economic importance and suitability of Mushroom Cultivation.
CO3: Explain the Procedure for Spawn Preparation and Production
CO4: Attain thorough knowledge about the Nutritional benefits of Mushroom.
CO5: Acquire knowledge on Mushroom diseases and Value added Products from Mushroom.

Unit I:

Introduction to Mushroom History and Scope of Mushroom Cultivation; Taxonomical rank of Mushroom; Vegetative characters of edible and poisonous mushrooms.

Unit II:

Common edible Mushrooms Button Mushroom (*Agaricus bisporus*), Oyster mushroom (*Pleurotus sajorcaju*), paddy straw mushroom (*Volvariella volvacea*), Milky Mushroom (*Calocybe indica*); Other economically important and medicinal mushroom- Shiitake Mushroom (*Lentinula edodes*), Kabul Dhingri (King Oyster) Mushroom.

Unit III:

Principle of Mushroom Cultivation -Structure and construction of mushroom house. Sterilization of substrates. Spawn production culture media preparation, Preparation of mother spawn, production of planting spawn, storage/transportation of spawn, Criteria for selection of good quality spawn. Cultivation of Button mushroom and paddy straw mushroom; Introduction to microbiology laboratory Laminar Air flow, Autoclave.

Unit IV:

Nutritional and health benefits of Mushroom -Nutritional and health benefits of mushrooms. Therapeutic aspects- antitumor effects.

Unit V:

Disease and Pest Management in cultivated mushrooms Dry Bubble and wet bubble- Major diseases of cultivated mushroom; Major insect pests Mushroom flies / nematodes / mites. Value addition of Mushroom Value added products / recipes, Quality assurance, Packing and packaging, Market opportunities.

References:

1. Pandey, R.K. and Ghosh, S.K. (2018). A handbook of Mushroom Cultivation. Emkey Publication.

2. Pathak, V.N. and Yadav, N. (2008). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
3. Nita, B. (2000). Handbook of Mushrooms. Vol 1 & 2. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Tewari, P. and Kapoor S.C. (2008). Mushroom Cultivation, Mittal Publication, New Delhi.

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1. https://indiaagronet.com/indiaagronet/Mushroom_cultivation/Spawn.htm
2. <https://www.medicalnewstoday.com/articles/278858#:~:text=Mushrooms%20contain%20protein%2C%20vitamins%2C%20minerals,metabolism%20and%20other%20bodily%20processes.>
3. <https://www.everydayhealth.com/diet-nutrition/potential-health-benefits-of-mushrooms/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UMB2SE3	SEC – III MUSHROOM TECHNOLOGY					2	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓		✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓		✓		✓	✓			✓	
CO4	✓		✓	✓	✓		✓	✓		✓	
CO5	✓	✓		✓		✓		✓	✓		
Number of Matches(✓) = 38 Relationship: High											

4.

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 23UMB3CC5

Instruction Hours: 6

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE V MOLECULAR BIOLOGY AND MICROBIAL GENETICS

Objectives:

- Provide knowledge on structure and replication of DNA
- Illustrate the significance and functions of RNA in protein synthesis
- Explain the cause and types of DNA mutation and DNA repair mechanisms
- Outline the role of plasmids and phages in genetics
- Examine mechanisms of gene transfer and recombination

Course outcomes:

CO1: Analyze the significance of DNA and elucidate the replication mechanism

CO2: Demonstrate an understanding of key concepts in immunology.

CO3: Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms

CO4: Evaluate the importance of plasmids and phages in genetics

Co5: Analyze gene transfer and recombination methods

Unit I

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. 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 - 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

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 2 μ 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 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..

Text Books

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 Snusted D.P.(2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd.
3. Trun N. and Trempy J. (2009). Fundamental Bacterial Genetics. 1st Edition. Blackwell Science Ltd.
4. Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd.
5. Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.

References Books

1. Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press
2. Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn
3. Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman
4. 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
5. 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](#)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UMB3CC5	CC III Molecular biology and Microbial Genetics					6	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓		
CO2	✓		✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓		✓	✓		
CO4	✓	✓	✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓		✓		✓	✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 23UMB3CC6P

Instruction Hours: 3

Credits: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

Core Course –VI – Practical III - Molecular Biology and Microbial Genetics

Objectives:

- Provide knowledge on structure and replication of DNA
- Elucidate the methods of Genomic and Plasmid DNA isolation
- Explain methods of protein separation
- Explain artificial transformation method
- Outline the role of phages in genetics

Course outcomes:

CO1: Illustrate different types of DNA and RNA

CO2: Utilize hands-on training in isolation of genomic and plasmid DNA.

CO3: Analyze importance of experimental microbial genetics

CO4: Apply the knowledge of molecular techniques in various fields

CO5: Investigate the significance of Phages

Unit I

Study of different types of DNA and RNA using micrographs and model / schematic representations.

Study of semi-conservative replication of DNA through micrographs / schematic representations.

Unit II

Isolation of Genomic and Plasmid DNA from *E. coli* and Analysis by Agarose gel electrophoresis.

Estimation of DNA using colorimeter (diphenylamine reagent), UV spectrophotometer (A260 measurement)..

Unit III

Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – Demonstration.

UV induced auxotrophic mutant production and isolation of mutants by replica plating technique – Demonstration

Unit IV

Perform artificial Transformation in *E. coli*.

Isolation of antibiotic resistant mutants by gradient plate method. - Demonstration.

Unit V

Screening and isolation of phages from sewage.

Perform RNA isolation.

Estimate RNA...

Text Books

1. Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pvt Ltd.New Delhi.

2. Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.
3. Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.
4. Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.

References Books

1. Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. 2018.
2. Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn
3. Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman
4. 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
5. Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd.

Web Resources

1. <https://www.molbiotools.com/usefullinks.html>
2. (PDF) Molecular Biology Laboratory manual (researchgate.net)
3. <https://www.molbiotools.com/usefullinks.html>
4. <https://geneticgenie.org3>
5. <https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
III	23UMB3CC6P	CC VI- PRACTICAL III Molecular Biology and Microbial Genetics					3	3				
Course Outcomes (COs)	Programme Outcomes(POs) Programme Specific Outcomes(PSOs)											
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓			
CO2	✓	✓	✓	✓	✓	✓		✓	✓			
CO3	✓	✓		✓		✓	✓	✓		✓		
CO4	✓		✓	✓	✓	✓	✓	✓		✓		
CO5	✓	✓	✓	✓		✓		✓	✓			
Number of Matches(✓) = 39 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 23UMB3AC3
Instruction Hours: 4
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ALLIED COURSE - III CLINICAL LABORATORY TECHNOLOGY

Objective

s:

- Demonstrate ethical and professional conduct with patients, laboratory personnel, health-care professionals, and the public.
- Explain how accurate and reliable information might be obtained about proper procurement, storage, and handling of laboratory specimens.
- Develop a sound scientific knowledge foundation that prepares them to interpret, analyze and evaluate scientific knowledge in clinical practice.
- Perform a full range of laboratory tests with accuracy and precision.
- Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.

Course outcomes:

CO1: Describe characteristics of laboratory organizations and demonstrate professionalism by displaying professional conduct, model ethical behavior and operate as a vital member of the medical lab team.

CO2: Accurately collect specimens for various purposes.

CO3: Identify the basic structure of cells, tissues and organs and describe their contribution to normal function. Interpret light and electron microscopic histological images and identify the tissue source and structures.

CO4: Recognize the pathologies behind benign and malignant disorders of erythrocytes, leucocytes, thrombocytes and familiar with the diagnosis, evaluation, and management of hematologic malignancies

CO5: Interpret, implement, and complying with laws, regulations and accrediting standards and guidelines of relevant governmental and non-governmental agencies

Unit I

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

Text Books

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, 2nd Edition, Jaypee Brothers Medical Publishers, New Delhi..
4. S. Ramakrishnan, KN Sulochana (2012). **Manual of Medical Laboratory Techniques**, Jaypee Brothers Medical Publishers Pvt. Ltd.
5. . **Talib V.H. (2019).** *Handbook Medical Laboratory Technology*, 2nd Edition, Directorate of health services, Government of India

References Books

1. Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby
2. Godkar (2021). Textbook of Medical Laboratory Technology, 3rd Edition, Bhalani Publishing House
3. M.N. Chatterjee and Rana Shinde. (2008). Textbook of Medical Biochemistry, 7th Edition, Jaypee Brothers Medical Publishers Pvt. Limited
4. James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York

Web Resources

1. <https://www.jaypeedigital.com> › book
2. <https://www.pdfdrive.com> › wintrobess-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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB3AC3	Allied Course III – Clinical Laboratory Technology					4	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓		
CO2	✓	✓		✓	✓	✓		✓	✓		
CO3	✓	✓		✓	✓	✓		✓	✓		
CO4	✓	✓		✓	✓	✓		✓	✓		
CO5	✓	✓		✓	✓	✓		✓	✓		
Number of Matches(✓) = 35 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 23UMB3SE4

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE – SEC -IV (ENTREPRENEURIAL SKILL) - ORGANIC FARMING & BIOFERTILISER TECHNOLOGY

Objectives:

- Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment
- To encourage organic farming in urban areas
- Comprehensive knowledge about bacterial biofertilizers, its advantages and future perspective
- Structure and characteristic features of Cyanobacterial and fungal biofertilizer
- Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assess the shelf life and bioefficacy of biofertilizers

Course outcomes:

- CO1: Become an Entrepreneur with wide knowledge about farming and sustainable resources.
- CO2: Implement organic farming in urban areas with knowledge on compost.
- CO3: Gain knowledge about the bacterial biofertilizers and its advantages.
- CO4: Understand the significance about Cyanobacterial and fungal biofertilizers
- CO5: Understand and implement the use of bio fertilizers

Unit I

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

Unit III

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

Unit IV

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

Unit V

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

Text Books

1. A.K. Sharma (2006). Hand book of Organic Farming.
2. Edwards A.C.Gaur (2017). Hand book of Organic Farming and Biofertilizers.
3. N.S. Subbarao (2017). Bio-fertilizers in Agriculture and Forestry (4th Edition) Med tech publisher.

- SubbaRao, N. S. (2002). Soil Microbiology. Soil Microorganisms and Plant Growth. (4th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.

Web Resources

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

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB3SE4	SEC IV Organic Farming and Biofertilizer Technology					2	1			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓		✓	✓	✓		✓	✓	✓	
Number of Matches(✓) = 45 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

Course Code: 23UMB3SE5
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

Course Objectives:

- To understand Aeromicrobiology and Air borne diseases.
- To study on Air Analysis Methods.
- To develop knowledge on Control Measures of Air Microorganism.
- To understand Water Microbiology and Waterborne Diseases.
- To gain information on Microbial analysis of Water.

Course Outcomes:

- CO1: Understand the significance of aero microbiology in food and Pharma Industries.
CO2: Reveal the different methods of air sample analysis.
CO3: Describe the practice of Control of Air Microorganism.
CO4: Compare and contrast the composition of Water borne diseases and Control Measures.
CO5: Acquire knowledge on Microbial analysis of Water and Potability of water samples.

Unit I

Aeromicrobiology -Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Unit II

Air Sample Collection and Analysis -Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics

Unit III

Control Measures - Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration

Unit IV

Water Microbiology: Water borne pathogens, water borne diseases. Control Measures Precipitation, chemical disinfection, filtration, high temperature, UV light

Unit V

Microbiological Analysis of Water Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Reference Books:

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and Water A Laboratory Manual, CRC Press
2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4 th edition. Benjamin/Cummings Science Publishing, USA
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2 nd edition, Academic Press
4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3 rd

edition, ASM press edition, ASM press

Web Resources:

1. <https://microbiologynote.com/bioaerosol/>
2. <https://biologyreader.com/air-sampling-methods.html>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4493476/>
4. <https://www.biologydiscussion.com/water-microbiology/determining-potability-of-water-water-microbiology/55536>.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB4SE7	Skill Enhancement Course-VII – Microbial analysis of water and air					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓		✓	
CO2	✓	✓		✓		✓		✓	✓		
CO3	✓	✓		✓	✓		✓	✓	✓	✓	
CO4	✓			✓	✓	✓	✓		✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓		✓	
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- IV

Course Code: 23UMB4CC7
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE – VII - IMMUNOLOGY AND IMMUNOTECHNOLOGY

Objectives:

- To gain knowledge about immune system, organs of immunity and cells involved.
- To distinguish the types of antigens and antibodies; their properties.
- To provide in-depth knowledge on immuno-techniques
- To discuss the role of MHC system in transplantation; functions of Tumor specific antigens
- To impart knowledge on immunological disorders

Course outcomes:

CO1: Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses

CO2: Investigate the structures of Ag and Ab; Immunization

CO3: Justify the Immunoassay and Immunotechniques.,

CO4: Explain about the immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation

CO5: Analyze the overreaction by our immune system leading to hypersensitive conditions and its consequences

Unit I

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

Text Books

1. Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York.
2. Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., 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.

References Books.

1. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition
2. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition., Wiley-Blackwell
3. William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York
4. Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell
5. Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3rd Edition

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](#)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB4CC7	CC VII - Immunology and Immunotechnology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓		
CO3	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- IV

Course Code: 23UMB4CC8P
Instruction Hours: 3
Credits: 3

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE COURSE –VIII-PRACTICAL-IV IMMUNOLOGY AND IMMUNOTECHNOLOGY

Objectives:

- To gain hands-on knowledge to identify Blood group and typing.
- To acquire adequate skill to perform latex agglutination reactions
- To analyze precipitation reactions in gels
- To investigate the antigen & antibody reactions in electrophoresis
- To familiarize with Separation of Lymphocytes

Course outcomes:

- CO1: Assess the blood groups and types
- CO2: Competently perform serological diagnostic tests such as RF, ASO, CRP
- CO3: Illustrate the antigen antibody reactions in gel
- CO4: Compare & contrast antigens and antibodies in electrophoresis
- CO5: Examine the concept of ELISA

Unit I

Identification of blood group and typing.

Coomb's test. TPHA.

Unit II

T cell identification (Demonstration)

Latex Agglutination reactions- RF, ASO, CRP.

Unit III

Ouchterlony's Double Diffusion Method (antigen pattern).

Single Radial Immuno Diffusion Method.

Unit IV

Electrophoresis - Serum, Counter and Immuno

Unit V

Separation of Lymphocytes by gradient centrifugation method.

ELISA: Hepatitis/ HIV

Text Books

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. 5thEdition., Wiley-Blackwell, New York.
4. Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York.
5. Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

References Books

1. Frank C. Hay, Olwyn M. R. Westwood. (2008). Practical Immunology, 4th Edition, Wiley-Blackwell
2. Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing
3. Rose. (1992). Manual of Clinical Lab Immunology, ASM
4. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition
5. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11th Edition., Wiley-Blackwell

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](#)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB4CC8P	Practical IV - Immunology And Immunotechnology					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓		
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓		✓	✓	✓		✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- IV

Course Code: 23UMB4AC4
Instruction Hours: 4
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ALLIED COURSE IV FOOD PROCESSING TECHNOLOGY

Objectives:

- To provide knowledge on objectives of food preservation
- To explain the freshness criteria and quality assessment of meat and fish
- To outline the methods of milk processing and fermented milk products
- To explain the importance of fat and oil processing
- To discuss the methods of microbiological examination of foods.

Course Outcomes:

CO1: Assess the fundamental concepts of food preservation,
CO2: Investigate the quality assessment of meat and fish.
CO3: Design the processing of milk and milk quality assessment
CO4: Explain about the importance of fats and oils
CO5: Plan the food safety and adulteration detection

Unit I

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 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; 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 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

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.

Text Books

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.

- Ramaswamy H & Marcotte M. (2006). Food Processing: Principles & Applications. Taylor & Francis.
- NIIR Board of Food and Technologist. (2005). Modern Technology of Food Processing and Agrobased industries, National Institute of Industrial Research, Delhi.
- Adams M.R. and Moss M. O (2007). Food Microbiology. New Age International.

References:

- Fellos PJ. (2005). Food Processing Technology: Principle & Practice 2nd Edition. CRC
- Peter Zeuthen and Leif Bogh-Sorenson. (2005). Food Preservation Techniques, Woodland Publishing Ltd, Cambridge, England.1
- Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano. (2004). Novel Food Processing Technologies, CRC.
- Suman Bhatti, Uma Varma. (1995). Fruit and vegetable processing organizations and institutions, 1st Edition., CBS Publishing, New Delhi.

Web Resources

- <https://sites.google.com/a/uasd.in/ecourse/food-processing-technology>
- <https://nptel.ac.in/courses/126105015>
- <https://engineeringinterviewquestions.com/biology-notes-on-food-adulteration/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB4AC4	FOOD PROCESSING TECHNOLOGY					4	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓		
CO2	✓	✓		✓	✓	✓		✓	✓		
CO3	✓	✓	✓	✓	✓	✓		✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- IV

Course Code: 23UMB4AP2
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 40
External Marks: 60

ALLIED PRACTICAL-II

Course Objectives:

- List the various tests done in a clinical biochemistry lab.
- Perform independently estimation of triglycerides, estimation of liver function tests and other clinical biochemistry tests.
- Maintain independently the various equipments in the Food Processing technology

Course Outcomes:

CO1: Enumerate on the various equipments in the clinical biochemistry laboratory.

CO2: Demonstrate blood test

CO3: Apply different methods to freeze and dry vegetables

CO4: Employ processing methods to prepare food products

CO5: Analyze the presence of food preservatives in food products

List of Practicals

1. Determination of haemoglobin
2. Determination of Total RBC count.
3. Determination of PCV
4. Differential Leucocyte Count
5. Determination of Plasma Haemoglobin
6. To prepare formalin from stock solution
7. Preparation of mixed fruit jam and jelly
8. Preparation of sauces
9. Preparation of syrups and squashes.
10. Estimation of pH and acidity in fruit juices

Reference books:

1. Ramani Sood, Laboratory Technology (Methods and interpretation) 4th Ed. J.P. Bros, New Delhi
2. Mukharji, Medical Laboratory Techniques, Vol - I, II & III, 5th Edn. Tata McGrawHill, Delhi.
3. James G. Brennan, (2006) Food Processing Hand book. Wiley-Vch Verlag GmbH&Co KGaA, Weinheim, Germany

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB4AP4	ALLIED PRACTICAL - II					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓		
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓		✓		
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- V

Course Code: 23UMB5CC9
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE IX BACTERIOLOGY AND MYCOLOGY

Objectives:

- Understand the role of normal flora and pathogenic microbes of various diseases and clinical microbiological techniques.
- Basic knowledge about Gram positive pathogenic bacteria and their epidemiology
- Acquire knowledge about Gram negative pathogenic bacteria and nosocomial infections
- Comprehensive knowledge about medically important, its classification and its significance
- Gain knowledge about the general characteristics and mode of action of various antibacterial agents

Course outcomes:

CO1: Understand the importance of normal flora of human body and acquire knowledge on the process of infectious disease.

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.

CO3: Compile a list of disease-causing bacteria and compare their modes of infection, symptoms, diagnosis and treatment.

CO4: Comprehend human-fungal interaction, which can be applied to obtain in-depth knowledge on fungal diseases and the mechanism behind the disease process.

CO5: Explain the types of mycoses caused in humans and categorize the modes of infection, pathogenesis, and treatment with introduction to mycotoxins.

Unit I

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 infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (*Streptococcus pyogenes*, *Streptococcus faecalis*), (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 - 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*, *Salmonella paratyphi*) (c) cholera (*Vibrio cholerae*) (d) bacillary dysentery (*Shigella dysenteriae*); Sexually Transmitted disease (syphilis–*Treponema pallidum*.Gonorrhoea - *Neisseria*

gonorrhoeae); Nosocomial infections – definition, importance, and their control (*Pseudomonas aeruginosa*).

Unit IV

Medically important Fungi - Classification of medically important fungi; Superficial mycoses: Pityriasis Versicolor; Tinea Nigra; Piedra. Cutaneous mycoses: *Microsporum* spp., *Trichophyton* spp., and *Epidermophyton floccosum*. Subcutaneous mycoses: Chromoblastomycosis; Sporotrichosis; Systemic Mycoses - Blastomycosis; Histoplasmosis; Opportunistic Infections - Candidiasis; Cryptococcosis; Zygomycosis; Mycotoxins: Aflatoxin

Unit- V

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.

Text Books

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, 18th Edition. Churchill Livingstone, London.
3. Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis.
4. Ananthanarayanan, R. and Jayaram Panicker C.K. (2020) Text book of Microbiology. Orient Longman, Hyderabad.
5. Jagdish Chander (2018). Textbook of Medical Mycology, 4th edition, Jaypee Brothers medical publishers.

References Books

1. Gerhardt, P., Murray, R.G., Wood, W.A. and Krieg, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
2. Kevin Kavanagh, (2018). Fungi Biology and Applications 3rd Edition. Wiley Blackwell publishers.
3. C.J. Alexopoulos, C.W. Mims, M. Blackwell, (2007). Introductory Mycology, 4th edition. Wiley publishers.
4. A.J. Salle (2007). Fundamental principles of bacteriology, fourth edition, Tata McGraw-Hill Publications.
5. Christopher C. Kibbler, Richard Barton, 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/>
5. <https://www.isham.org/mycology-resources/mycological-links>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB5CC9	BACTERIOLOGY AND MYCOLOGY					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓		
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- V

Course Code: 23UMB5CC10
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Mark: 75

CORE COURSE X - VIROLOGY AND PARASITOLOGY

Course Objectives:

- To gain knowledge on properties and classification of viruses and collection of relevant clinical samples for diagnosing viral infections.
- To understand pathogenic microorganisms of viruses and the mechanisms by which they cause disease in the human body.
- To gain knowledge about reemerging viral infections and develop diagnostic skills, including the use and interpretation of laboratory test in the diagnosis of infectious diseases.
- Understand the types of parasites causing infections in the intestine.
- To develop skills in the diagnosis of parasitic infections.

Course outcomes:

CO1: Understand the structure and properties of viruses, cultivation methods and diagnosis of viral diseases.

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.

CO3: Insights to treatment options of viral diseases.

CO4: Knowledge about the importance of protozoans in the intestine.

CO5: Knowledge of Nematodes as infectious agent

Unit I

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

Viral diseases with reference to symptoms, pathogenesis, transmission, prophylaxis and control – Arboviruses (Flavi virus), Picorna viruses (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): Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations.

Unit III

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

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: *Entamoeba histolytica*, flagellates (*Giardia lamblia*, *Leishmania donovani*), Sporozoa- *Plasmodium* spp.

Unit V

Introduction to Helminthes, Platyhelminthes – *Taenia* – *Fasciola* – *Paragonimus* – *Schistosoma* spp.. Nematelminthes – *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 (Floation and Sedimentation techniques), Examination of blood for parasites. Cultivation of parasites.

Text Books

1. S., Rajan(2007). Medical microbiology, MJP publisher.
2. JeyaramPaniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers, New Delhi.
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. Parija S. C. (1996). Text Book of Medical Parasitology. 4th edition, Orient Longman, All India Publishers & Distributors.

References

1. Jawetz, E., Melnick, J.L. and Adelberg, E.A. (2000). Review of Medical Microbiology, 19th Edition. Lange Medical Publications, U.S.A.
2. Ananthanarayan, R. and JeyaramPaniker, C.K. (2009). Text Book of Microbiology, 8th Edition. Orient Longman, Chennai .
3. Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey.
4. Topley & Wilson's (1990). Principles of Bacteriology, Virology and Immunity, 8th Edition, Vol. III Bacterial Diseases, Edward Arnold, London.
5. Finegold, S.M. (2000). Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis.

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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UMB5CC10	VIROLOGY AND PARASITOLOGY					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓	✓	✓	✓			✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓			
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- V

Course Code: 23UMB5CC11P
Instruction Hours: 5
Credits: 4

Exam Hours: 3
Internal Marks: 40
External Mark: 60

CORE COURSE XI - PRACTICAL V

Course Objectives:

- To familiarize students with medical microbiology techniques and technical knowledge on collection and processing of clinical samples.
- To learn the techniques for isolation and identification of bacterial pathogens.
- To gain expertise in various techniques of clinically important viral pathogens and their identification.
- To get acquainted with medically important fungi and their metabolism.
- To categorize parasites and understand their role in infections.

Course outcomes:

CO1: Demonstrate methods to observe and measure microorganisms by standard microbiological techniques

CO2: Identify pathogenic microorganisms in the laboratory set-up and interpret their sensitivity towards commonly administered antibiotics.

CO3: Understand experimental tools used to cultivate and characterize clinically important viruses and bacteriophages

CO4: Elucidate clinically important fungi.

CO5: Investigate Parasites of medical importance and identify them from clinical specimens.

Unit I

1. Collection and Transport of Clinical specimens.
2. Simple, Differential and Special staining of Clinical materials.
3. Culture techniques used to isolate microorganisms.

Unit II

4. Identification of bacterial pathogens by their biochemical reactions.
5. Antimicrobial susceptibility testing by disc-diffusion technique and determination of Minimum Inhibitory Concentration.

Unit III

6. Isolation of Bacteriophages from Sewage and other natural sources.
7. Identification of Viruses in Slides/Smears/Spotters. Demonstration of Negri bodies (Staining).
8. Cultivation of Viruses in Embryonated eggs – Amniotic, Allantoic, Yolk sac routes and Chorio-allantoic membrane

Unit IV

9. Microscopic identification of medically important Fungi – KOH and Lactophenol cotton Blue staining.
10. Slide culture techniques for fungal Identification
11. Identification of Dermatophytes.
12. Germ tube test, Carbohydrate fermentation and assimilation tests for Yeasts.

Unit V

13. Direct Examination of Faeces – wet mount and Iodine mount – Demonstration of Protozoan cysts and Helminthes eggs.
14. Concentration techniques of stool specimen – Floatation and Sedimentation methods.
15. Examination of blood for Malarial parasites – thin and thick smear preparations.
16. Identification of Medically important parasites in slides / specimens as spotters.

Text Books

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. Collee, J.G., Fraser, A.G., Marnion, B.P. and Simmons, A. (1996). Mackie & McCartney Practical Medical Microbiology. 14th Edition. Elsevier. ISBN-10: 813120393X, ISBN-13: 978-8131203934.
4. Prince CP (2009). Practical Manual of Medical Microbiology, Ist edition, Jaypee digital publishing
5. James H. Jorgensen, Karen C. Carroll, Guido Funke, Michael A. Pfaller, Marie Louise Landry, Sandra S. Richter, David W. Warnock (2015). Manual of Clinical Microbiology, 11th Edition, ASM press

Reference Books

1. Patricia M. Tille (2021). Bailey & Scott's Diagnostic Microbiology, 15th Edition. Elsevier. ISBN-10: 0323681050, ISBN-13: 978-0323681056.
2. Monica Cheesbrough (2006). District Laboratory Practice in Tropical Countries. Part 1. 2nd Edition. Cambridge University Press. ISBN-10: 0521171571, ISBN-13: 978-0521171571.
3. Michael A. Pfaller (ed.) (2015). Manual of Clinical Microbiology. Vol. 1 and 2. 11th Edition. ASM Press. ISBN-10: 9781555817374, ISBN-13: 978-1555817374.
4. Josephine A. Morello, Paul A. Granato and Helen EckelMizer (2002). Laboratory Manual and Workbook in Microbiology. 7th Edition. The McGraw Hill Company. ISBN: 0-07-246354-6.

- 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

- <https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf>
- http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf
- https://www.academia.edu/11977315/Basic_Laboratory_Procedures_in_Clinical_Bacteriology
- <https://cmr.asm.org/content/31/3/e00062-17.full.pdf>
- <https://microbiologyinfo.com/techniques-of-virus-cultivation/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
V	23UMB5CC11P	CORE COURSE XI - PRACTICAL V					5	4				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓		✓	✓	✓		✓	✓			
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓		✓	✓			
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 44 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

Course Code: 23UMB5CC12PW

Instruction Hours: 5

Credits: 3

PROJECT WORK

Each of the students has to undertake a Project individually under the supervision of a teacher. A project report should have the following components:

- 1) Cover Page: This should contain the title of the project proposal, to whom it is submitted, for which degree, the name of the author, name of the supervisor, year of submission of the project work, name of the University.
- 2) Acknowledgement: Various organizations and individuals who might have provided assistance /co-operation during the process of carrying out the study.
- 3) Table of Content: Page-wise listing of the main contents in the report, i.e., different Chapters and its main Sections along with their page numbers.
- 4) Body of the Report: The body of the report should have these four logical divisions a) Introduction: This will cover the background, rationale/ need / justification, brief review of literature, objectives, methodology (the area of the study, sample, type of study, tools for data collection, and method of analysis), Limitations of the Study, and Chapter Planning. b) Review of Literature (relating to the topic of the Project). c) Materials and Methods d)Results and Discussion e)Summary and Conclusion
- 5) Bibliography or References: This section will include the list of books and articles which have been used in the project work, and in writing a project report.
- 6) Annexures: Questionnaires (if any), relevant reports, etc.

S.No	Work Description	Maximum marks
1	Dissertation	80
2	Viva voce	20

Note:

Attending the reviews is compulsory

Font size in documentation has to be 12, Times New Roman, Space 1.5

Document should be neatly aligned and justified

SEMESTER- V

Course Code: 23UMB5DE1

Instruction Hours: 4

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE- I RECOMBINANT DNA TECHNOLOGY

Objectives:

- Understand the principles of rDNA technology.
- Illustrate the molecular tools employed in gene cloning.
- Discuss the importance of various molecular techniques and their importance in Biotechnology.
- Acquire knowledge about the concepts of tissue culture methods and transgenic organisms.
- Examine recent trends in genetic engineering and its application in human welfare.

Course outcomes:

CO1: Illustrate the steps involved in introduction and expression of foreign DNA into bacteria, animal and plants cells and their screening.

CO2: Discuss the various cloning vectors and their applications.

CO3: Assess the usage and advantages of molecular tools.

CO4: Explain plant and animal tissue culture protocols and gene transfer mechanism.

CO5: Elucidate and understand the application of genetic engineering and gene therapy.

Unit I

Milestones in rDNA Technology- Gene Manipulation-

Steps involved in Gene Cloning. Isolation of Chromosomal and Plasmid DNA. Restriction endonuclease - Discovery, Types, Mode of action- Application of Ligase, DNA Polymerase, DNA Modifying enzymes and Topoisomerases. Use of Linkers and Adapters.

Unit II

Artificial Gene Transfer methods- Calcium Chloride Induction, Electroporation, Microinjection, Biolistic method, Liposome and Viral-mediated delivery. Cloning vectors – Properties and Applications - Plasmid Based Vectors- Natural Vectors- pSC101 and pMB1. Artificial Vectors- pBR322 and pUC. Phage Based Vectors- Lambda phage. Hybrid Vectors, Phagemid, Cosmid, BAC and YAC. Screening of Recombinants. Genomic DNA and cDNA Library- Construction and Screening.

Unit III

Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGE Blotting Techniques- Southern, Western & Northern. DNA sequencing methods- Sanger's and Automated method. Recent Trends in Genetic Engineering- Targeted Genome Editing- ZFNs, TALENs, CRISPRs. Gene Targeting- Knock-in & Knock-outs. DNA Fingerprinting,

Unit IV

Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture- Explant Culture- Micropropagation- Callus and Protoplast Culture- Production of Bio-Active Secondary Metabolites by Plant Tissue Culture - Agrobacterium and Crown Gall Tumors, Ti Plasmid and Ri Plasmid- Animal Biotechnology- Principles of Animal Cell Culture, Media and Equipment for Animal Cell Culture – Primary and Secondary Cultures- Cell Lines- Types, Establishment and

Maintenance of Cell Lines.

Unit V

Applications of Genetic Engineering - Transgenic Animals – Mice and Sheep- Recombinant Cytokines and their use in the Treatment of Animal infections- Monoclonal Antibodies in Therapy- Vaccines and their Applications in Animal Infections - Human Gene Therapy- Germline and Somatic Cell Therapy -*Ex-vivo* Gene Therapy- SCID (Severe Combined Immuno Deficiency) – *In-vivo* Gene Therapy- CFTR (Cystic Fibrosis Transmembrane Regulator) – Vectors in Gene Therapy- Viral and Non-Viral Vectors. Transgenic Plants – Bt Cotton, Bt Corn, Round Ready soybean, Flavr Savr Tomato and Golden Rice.

Text Books

1. Brown T.A. (2016). Gene Cloning and DNA Analysis. 7th Edition . John Wiley and Jones, Ltd.
2. Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. 3rd Edition. John Wiley and Sons Ltd.
3. Keya Chaudhuri (2013). Recombinant DNA technology. The Energy and Resources Institute
4. Siddra Ijaz, Imran UI Haq (2019). Recombinant DNA Technology. Cambridge Scholars Publishing.
5. Monika Jain (2012). Recombinant DNA Techniques: A Textbook, I Edition, Alpha Science International Ltd

Reference Books

1. Maloy S. R., Cronan J.E. Jr. and Freifelder D. (2011). Microbial Genetics. 2nd Edition. Narosa Publishing Home Pvt Ltd.
2. Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
3. Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition. Pearson New International Edition.
4. 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.
5. James D. Watson, Michael Gilman, Jan Witkowski, Mark Zoller (1992). Recombinant DNA. Scientific American Books

Web Resources

1. <https://www.britannica.com/recombinant-DNA-technology>
2. <https://www.byjus.com/recombinant-dna-technology>
3. <https://www.rpi.edu>
4. <https://www.ncbi.nlm.nih.gov>
5. <https://www.le.ac.uk/recombinant-dna-and-genetic-techniques>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UMB5DE1	RECOMBINANT DNA TECHNOLOGY					4	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓		✓		✓	✓	✓	✓	✓	
CO4	✓	✓		✓		✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- V

Course Code: 23UMB5DE2
Instruction Hours: 4
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Mark: 75

DISCIPLINE SPECIFIC ELECTIVE II – BIOSAFETY&BIOETHICS

Course 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
- Rights in order to assist their application and promotion in the areas of science, biotechnology and medicine.
- To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.
- To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To understand the importance of IPR, Patents and Patent laws.

Course Outcomes:

CO1: Understand the control measures of laboratory hazards (chemical, biological and physical) and to practice safety strategies and personal protective equipment

CO2: Develop stratagems for the use of genetically modified organisms and Hazardous materials

CO3: Develop skills of critical ethical analysis of contemporary moral problems in medicine and health care.

CO4: Analyze and respond to the comments of other students regarding philosophical issues.

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

Unit I

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 - 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 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

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

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.

Text Books

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, Biosafety and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700
4. Rajmohan Joshi (2006). Biosafety and Bioethics. Gyan Books publisher.
5. Sateesh. M.K. (2013). Bioethics and Biosafety. i.K. International pvt,Ltd.

Reference Books

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited, ISBN-10: 9386668572
2. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited, ISBN : 9788120349896
3. Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis, ISBN-10: 8131251659.
4. Edited by Sylvia Uzochukwu, Nwadiuto (Diuto) Esiobu, Arinze Stanley Okoli, Emeka Godfrey Nwoba, EzebuiroNwagboChristpeace, Charles OluwaseunAdetunji, Abdulrazak B. Ibrahim, Benjamin Ewa Ubi (2022). Biosafety and Bioethics in Biotechnology-Policy, Advocacy, and Capacity Building,1st edition. CRC Press
5. 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.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UMB5DE2	BIOSAFETY&BIOETHICS					4	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓		✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓		✓	✓	✓	✓	✓	
CO4	✓	✓				✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- VI

Course Code: 23UMB6CC13
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Mark: 75

CORE COURSE –XIII ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY

Course 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.
- To acquire knowledge about the role of microorganism in water pollution and water quality
- Gain knowledge about microbes as biofertilizers and the aspects of application.
- To learn about the process of solid waste management and sewage water treatment.
- Gain knowledge on various plant diseases and pathogens

Course outcomes:

CO1: Describe about the structure and function of ecosystems and understand the role of microbes in various environments

CO2: Identify the cause of water pollution, and perform methods to assess the quality of water.

CO3: Explain the production of biofertilizers and biopesticides.

CO4: Explain about waste treatment process and microbial decomposition and bio-remediation process.

CO5: Describe about plant diseases caused by microbes and acquire a clear idea on plant pathogenic interaction

Unit I

Microorganisms and their Habitats: Structure and function of ecosystems

Terrestrial Environment: Soil profile and soil microflora, Microbial succession in decomposition of soil organic matter. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen. Aquatic Environment: Microflora of fresh water and marine habitats, factors influencing microbial growth in the aquatic environments.

Atmosphere: Aeromicroflora and dispersal of microbes, Assessment of air quality, Enumeration of microorganism in air, Air sanitation. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Predisposing factors for Environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases. Environmental Protection Agency (EPA) - role in environmental protection.

Unit II

Water potability: 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: Rhizosphere microflora. Concepts of Nitrogen fixation – Symbiotic and asymbiotic nitrogen fixers. Brief account of microbial interactions: Symbiosis, neutralism,

commensalism, competition, Ammensalism, Synergism, parasitism, and predation. General account and Significance of Biofertilizers and biocontrol agents – Bacterial, cyanobacterial, VAM. Mass production of Rhizobialbiofertilizer. Biocontrol agents – Bacterial, viral, fungal.

Unit IV

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: 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.

Text Books

1. Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. BrightSun 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. K. Vijaya Ramesh.(2004).Environmental Microbiology. 1st Edition. MJP Publishers.
5. SubbaRao.N.S.(2017). Soil Microbiology.4th Edition. Oxford and IBH Publishing Pvt.Ltd.

References

1. Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil
2. EcEldowney S, Hardman D.J., Waite D.J., Waite S.(1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
3. Mitchel, R.(1992). Environmental Microbiology. Wiley –John Wiley and Sons. Inc.
4. Clescri, L.S., Greenberg, A.E. and Eaton, A.D.(1998). Standard Methods for Examination of Water and Wastewater, 20th Edition. American Public Health Association.
5. Atlas, R.M. and Bartha, R.(1992). Microbial Ecology: Fundamentals and Applications, 2nd Edition. The Benjamin / Cummings Publishing Co.,Redwood City, CA.

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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	23UMB6CC13	Environmental And Agriculture Microbiology					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓		✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓		✓	✓	✓	✓	✓	
CO4	✓	✓			✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 42 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- VI

Course Code: 23UMB6CC14

Instruction Hours: 6

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE COURSE - XIV FOOD, DAIRY AND PROBIOTIC MICROBIOLOGY

Objectives:

- To impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety.
- Gives an insight into various types of food borne diseases and their prevention
- To gain information about microflora of milk
- To study about the production of fermented dairy products
- To impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits
- To create a sustainable environmentally and technologically advanced dairy farm

Course outcomes:

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.

CO2: Acquire a thorough understanding of food borne diseases, testing methods, and preventive technique

CO3: Gain information about spoilage of milk and its products and its antimicrobial properties

CO4: Learn about the various fermented product and its various stage spoilage

CO5: Impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits

Unit I

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

Unit II

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

Microflora 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: 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, 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. Biopreservation. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora - Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods.

Text Books

1. Frazier WC and West off DC. (2017). Food microbiology. 5th Edition TATA McGraw Hill Publishing Company Ltd. New Delhi.
2. Adams, M.R., Moss, M.O.(2018). Food Microbiology 1st edition. New Age Publishers by New Age International (P) Ltd., Publishers.
3. R.C. Dubey. (2014). Advanced Biotechnology. S. Chand publishers.
4. Banwart GJ. (1989). Basic food microbiology, Chapman & Hall, New York.
5. Sugumar D. (1997). Outlines of dairy technology, Oxford University press. 1997.

References

1. Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology. 7th Edition
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. Clescri, L.S., Greenberg, A.E. and Eaton, A.D.(1998).
4. Yuankunlee, Sepposalminen. (2008). Handbook of probiotics and prebiotics Second Edition. A John Wiley & Sons publication Inc.
5. Dharumaurai Dhansekar, Alwarappan Sankaranarayanan. (2021). Advances in Probiotics Microorganisms in Food and Health 1st Edition. eBook ISBN:9780128230916.

Web Resources

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

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UMB6CC14	Core Course - XIV Food, Dairy And Probiotic Microbiology					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓		✓		✓		
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓		✓	✓	✓	✓	✓	
CO4		✓			✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 38 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- VI

Course Code: 23UMB6CC15P
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 40
External Marks: 60

CORE COURSE – XV- PRACTICAL VI

Course Objectives:

- To assess the water quality and potability.
- To acquire knowledge on enumeration of bacteria from milk and milk quality analysis
- To investigate various extracellular enzyme producers in soil and to gain knowledge on preparation of biofertilizers
- Improve knowledge on plant pathogens
- To acquire knowledge on preparation of probiotics and prebiotics

Course outcomes:

CO1: Assess the microbial quality of water and relate the experimental results to the prescribed standards by the statutory bodies

CO2: Evaluate the quality of milk and enumerate bacteria in milk by standard plate count method

CO3: Identify extracellular enzyme producing and nitrogen fixing microorganism from soil and to prepare a biofertilizer.

CO4: Identify various plant pathogenic bacteria

CO5: Synthesize probiotic fermented milks using microorganisms

Unit I

1. Physical, chemical, and microbiological assessment of water and potability test for water.

o Physical a – Color, pH,

o Chemical - alkalinity, acidity, DO, BOD, COD

o Microbiological – MPN index (Presumptive, Completed and Confirmatory test)

2. Study of air microflora by settle plate method.

Unit II

Isolation and identification of bacteria and fungi from fruits and vegetables

4. Direct microscopic count of milk.

5. Methylene blue reductase test and Resazurin test

6. Microbiological examination of milk by SPC.

Unit III

7. Isolation of extracellular enzyme producers – Amylase, protease, lipase

8. Microbiological assay of antibiotics by cup plate method and other methods

9. Isolation of *Rhizobium*/ *Azotobacter*/ phosphate solubilizing organisms

10. Preparation of biofertilizers – Demonstration

Unit IV

11. Study of plant pathogens- Tikka Disease, Red rot of sugarcane, Citrus

canker, Blight of paddy.

12. Study of fungi - *Mucor*, *Curvularia*, *Alternaria*, *Rhizopus*, *Aspergillus*

Unit V

13. Isolation of constituent flora of fermented milk.

14. Growth of probiotic LAB in broth, milk and whey.

15. Preparation of probiotic fermented milks like dahi, yoghurt, lassi and whey drink.

16. Effect of prebiotics on the growth of LAB in milk and broth.

17. Survivability of probiotic organisms in fermented milks.

18. Antimicrobial potential of the functional dairy products.

Text Books

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. (2014). Advanced Biotechnology. S. Chand publishers.
4. Neelima Garg, K.L. Garg, K.G. Mukerji (2010). Laboratory Manual of Food Microbiology, Wiley publication
5. Aneja, KR.(2010). Experiments in Microbiology, Plant pathology and Biotechnology. New Age International (P) Limited.

References

1. 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.
2. James G Cappucino and Natalie Sherman.(2016). Microbiology – A laboratory manual. 4th Edition. The Benjamin publishing company, New York.
3. Marylynn V. Yates, Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai (2016). Manual of Environmental Microbiology, 4th Edition, ASM press.
4. Burns, Richard G (2005). Environmental Microbiology A Laboratory Manual, 2nd Edition .Lippincott Williams & Wilkins, Inc.
5. Ian Pepper, Charles Gerba, Jeffrey Bredecke (2004). Environmental Microbiology-A laboratory manual, Elsevier.

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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UMB6CC15P	CORE COURSE – XV- PRACTICAL VI					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓		✓		✓		
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓		✓	✓		✓	✓		✓	✓	
CO4		✓			✓	✓		✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓		✓	
Number of Matches(✓) = 34 Relationship: Moderate											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- VI

Course Code: 23UMB6DE3

Instruction Hours: 6

Marks: 25

Credits: 4

Marks: 75

Exam Hours: 3

Internal

External

DISCIPLINE SPECIFIC ELECTIVE- III PHARMACEUTICAL MICROBIOLOGY

Course Objectives:

- To provide the knowledge on basics of chemotherapy
- To learn the assays and testing methods of antibiotics.
- To gain information about spoilage of pharmaceutical products
- To provide the knowledge on drug discovery and clinical trials
- To learn about regulations in pharmaceutical industry

Course outcomes:

CO1: Learn the basics of chemotherapy and action of antibiotics

CO2: Carry out the microbiological assay of antibiotics

CO3: Analyse Microbiological standardization of Pharmaceuticals ,sterility testing of pharmaceutical productsApplysterilization in pharmaceutical industry.

CO4: Evaluate the process and develop new strategies for rational drug design.

CO5: Learn the Regulatory guidelines in pharmaceuticals product.

Unit I

Introduction to Pharmaceutical microbiology: Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, skin and respiratory flora of workers, raw materials, packaging, building and equipments and their control measures; Design and layout of sterile manufacturing.

Unit II

Microbial contamination and spoilage of pharmaceutical products: Microbial aspects of pharmaceutical products; Sterilization of pharmaceutical products: Heat, gaseous, radiation and filtration; Contamination and Spoilage of Pharmaceutical products: sterile injectable and non-injectable, ophthalmologic preparation, implants.

Unit III

Production of antibiotics: Production of antibacterial – Penicillin, Tetracycline; antifungal – Griseofulvin, Amphotericin; antiparasitic agents – Artemesin, Metronidazole; Semi-synthetic antibiotics and anticancerous agents; Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase, Streptodornase, L-asperginase and clinical dextrin; Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals.

Unit IV

Production of immunological products and their quality control: Vaccines - DNA vaccines, synthetic peptide vaccines, multivalent vaccines; Vaccine clinical trials; Immunodiagnosics - immuno sera and immunoglobulin; Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests.

Unit V

Quality Assurance and Validation: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry; Regulatory aspects of quality control;

Quality assurance and quality management in pharmaceuticals – BIS (IS), ISI, ISO, WHO and US certification.

Text Books

1. Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher.
2. Hugo WB and Russell AD. (2004).Pharmaceutical Microbiology VII edition. Blackwell Scientific Publication, Oxford.
3. Franklin,DJ. and Snow, GA. (2013). Biochemistry of antimicrobial action.Chapman& Hall.
4. Kuntal Das (2019). Pharmaceutical Microbiology, second edition, NiraliPrakashan.
5. PriyatamaPowar, Shital Nimbargi, VaijayantiSapre (2020). Pharmaceutical Microbiology, I edition, Technical publications.

References

1. Handa, S.S. and Kapoor, V.K. (2022) .Pharmacognosy. 4thEdition.VallabhPrakashanPublishers,New Delhi.
2. Kokate, C.K., Durohit, A.P. and Gokhale, S.R.,(2002). Pharmacognosy. 12thedition NiraliPrakasham Publishers, Pune.
3. S. P. Vyas & V. K. Dixit.(2003). Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi.
4. Wallis, T.E. (2005). Text book of Pharmacognosy. 5th edition. CBS publishers and distributors, New Delhi.
5. Garrod, L.P., Lambert, HP. And C'Grady, F. (1973). Antibiotics and Chemotherapy. (eds). Churchill Livingstone.

Web Resources

1. <https://www.pharmapproach.com/introduction-to-pharmaceutical-microbiology/>
2. https://www.iptsalipur.org/wp-content/uploads/2020/08/BP303T_PMB_UNIT_I.pdf
3. <https://www.pharmanotes.org/2021/11/pharmaceutical-microbiology-b-pharma.htmlhttps://www.sfamjournals.onlinelibrary.wiley.com>
4. https://sncourseware.org/snscphs/notes.php?cw=CW_604b15c6313c5
5. <https://www.thermofisher.com>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UMB6DE3	Discipline Specific Elective- III Pharmaceutical Microbiology					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓		✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓	✓		✓	✓	
CO4		✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- VI

Course Code: 23UMB6DE4
Instruction Hours: 6
Credits: 4

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DISCIPLINE SPECIFIC ELECTIVE- IV ENTREPRENEURSHIP AND BIO-BUSINESS

Course Objectives:

- Understanding basic concepts in the area of entrepreneurship, the role and importance of entrepreneurship for economic development
- Developing personal creativity and entrepreneurial initiative, adopting the key steps in the elaboration of business idea.
- Understanding the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.
- Explain the central components of successful business strategies in biotechnology, and create a business plan.
- Understand the various funding resources and develop as Entrepreneur

Course outcomes:

CO1: Describe and apply several entrepreneurial ideas and business theories in practical framework.

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.

CO3: Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides in response with field application and crop response.

CO4: Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits.

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.

Unit I

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

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

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

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

Unit V

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.

Text Books

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 Scholarly Editions: Atlanta, Georgia.
3. Jennifer Merritt, Jason Feifer (2018). Start Your Own Business, 7th edition, Entrepreneur Press publisher.
4. Peter F. Drucker (2006). Innovation and Entrepreneurship. Harper Business publisher.
5. Leah Cannon (2017). How to Start a Life Science Company: A Comprehensive Guide for First-Time Entrepreneurs. International Kindle paperwhite.

Reference Books

1. Crueger, W, and Crueger. A.(2000). Biotechnology: A Text Book of Industrialmicrobiology, 2nd Edition, Sinauer Associates: Sunderland.Mass.
2. Paul S Teng. (2008). Bioscience Entrepreneurship in AsiaWorld Scientific Publishing Company.
3. Charles E. Bamford, Garry D. Bruton (2015). ENTREPRENEURSHIP: The Art, Science, and Process for Success, 2nd Edition, McGraw Hill publisher.
4. Yali Friedman (2014). Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science 4th Edition, Logos press publication.
5. 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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UMB6DE4	Discipline Specific Elective- IV Entrepreneurship and bio-business					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓		✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓	✓		✓	✓	
CO4		✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High