

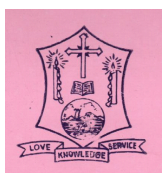
2022

# **B.Sc MICROBIOLOGY**

## **Course Structure and Syllabus**

(For the candidates admitted from the academic year 2022-2023 onwards)

### **CHOICE BASED CREDIT SYSTEM (CBCS)**



**THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)**  
(Approved by NAAC, Affiliated to Bharathidasan University)  
**ELAMBALUR, PERAMBALUR – 621 220**



For the candidates admitted from the academic year 2022-2023 onwards

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

**Bachelor of Microbiology - UG Course Structure under CBCS**

(For the candidates admitted from the academic year 2022-2023 onwards)

Se me ster	P a r t	Course Code	Title of the Course	Ins. Hours/ Weeks	Cre dits	Exam Hour s	CIA (Max )	ESE (Max )	Total (Max )
1	I	22UT1/ 22UH1	Language-I	6	3	3	25	75	100
1	II	22UE1	English-I (Communicative English)	6	3	3	25	75	100
1	III	20UMB1CC1	Basic Microbiology	5	5	3	25	75	100
1	III	22UMBIAC1	Biochemistry-I	5	5	3	25	75	100
1	III	22UMB1CP1	Basic Microbiology (P)	3	2	3	40	60	100
1	III	22UMB2AP1	Biochemistry I & II (P)	3	--	--	--	--	--
1	IV	22UVE	Value Education	2	2	3	25	75	100
<b>Total</b>				<b>30</b>	<b>20</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>600</b>
2	I	22UT2/ 22UH2	Language-I	6	3	3	25	75	100
2	II	22UE2	English-II (Communicative English)	6	3	3	25	75	100
2	III	22UMB2CC2	Microbial Metabolism	5	4	3	25	75	100
2	III	22UMB2AC2	Biochemistry-II	5	4	3	25	75	100
2	III	22UMB2CP2	Microbial Metabolism (P)	3	3	3	40	60	100
2	III	22UMB2AP1	Biochemistry I & II (P)	3	3	3	40	60	100
2	IV	22UES	Environmental Studies	2	2	3	25	75	100
<b>2</b>		<b>22UMB2FP</b>	<b>Field Project</b>	<b>-</b>	<b>2*</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Total</b>				<b>30</b>	<b>22</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>700</b>
3	I	22UT3/ 22UH3	Language-I	6	3	3	25	75	100
3	II	22UE3	English-III (Short Story and Effective Communication Skill)	6	3	3	25	75	100
3	III	22UMB3CC3	Immunology	5	5	3	25	75	100
3	III	22UMB3CP3	Immunology (P)	3	2	3	40	60	100
3	III	22UMB3AC3	Biostatistics	5	5	3	25	75	100

For the candidates admitted from the academic year 2022-2023 onwards

3	III	22UMB4AP2	Biostatistics & Bioinformatics (P)	3	--	--	--	--	--
3	IV	NME1		2	2	3	25	75	100
Total				<b>30</b>	<b>20</b>	-	-	-	<b>600</b>
4	I	22UT4/ 22UH4	Language-I	6	3	3	25	75	100
4	II	22UE4	English-IV (One Act Play and Effective Communication Skill)	6	3	3	25	75	100
4	III	22UMB4CC4	Introductory Virology	4	4	3	25	75	100
4	III	22UMB4CP4	Introductory Virology (P)	3	3	3	40	60	100
4	III	22UMB4AC4	Bioinformatics	4	3	3	25	75	100
4	III	22UMB4AP2	Biostatistics & Bioinformatics (P)	3	3	3	40	60	100
4	IV	22UMB4SBE1:1 22UMB4SBE1:2 22UMB4SBE1:3	Microbial nanotechnology Clinical Microbiology Pharmacognosy	2	2	3	25	75	100
4	IV	NME2		2	2	3	25	75	100
<b>4</b>		<b>22UMB4IP</b>	<b>Internship</b>	<b>-</b>	<b>2*</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
Total				<b>30</b>	<b>23</b>	-	-	-	<b>800</b>
5	III	22UMB5CC5	Medical Microbiology	5	5	3	25	75	100
5	III	22UMB5CC6	Environmental and Agricultural Microbiology	5	5	3	25	75	100
5	III	22UMB5CC7	Microbial Genetics & Molecular Biology	6	5	3	25	75	100
5	III	22UMB5CP5	Medical Microbiology, Environmental and Agricultural and Microbiology & Microbial Genetics and Molecular Biology (P)	3	2	3	40	60	100
5	III	22UMB5MBE1:1 22UMB5MBE1:2 22UMB5MBE1:3	Nutrition in health & disease Fundamentals of Biological Science Entomology	5	4	3	25	75	100
5	IV	22UMB5SBE2:1 22UMB5SBE2:2 22UMB5SBE2:3	Fundamentals of Enzymes Diagnostic Microbiology Quality Control and Hygiene Practices	2	2	3	25	75	100
5	IV	22UMB5SBE3:1 22UMB5SBE3:2 22UMB5SBE3:3	Antimicrobial Agents Bioinstrumentation Basic Computer Applications in Biology	2	2	3	25	75	100

For the candidates admitted from the academic year 2022-2023 onwards

5	IV	22USSD	Soft Skill Development	2	2	3	25	75	100
Total				<b>30</b>	<b>27</b>	-	-	-	<b>800</b>
6	III	22UMB6CC8	Food Microbiology	6	6	3	25	75	100
6	III	22UMB6CC9	Industrial Microbiology	6	6	3	25	75	100
6	III	22UMB6CP6	Food Microbiology & Industrial Microbiology (P)	6	4	3	40	60	100
6	III	22UMB6MBE2:1 22UMB6MBE2:2 22UMB6MBE2:3	rDNA technology Entrepreneurial Microbiology Biosafety and Bioethics	6	5	3	25	75	100
<b>6</b>	<b>III</b>	<b>22UMB6PW</b>	<b>Project Work</b>	<b>5</b>	<b>5</b>	<b>3</b>	<b>40</b>	<b>60</b>	<b>100</b>
6	V		Extension Activities	-	1	-	-	-	-
6	V	22UGS	Gender Studies	1	1	3	25	75	100
Total				<b>30</b>	<b>28</b>	-	-	-	<b>600</b>
Grand Total				<b>180</b>	<b>140</b>				<b>4100</b>

### List of Allied Courses

#### I Year

1. Biochemistry - I
2. Biochemistry - II

#### II Year

1. Biostatistics
2. Bioinformatics

### Paper Details:

Tamil/Hindi Paper-Part I	- 4
English Paper-Part II	- 4
Core Course Paper	- 9
Core Course Practical	- 6
Allied Course Paper	- 4
Allied Course Practical	- 4
Non-Major Elective	- 2
Skill Based Elective	- 3
Major Based Elective	- 2
Environmental Studies	- 1
Value Education	- 1
Soft Skill Development	- 1
Gender Studies	- 1
Project Work	- 1
Extension Activities	- 1 (Credit Only)

- for those who studied Tamil up to 10th +2 (Regular Stream)
  - Syllabus for other Languages should be on par with Tamil at degree level
  - those who studied Tamil up to 10th +2 but opt for other languages in degree level under Part I should study special Tamil in Part IV
  - Extension Activities shall be outside instruction hours
- Non-Major Elective I & II – for those who studied Tamil under Part- I

For the candidates admitted from the academic year 2022-2023 onwards

- i) Basic Tamil I & II for other language students  
ii) Special Tamil I & II for those who studied Tamil up to 10th or +2 but opt for other languages in degree programme

**Note:**

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

**NME Courses offered to other Department**

22UMB3NME1 - Mushroom and Vermitechnology

22UMB4NME2 - Food and Diary Microbiology

**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]

### List of Elective Courses

Semester	Part		Course Code	Title of the Course	
3	IV	Non-Major Elective	22UMB3NME1	Mushroom and Vermitechnology	
4	IV		22UMB4NME2	Food and Diary Microbiology	
4	IV	Skill Based Elective	22UMB4SBE1:1 22UMB4SBE1:2 22UMB4SBE1:3	Microbial nanotechnology Clinical Microbiology Pharmacognosy	
5	IV		22UMB5SBE2:1 22UMB5SBE2:2 22UMB5SBE2:3	Fundamentals of Enzymes Diagnostic Microbiology Quality Control and Hygiene Practices	
5	IV		22UMB5SBE3:1 22UMB5SBE3:2 22UMB5SBE3:3	Antimicrobial Agents Bioinstrumentation Basic Computer Applications in Biology	
5	III		Major Based Elective	22UMB5MBE1:1 22UMB5MBE1:2 22UMB5MBE1:3	Nutrition in Health and Disease Fundamentals of Biological Science Entomology
6	III			22UMB6MBE2:1 22UMB6MBE2:2 22UMB6MBE2:3	rDNA technology Entrepreneurial Microbiology Biosafety and Bioethics

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-I

Course Code: 22UMB1CC1  
Instruction Hours: 5  
Credits: 5

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

### CORE COURSE 1– BASIC MICROBIOLOGY

#### Objectives:

- To acquire fundamental knowledge in microbiology and understand the principles of microscopy and its applications
- Imparting knowledge on microbial culture preparations and characters of different microorganisms.

#### Course outcomes:

- Understand the basic microbial structure, function and techniques
- Have a good knowledge about the maintaining of microbial culture and characters of different types of microorganisms.
- Understand the methods for identification of microorganisms will implement in various eco friendly approaches
- Good exposure about the fundamental concepts and skills in microbiology
- Wide knowledge about microorganisms and their characteristic features

#### Unit I

Historical development of Microbiology: Theories of spontaneous generation – Biogenesis-The scope of Microbiology and the opportunities for microbiologists- between the prokaryotic and microorganisms. General principles and nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept.

#### Unit II

Microscopy: Principles and applications of bright field, dark field, phase contrast, fluorescent SEM and TEM. Specimen preparation of Electron Microscopy. Principles and types of staining– Simple, differential (Gram, Spore, AFB) Capsule staining (Negative), Sterilization: Principles and methods – physical moist heat, dry heat, filtration (Membrane and HEPA). Radiations- chemical agents and mode of action.

#### Unit III

General characteristics and nature of Archaeobacteria, Cyanobacteria, Mycoplasma, Rickettsiae, Chlamydia, Spirochaetes, Actinobacteria, Protozoa, Algae, Fungi and Viruses. Basic understanding of classification of viruses (ICTV), algae (Chapman Fritch), fungi (Alexopoulos) and protozoa.

#### Unit IV

Outline classification for bacteria as per the Bergey's Manual of Systematic Bacteriology (9th edition) -Structural organization of bacteria – Size, shape and arrangement of bacterial cells -Ultrastructure of a bacterial cell - cell wall, cell membrane, ribosomes, nucleoid, slime, capsule, flagella, fimbriae, spores, cysts, plasmid, mesosomes and cytoplasmic inclusions.

#### Unit V

Cultivation of microbes: Types of culture media with specific examples for each type. Aerobic and Anaerobic culture techniques-Pure culture techniques (Tube dilution, Pour plate, Spread plate and Streak plate) - Methods of maintenance and preservation of microbes, safe decontamination practices.

## REFERENCES

1. Alcamo IE. Fundamentals of Microbiology, sixth edition, Addison wesley Longman, Inc. California. 2001.
2. Atlas RA and Bartha R. Microbial Ecology. Fundamentals and Application, Benjamin Cummings, New York. 2000.
3. Dubey RC and Maheswari DK. A Text Book of Microbiology. S Chand, New Delhi. 2010
4. Pelczar MJ, Chan ECS and Kreig NR. Microbiology, fifth edition. McGraw- Hill. Book Co. Singapore. 2009.
5. Rajan S and Selvi Christy R. Essentials of Microbiology, Anjanaa Book House, Chennai, 2015.
6. <https://www.ed.ac.uk/microscopy>

### Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	22UMB1CC1	Basic Microbiology					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-I

Course Code: 22UMB1AC1  
Instruction Hours: 5  
Credits: 5

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

### ALLIED COURSE 1 – BIOCHEMISTRY I

#### Objectives:

- To enrich the students in the field of biochemistry and they learn the basic biomolecules and its functions
- To understand about the diagnosis and clinical testing in biology

#### Course outcomes:

- Developed a very good understanding of various biomolecules.
- Students are able to make buffer, study the structure & function of biomolecules.
- Gain knowledge of vitamins & its classifications.
- Acquire knowledge about diagnostic and clinical testing
- Broad knowledge about the concepts in fundamental biochemistry

#### Unit I

Carbohydrate - Definition, sources, classification, structure of glucose, biological significance, digestion and absorption.

#### Unit II

Proteins – Definition, sources, classification and structure of proteins (Primary, secondary, tertiary), Amino acids–structure- classification - essential and non- essential, protein and non-protein amino acids.

#### Unit III

Lipids - Definition, sources, classification, structure, properties and functions, Fatty acids-saturated, unsaturated and essential fatty acids

#### Unit IV

Nucleic acids – Definition, structure, forms and functions of DNA. Types, structure and functions of RNA (mRNA, tRNA, rRNA).

#### Unit V

Vitamins – Definition, sources, deficiency syndromes and functions of Fat soluble vitamins (A, D, E and K) and Water soluble vitamins (B complex and C).

#### REFERENCES

1. Deb AC. Fundamentals of Biochemistry, 10th edition, New Central Book Agency (p) ltd, London. 2011.
2. Ambika Shanmugam. Fundamentals of Biochemistry for Medical students. Nagaraj and Company Pvt ltd, India. 2011.
3. Charlotte W Pratt and Kathleen Comely. Essential Biochemistry, 3rd edition Wiley publisher. 2013.
4. Sathyanarayana U and Chakrapani U. Biochemistry, 4th edition, Elsevier publishers. 2013.
5. Rafi MD. Textbook of Biochemistry for medical students, 2nd edition, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2014.
6. <https://byjus.com/chemistry/nucleic-acids>

### Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	22UMB1AC1	Biochemistry I					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(✓) = 44 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-I

Course Code: 22UMB1CP1  
Instruction Hours: 3  
Credits: 2

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

### CORE PRACTICAL 1– FUNDAMENTALS OF MICROBIOLOGY (P)

#### Objective:

- Students will get practical exposure about microbiology laboratory fundamental techniques and instruments.

#### Course outcomes:

- Understand the general rules and regulations for microbiology laboratory
- Students can able to perform basic microbiology lab techniques
- Know the handling and care of laboratory equipment
- Acquire a basic practical skill in microbiology
- Broad knowledge on fundamental techniques in microbiology

#### Fundamentals of Microbiology

1. Safety practices in Microbiological laboratory
2. Microscope and its operation
3. Principles and operations – Autoclave, Hot Air Oven, Filtration, Laminar Air Flow, Incubators, colony counter, Centrifuge, pH meter, Colorimeter and Spectrophotometer
4. Preparation of culture media, cleaning of glassware and sterilization methods
5. Demonstration of ubiquitous nature of microorganisms.
6. Measurement of size of microbes – micrometry.
7. Observation of permanent slides to study the structural characteristics of algae (*Anabena*, *Nostoc*, *Spirulina*, *Oscillatoria*), fungi (*Pythium*, *Rhizopus*, *Saccharomyces*, *Penicillium*, *Aspergillus*, *Agaricus*) and protozoa (*Entamoeba histolytica* and *Plasmodium* spp.).
8. Enumeration of bacterial numbers by Viable count ( Plate count) and Total count (Haemocytometer count)
9. Pure culture techniques - Streak plate, Pour plate and Spread plate.
10. Test for motility of bacteria – Hanging drop method.
11. Staining techniques – Simple staining, Gram's staining, Spore-staining, Capsular staining.

#### REFERENCES

1. Cappuccino and Sherman. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi. 2012.
2. Gunasekaran P. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi. 2008.
3. Kanika Sharma. Manual of Microbiology – Tools and Techniques. 2nd edition, Ane Books Pvt. Ltd., New Delhi. 2009.
4. Microbiology – Tools and Techniques. 2nd edition, Ane Books Pvt. Ltd., New Delhi. 2009.
5. <https://www.sas.upenn.edu/pureculture>

### Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	22UMB1CP1	Fundamentals of Microbiology (P)					3	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(✓) = 42 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-II

Course Code: 22UMB2CC2

Instruction Hours: 5

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE 2 – MICROBIAL METABOLISM

#### Objectives:

- Students got comprehensive idea about fermentation aerobic and anaerobic pathways in microbial cells
- Acquire knowledge on the growth of microorganisms and its concepts in metabolism

#### Course outcomes:

- Understand major fermentation aerobic and anaerobic pathways for energy generation in microbial cells
- Describing the growth character of the micro-organisms with require different nutrient for growth
- Acquired knowledge in metabolism and growth under normal & stress conditions.
- Know about the microbial cross-talk
- Broad understanding about the concepts in metabolism

#### Unit I

Nutrition and growth of microorganisms: Nutritional types of microorganisms, nutritional requirements. Factors influencing the growth of microorganisms – temperature, pH, Osmotic pressure, moisture, radiations and different chemicals, Physiology of growth – Significance of various phases of growth. Growth measurements – batch, continuous and synchronous.

#### Unit II

Bacterial enzymes - classification, properties, Mechanism of enzyme action- coenzymes and cofactors, isozymes.

#### Unit III

Metabolism of carbohydrates: Anabolism – photosynthesis – oxygenic – an oxygenic, synthesis of carbohydrate – catabolism of glucose – Embden Mayer – Hoff – Parnas pathway – Pentose pathway, Krebs's cycle (TCA) – electron transport system and ATP production.

#### Unit IV

Metabolism of protein – synthesis and degradation of amino acids – glycine tyrosine, cysteine, Gaiarine, glutamine, synthesis of peptides and proteins – urea cycle.

#### Unit V

Anaerobic Respiration – Nitrate, sulphate and Methane respiration – Fermentations – alcohol, mixed acid, lactic acid fermentation – biosynthesis of fatty acids and cholesterol – oxidation of fatty acids.

#### REFERENCES

1. Nelson David L, Albert L Lehninger and Michael M Cox. Lehninger principles of biochemistry. Macmillan.2008.
2. oelle HW. Microbial Metabolism, Academic Press. 2005.
3. Lansing M. Prescott JP, Harley and Donald A Klein. Microbiology, 5th edition, McGraw-Hill Company, New York. 2003.
4. Stryer L. Biochemistry, 4th edition, W.H. Freeman and company, New York. 2015

For the candidates admitted from the academic year 2022-2023 onwards

5. <https://www.sciencedirect.com/.../fermentation>

**Relationship Matrix for COs, POs and PSOs**

Semester	Code	Title of the Course					Hours	Credits			
II	22UMB2CC2	Microbial Metabolism					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 (✓) = 43      Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-II

Course Code: 22UMB2AC2  
Instruction Hours: 5  
Credits: 4

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

### ALLIED COURSE 2 – BIOCHEMISTRY II

#### Objective:

- Students can learn about the blood, hormones and advanced instruments in the field of biochemistry.

#### Course outcomes:

- Able to understand structure & functions of blood groups.
- Developing knowledge in hormonal diseases.
- Understood the plant pigment structure & functions.
- Gain a knowledge in plant & animal hormones.
- Thorough knowledge on advanced techniques in biochemistry

#### Unit I

Blood—Introduction, origin, composition, characterization, functions and coagulation of blood.

#### Unit II

Hormones - Definition, classification of hormones, Human- Endocrine glands – Pituitary, thyroids, Para thyroid, pancreas, adrenal, testis and ovary.

#### Unit III

Diseases associated with deficiency of endocrine hormones- hypo and hyper secretions.

#### Unit IV

General account and secondary metabolites. Major and accessory plant pigments - chlorophylls, carotenoids, phycobilins and anthocyanins - Animal pigments-bile pigments, heme.

#### Unit V

Phytohormones - structure and functions of auxin, gibberellins, cytokinins, abscissic acid, ethylene, Traumatic acid and Morphactirus.

#### REFERENCES

1. Ambika Shanmugam. Fundamentals of Biochemistry for Medical students. Nagaraj and Company Pvt ltd, India. 2011.
2. Thomas M Devlin. Textbook of Biochemistry with Clinical Correlations, 7th edition, Wiley publisher. 2010.
3. Charlotte W Pratt and Kathleen Comely. Essential Biochemistry, 3rd edition, Wiley publisher.2013.
4. Albert L Lehninger, David L Nelson and Michael M Cox. Lehninger Principles of Biochemistry, 2nd edition, Wiley publisher. 2010.
5. Rajagopal G. Concise textbook of biochemistry, 2nd edition. Ahuja Publishing House.2010.
6. <https://www.sciencedirect.com/.../plant-pigments>

### Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
<b>II</b>	22UMB2AC2	Biochemistry II					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											

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

For the candidates admitted from the academic year 2022-2023 onwards



## SEMESTER- II

Course Code: 22UMB2CP2  
Instruction Hours: 3  
Credits: 3

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

### **CORE PRACTICAL 2 - MICROBIAL METABOLISM (P)**

#### **Objectives:**

- Students will get practical knowledge on fundamental techniques and biochemical tests in microbiology

#### **Course outcomes:**

- Understand the general microbial metabolism
- Students can able to perform fundamental techniques in metabolism
- Acquire knowledge about microbial growth
- Gaining a good knowledge on fermentation and biochemical tests
- Wide knowledge on various techniques in microbiology

#### **Microbial Metabolism**

1. Bacterial growth curve: Cell count/viable count/absorbance (total count)
2. Carbohydrate fermentation tests: Glucose, Lactose, Sucrose and Mannitol.
3. Biochemical test for identification of bacteria: IMViC tests - TSI agar test- Urease- Catalase- Oxidase.

#### **REFERENCES**

1. Cappuccino and Sherman. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi. 2012.
2. Gunasekaran P. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi. 2008.
3. Kanika Sharma. Manual of Microbiology – Tools and Techniques. 2nd edition, Ane Books Pvt. Ltd., New Delhi. 2009.
4. <https://clinicalgate.com/microbiological-laboratory-techniques>

**Relationship Matrix for COs, POs and PSOs**

Semester	Code	Title of the Course					Hours	Credits			
<b>III</b>	22UMB2CP2	Microbial Metabolism Practical					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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-II

Course Code: 22UMB2AP1  
Instruction Hours: 3  
Credits: 3

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

### **ALLIED PRACTICAL 1- BIOCHEMISTRY I AND II (P)**

#### **Objectives:**

- Students will get comprehensive idea about qualitative and quantitative analysis and good laboratory practices in biochemistry laboratory

#### **Course outcomes:**

- Acquire a basic knowledge on qualitative and quantitative analysis
- Understanding good laboratory practices in a biochemistry lab
- Students can able to learn all diagnostic tests in biochemistry
- Good exposure on analytical skills in biochemistry
- Understanding the practical knowledge on fundamental biochemical test

#### **BIOCHEMISTRY I AND II**

1. Qualitative and Quantitative estimation of carbohydrates.
2. Qualitative and Quantitative estimation of Amino acids.
3. Qualitative and Quantitative estimation of proteins.
4. Qualitative and Quantitative estimation of Lipids.
5. Estimation of nucleic acids.
6. Estimation of ascorbic acid (from biological sample).

#### **REFERENCES**

1. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain. 2002
2. Oser BL Hawks. Physiological Chemistry, TATA Mc Graw Hill. 2004.
3. Shawn O' Farrell and Ryan T Ranallo. Experiments in Biochemistry: Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia. 2000.
4. <https://biologyreader.com/qualitative-analysis-of-carbohydrate.html>

For the candidates admitted from the academic year 2022-2023 onwards

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	22UMB2AP1	Biochemistry I and II Practical					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(✓) = 38 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-III

Course Code: 22UMB3CC3  
Instruction Hours: 5  
Credits: 5

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

### CORE COURSE 3- IMMUNOLOGY

#### Objective:

- Students imparting knowledge on immunology, antigen-antibody reactions and its diagnostic procedures

#### Course outcomes:

- To gain a deep knowledge about the features & mechanisms of innate immunity & adaptive immunity immune response.
- Demonstrate an understanding of key concepts in immunology.
- To make them understand the salient features of antigen antibody reaction & its uses in diagnostics & various other studies
- Acquiring knowledge on advanced laboratory techniques
- Having good exposure on significance of immune systems and their functions

#### Unit I

Introduction- History of immunology – Immunohematology- Blood groups, Blood transfusion, Rh- *Erythroblastosis foetalis* – immunity – types of immunity – innate and acquired immunity.

#### Unit II

Immune systems- Anatomy of lymphoid organ- Primary and Secondary Lymphoid organs – Cells of the immune system- detailed aspects of T and B cells receptors -subsets– Humoral and cell mediated immune response- activation and function, Complement, MHC.

#### Unit III

Antigen- Types, properties, haptans- adjuvants- vaccines- types – toxoids, antitoxins, Immunoglobulins- structure, types and properties. Theories of antibody production.

#### Unit IV

Antigen – antibody reaction- *in-vitro* methods- Agglutination – Precipitation, Complement fixation, Immunofluorescence, ELISA, RIA, *in-vivo* methods- Skin test, immunodeficiency disorder – AIDS.

#### Unit V

Hypersensitivity reactions – Immediate type - Type I Anaphylaxis, Type II Antibody dependent cell cytotoxicity, Type III Immune complex mediated, Type V Stimulatory; Delayed type- Type IV Cell mediated delayed hypersensitivity. Lymphokines and Cytokines. Basic concept in auto immunity and transplantation.

#### REFERENCES

1. Charles A Janeway, Jr. Paul Travers, Mark Walport and Donald Capra J. Immunobiology – The immune system in health and disease, 4th edition, Current Biology Publications, London.1999.

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2. Goldsby RA, Kindt TK, Osborne BA and Kuby J. Immunology, 5th edition, W.H. Freeman and Company, New York, 2007.
3. Kuby J. Immunology, 7th edition WH Freeman and company, New York. 2008.
4. Richard Hunt, Becker, Holger, Hlawatsch, Nadine, Julich, Sandra and Mieth Peter. Microbiology and Immunology Online. University of South Carolina.2004.
5. Sudha Gangal and Shubhangi Sontakke. Textbook of Basic and clinical Immunology, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2013.
6. <https://www.scribd.com/document/524052320/Immunobiology-by-Charles>

### Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	22UMB3CC3	Immunology					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(✓) = 39 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-III

Course Code: 22UMB3CP3  
Instruction Hours: 3  
Credits: 2

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

### CORE PRACTICAL 3 - IMMUNOLOGY (P)

#### Objective:

- Students will get practical exposure on methods and applications of diagnostic kits and immunotechniques

#### Course outcomes:

- Able to determine and quantify presence/absence of antigen & antibodies in biological samples.
- Viral disease diagnosis tests using radio-immunoassay/ELISA and PCR.
- Good exposure on various diagnostic tests
- Students can learn about advanced immunotechniques
- Understanding a methods and clinical skills on immunotechniques

#### IMMUNOLOGY

1. ABO Blood grouping
2. Rh typing
3. WIDAL Test
4. RPR
5. CRP
6. ASO
7. Total and differential blood cell count by haemocytometer
8. Double immunodiffusion
9. Demonstration of ELISA

#### REFERENCES

1. Li Zongxi, Zheng Li, Feng Hui, Cao Yan, Li Cheng and Pang Wei. Immunology Methods for Medical Students. Department of Immunology, China medical university.2006.
2. Goldman, Emanuel and Lorrence H Green. Practical Handbook of Microbiology, Boca Raton, FL: CRC press, Francis. 2009.
3. Morag C Timbury. Medical Virology. 10th edition, Churchill Livingstone.1994.
4. Rajan S and Selvi Christy R. Experiments in Microbiology. Anjana Books House, Chennai. 2015.
5. <https://microbiologynote.com/blood-grouping-principle-and-procedure>

Relationship Matrix for COs, POs and PSOs

For the candidates admitted from the academic year 2022-2023 onwards

Semester	Code	Title of the Course					Hours	Credits			
III	22UMB3CP3	Immunology Practical					3	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(✓) = 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

For the candidates admitted from the academic year 2022-2023 onwards



## SEMESTER-III

Course Code: 22UMB3AC3  
Instruction Hours: 5  
Credits: 5

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

### ALLIED COURSE 3 - BIOSTATISTICS

#### Objective:

- Students can learn the fundamental statistical concepts, collection of data and its applications in biology

#### Course outcomes:

- Understand the basic biological mathematics
- Acquiring a fundamental knowledge on mathematics as applied biological phenomenon
- Have developed basic concepts of statistics and importance
- Broad knowledge about sampling and collection of data with statistical skills
- Students can able to apply statistical concepts in biology

#### Unit I

Introduction to biostatistics - Definition, statistical methods, biological measurement, kinds of biological data, functions of statistics and limitation of statistics.

#### Unit II

Collection of data, sampling and sampling design, classification and tabulation, types of representations, graphic–bar diagrams, pie diagrams and curves.

#### Unit III

Measures of central tendency, mean, median, mode, geometric mean, harmonic mean.

#### Unit IV

Measures of dispersion and variability-changes. Deviations–Mean Deviation, Standard Deviation, Coefficient of variation, Loren Zen's curve.

#### Unit V

Skewness, Kurtosis, Moments, Meaning, test of skewness, characteristics of dispersion and skewness. Measures of skewness, objectives. Karl Pearson's Coefficient of skewness, Bocoly's coefficient of skewness.

### REFERENCES

1. Bernard Rosner. Fundamentals of Biostatistics, 7th edition, Cengage Learning, 2010.
2. Maicello Pagano and Kimberlee Gauvreau, 2nd edition Principles of Biostatistics, Duxbury Press.2000.
3. Jerrold H Zar. Bio statistical Analysis, 5th Ed, Prentice Hall. 2010.
4. Sundar Rao and Richard. Introduction to Biostatistics and Research Methods, 5th edition, PHI Learning Pvt. Ltd. 2012.
5. .Pranab Kumar Banerjee. Introduction to Bio statistics. 4th edition, S. Chand and company Ltd. 2014.
6. <https://testbook.com/learn/maths-measures-of-central-tendency>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	22UMB3AC3	Biostatistics					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(✓) = 35 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-III

Course Code: 22UBM3NME1  
Instruction Hours: 2  
Credits: 2

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

### NON-MAJOR ELECTIVE 1- MUSHROOM AND VERMITECHNOLOGY

#### Objective:

- Students imparting knowledge on mushroom cultivation, methods in vermin composting and its applications

#### Course outcomes:

- Develop knowledge in cultivating the mushrooms.
- To gain Knowledge in composting and its value.
- Have developed a very good understanding of nutritional aspects and commercial use of mushrooms for human consumption.
- Students can apply these concepts in Entrepreneurial activities
- Develop their capability to become a good Entrepreneur

#### Unit I

Edible and non-edible mushroom (Historical account, most commonly cultivated mushrooms in the world, distribution and production in various countries). Cultivation of button mushroom -morphology raising a pure culture & spawn preparation.

#### Unit II

Preparation of compost & cultivation of *Agaricus bisporus*, *Pleurotus flabellatus*, harvest. Pests and diseases of Edible mushrooms (Environmental, fungal, bacterial, viral, insect pests and Nematode diseases and competitor moulds.

#### Unit III

Soil biota -Earthworms -Ecological classification of earth worms as Epigeics -Introduction to earthworm biology - physical and chemical effects of earth worms on soils - Role of earthworms in soil -classification of earthworms based on ecological strategies- Burrowing activity of earthworms- Microorganisms and their relationship with earthworms.

#### Unit IV

Vermicompost - setting up vermicompost quality N, P, K, C, N, Microbial quality applications – earthworm species- endemic. vermiculture – vermiwash - role of vermicompost in organic farming - its quality and advantages over chemical inputs. Earthworms in Bio-reclamation of soil.

#### Unit V

Antiviral value, antibacterial effect, antifungal effect, anti-tumour effect, haematological value cardiovascular & renal effect, in therapeutic diets, adolescence, for aged persons & diabetes mellitus.

#### REFERENCES

1. B C;Suman;V P Sharma. 2007 Mushroom Cultivation in India. Daya Publishing House, New Delhi.
2. Clive A. Edwards, Norman Q. Arancon, Rhonda L. Sherman 2010 Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management CRC Press
3. Clive A. Edwards 2004 Earthworm Ecology CRC Press
4. Kannaiyan. 2001. Handbook of Edible Mushrooms" TNAU Publication.
5. [https://agricoop.nic.in/sites/default/files/Vermicompost Production](https://agricoop.nic.in/sites/default/files/Vermicompost%20Production)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	22UMB3NME1	Mushroom and Vermitechnology					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(✓) = 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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-IV

Course Code: 22UMB4CC4  
Instruction Hours: 4  
Credits: 4

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

### CORE COURSE 4 - INTRODUCTORY VIROLOGY

#### Objective:

- To enrich the students in virology and imparting knowledge in the classifications of virus and its interactions

#### Course outcomes:

- Know how viruses are classified.
- Know the methods used in studying viruses.
- An understand the interactions between viruses and the host immune system.
- Have develop knowledge to differentiate DNA&RNA viruses.
- Understanding about viral diseases and their factors

#### Unit I

History of virology, terminologies, origin of viruses, occurrence, morphology of viruses, helical, icosahedral and complex viruses. Viral envelope, nucleic acids, proteins, carbohydrates, classification of viruses- LHT and ICTV system of classification.

#### Unit II

Purification, Characterization, Separation and Assay. Cultivation and quantification of viruses, Separation and characterization of viral components.

#### Unit III

Bacteriophages- Life Cycle, Classification, Morphological groups, the virulent dsDNA phage, the ssDNA phage, phage lambda, Temperate and Transposable phage, Phage Mu the ssDNA phages, phage M13, Bacteriophage typing, Phage therapy (bacteriophage therapy), Cyanophages, Mycoviruses (Mycophages), Rhizobiophages.

#### Unit IV

General characteristics and multiplication of DNA containing viruses- Adenoviruses, Herpes viruses, Poxviruses. RNA containing viruses- Picorna virus, Rhabdo viruses, Orthomyxo viruses, Reoviridae, SARS and H1N1- Influenza A virus. Subviral agents - Viroids, Prions.

#### Unit V

History, Classification and nomenclature of plant viruses, Transmission, Multiplication, symptoms and control of plant viral diseases - DNA containing virus - Cauliflower mosaic virus, RNA containing virus - Tobacco mosaic virus - Poty virus, Tomato spotted wilt, Potato leaf roll virus, Rice tungro virus, Mosaic disease of sugarcane. Sub viral agents –Virusoids and Satellite virus.

#### REFERENCES

1. Alan J Cann. Principles of Molecular Virology. 6th edition, Academic press, California.2015.
2. Dimmock NJ and Primerose SB. Introduction to modern virology. 6th edition. Blackwell scientific publication, Oxford, London. 2007.
3. Dimmock NJ, Easton AJ and Leppard K. Introduction to Modern Virology, (Oxford: Blackwell Publishers, London. 2007.
4. Robert I Krasner. The Microbial challenge: Human Microbe Interaction, American Society for

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Microbiology, 2nd edition, Washington. 2002.

5. Roger Hull. Mathews' Plant Virology, 4th edition, Academic press- A Harcourt Science and technology company, New York. 2002.
6. <https://extension.psu.edu/tobacco-mosaic-virus-tmv>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	22UMB4AC4	Introductory Virology					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(✓) = 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- IV

For the candidates admitted from the academic year 2022-2023 onwards

Course Code: 22UMB4CP4  
Instruction Hours: 3  
Credits: 3

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

### **CORE PRACTICAL 4 - INTRODUCTORY VIROLOGY (P)**

#### **Objective:**

- Students will get practical knowledge in isolation and cultivation of virus and its techniques

#### **Course outcomes:**

- To visualize cytopathic effects of viruses
- To demonstrate the mechanical transfer of virus in plants
- To diagnose viral infections of humans
- To demonstrate about the cultivation of viruses
- Have a good exposure about the advanced virology techniques

#### **Introductory Virology**

1. Isolation of Bacteriophage from sewage
2. Concentration of bacteriophages
3. Demonstration of mechanical transfer of viruses in plants
4. Demonstration of cultivation of viruses by embryonated egg method.
5. Observation of selected bacterial, plant and animal viruses – T4 and M13 Phages, TMV, CaMV, HIV, Influenza, HSV, HBV, Rabies and Blue tongue virus

#### **REFERENCES**

1. Li Zongxi, Zheng Li, Feng Hui, Cao Yan, Li Cheng and Pang Wei. Immunology Methods for Medical Students. Department of Immunology, China medical university.2006.
2. Florence G Burleson, Thomas M Chambers and Danny L Wiedbrauk. Virology: A laboratory Manual. Academic Press, UK.2014.
3. Goldman, Emanuel and Lorrence H Green. Practical Handbook of Microbiology, Boca Raton, FL: CRC press, Francis. 2009.
4. Morag C Timbury. Medical Virology. 10th edition, Churchill Livingston.1994.
5. Rajan S and Selvi Christy R. Experiments in Microbiology. Anjana Books House, Chennai. 2015.
6. <https://courses.lumenlearning.com/microbiology/chapter/isolation>

Relationship Matrix for COs, POs and PSOs

For the candidates admitted from the academic year 2022-2023 onwards

Semester	Code	Title of the Course					Hours	Credits			
IV	22PMB4CP4	Introductory Virology Practical					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

For the candidates admitted from the academic year 2022-2023 onwards



## SEMESTER- IV

Course Code: 22UMB4AC4  
Instruction Hours: 4  
Credits: 3

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

### ALLIED COURSE 4- BIOINFORMATICS

#### Objective:

To impart knowledge on fundamentals of computers, internet and biological databases

#### Course outcomes:

- Developed basic skills for data retrieval, representation, analysis and interpretation
- Skill to use important biological database, use tools to retrieve data and compare the data of the biological macromolecules
- Having good exposure about advanced sequence alignment and structure analysis tools
- Acquiring a good knowledge and skills in advanced tools and databases

#### Unit I

Computers – Characteristics of Computers – Areas of computer applications- I-P-O Cycle. Components of Computers – Memory and control units-Input devices and output devices- Hardware and Software -Operating Systems.

#### Unit II

Internet –History of Internet-Uses of internet. Connection to Internet -Web page-Modem-Internet Service providers-E-mail and Voice Mail, Creating E-mail Address.

#### Unit III

Introduction to bioinformatics – history and its development – Scope and applications of bioinformatics – Data Integration and Data Analysis.

#### Unit IV

Biological database – NCBI-GenBank, EMBL, DDBJ. Sequence Alignment- Pairwise (BLAST and FASTA) and Multiple sequence alignment (ClustalW).

#### Unit V

Structure of Protein, Classification –PDB, Swiss-PROT, SCOP, CATH. Protein visualization tools-RASMOL, Swiss PDB viewer.

#### REFERENCES

1. Chavali LN. Bioinformatics and Bioprogramming in C, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2009.
2. Srinivasa Vallabhan SV. Computer Applications in Business, 3rd edition, Sultan Chand and sons, Educational publishers. New Delhi. 2006.
3. Des Higgins and Willie Taylor, Bioinformatics: Sequence, Structure and databanks. Oxford University Press. 2002.
4. Rashidi HH and Buehler LK. Bioinformatics Basics: Applications in Biological Science and Medicine, Second Edition CRC Press, London. 2005.
5. Cynthia Gibas and Per Jambeck Developing Bioinformatics Computer Skills: First Edition Shroff Publishers and Distributors Pvt. Ltd (O'Reilly), Mumbai.2001.
6. <https://www.uniprot.org/help/sequence-alignments>

Semester	Code	Title of the Course					Hours	Credits			
IV	22UMB4AC4	Bioinformatics					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(✓) = 41 Relationship: High											

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

#### SEMESTER- IV

For the candidates admitted from the academic year 2022-2023 onwards

Course Code: 22UMB4AP2  
Instruction Hours: 3  
Credits: 3

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

## **ALLIED PRACTICAL 2 - BIOSTATISTICS AND BIOINFORMATICS (P)**

### **Objective:**

- Students will get good practical knowledge on biostatistics, biological databases and Structural analysis of proteins

### **Course Outcomes:**

- Developing knowledge in mean, median, mode, Co-efficient of variance using biological materials
- Skill to use important biological database, use tools to retrieve data, and compare the data of the biological macromolecules.
- Good practical exposure about biological databases and tools
- Apply biological databases in advanced research
- Broad understanding about the advanced concepts and skills in biological databases

### **Biostatistics and Bioinformatics**

1. Collection of data, sampling designs, tabulation and graphic representation using biological materials.
2. To find Mean, Mode, Median, Co-efficient of variance using biological materials.
3. Tests of significance 't' test, 'chi' square, standard error and standard deviation.
4. 't' Test, chi square, statistical error, standard deviation also, to be practically done through SPSS programme [statistical Package for Social Sciences].
5. Study of Nucleic acid sequence databanks - GenBank, NCBI, EMBL and DDBJ.
6. Pairwise sequence alignment - BLAST
7. Multiple alignment - Clustal W
8. Study of Protein Structure - PDB
9. Evaluation of protein structure by Swiss PDB viewer and RASMOL.

### **REFERENCES**

1. Maicello Pagano, Kimberlee Gauvreau. Principles of Biostatistics, 2nd edition, Duxbury Press. 2000.
2. Roland Ennos. Statistical and Data Handling Skills in Biology, 3rd edition. Pearson. 2011.
3. S.Igancimuthu. Basic Bioinformatics Second Edition Alpha Science 2013
4. <https://www.ncbi.nlm.nih.gov>
5. <https://www.ncbi.nlm.nih.gov/genbank>
6. <https://blast.ncbi.nlm.nih.gov>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	22UMB4AP2	Biostatistics and Bioinformatics Practical					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- IV

Course Code: 22UMB4SBE1:1  
 Instruction Hours: 2  
 Credits: 2

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

**SKILL BASED ELECTIVE 1 - MICROBIAL NANOTECHNOLOGY**

**Objectives:**

- Students will get wide knowledge on nanomaterials, nano architecture and bionano systems

**Course Outcomes:**

- Gained knowledge about history of Nanomaterials.
- Understanding about the Nano architecture.
- Students can learn about the role of DNA analyzer as biochips.
- Describing the diagnosis of cancer and other diseases using bionano systems.

For the candidates admitted from the academic year 2022-2023 onwards

- Broad knowledge about the bionanomaterials and their characteristics

### Unit I

Definition - history of nanomaterials – Richard Feynman and his contributions – classification and properties of nanomaterials – concept of nanoscale engineering - size and confinement effects.

### Unit II

Nano architecture: strategies - bottom up, top down and functional approaches; Chemical and physical synthesis of nanoparticles - characteristics of nanoparticles; Characterization of nanoscale materials using UV spectroscopy, TEM, AFM/STM, XRD and FTIR.

### Unit III

Bionanomaterials – DNA, protein and lipids based nanostructures- synthesis, characterization and applications; Bionanopores- Microbial synthesis (bacteria, fungi and yeast) of nanoparticles – mechanism of synthesis – Molecular Self assembly in biology.

### Unit IV

DNA/protein-gold nanoparticle conjugates; DNA nanostructures for mechanics and computing; DNA as smart glue- DNA analyzer as biochips; Biologically inspired nanocomposites ; Peptide nanostructures and their applications– electronics, antibacterial agents.

### Unit V

Antimicrobial activity of nanoparticles- mechanism; Nanoanalytics- Quantum dots - Bioconjugates in cell and tissue imaging; Diagnosis of cancer and other diseases using bionano systems; Drug and gene delivery.

## REFERENCES

1. Rao CNR, Muller A, Cheetham AK. The Chemistry of Nanomaterials - Synthesis, Properties and Applications – Published by John Wiley and Sons. 2006.
2. Pradeep T. Nano: The Essentials –Tata Mcgraw Hill, New Delhi. 2007.
3. Niemeyer CM and Mirkin CA. Nanobiotechnology: Concepts, Applications and perspectives - Wiley-VCH Verlag GmbH and Co., KgaA, Weiheim. 2004.
4. Claudio Nicolini. Nanobiotechnology and Nanobiosciences - Pan Stanford Publishing Pvt. Ltd. 2009.
5. David Goodsell S. Bionanotechnology, Lessons from Nature - Wiley-Liss, Inc. 2004.
6. Bhushan B. Handbook of Nanotechnology - Springer, Heidelberg. 2006.
7. <https://www.bionanomaterials.org>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	22UMB4SBE1:1	Microbial Nanotechnology					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	✓	✓		✓	✓	✓	✓	✓	✓	✓	

For the candidates admitted from the academic year 2022-2023 onwards

CO5	✓	✓		✓	✓	✓	✓	✓	✓	✓
Number of Matches(✓) = 45 Relationship: Very High										

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER-IV

Course Code: 22UMB4NME2  
Instruction Hours: 2  
Credits: 2

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

### NON-MAJOR ELECTIVE 2- FOOD AND DAIRY MICROBIOLOGY

#### Objective:

- Students can learn about food preservation, food spoilage and fermented food and dairy products

#### Course outcomes:

- Acquiring knowledge on importance and microorganisms in food products
- Good exposure about food preservation
- Facilitating the knowledge about dairy products
- Imparting knowledge on fermented foods and food control agencies

#### Unit I

Importance of Food and Dairy Microbiology- Food Additives - Food as substrate for microbial growth-intrinsic and extrinsic factors affecting growth and survival of microorganism in foods

#### Unit II

Microorganisms present in the vegetables, fruits, cereals, milk, cheese, yoghurt and other dairy products - Sources of contamination of microorganisms in foods- Features of food spoilage

#### Unit III

Food preservation by removal of microorganisms, low temperature, high temperature irradiation and chemical methods. Food borne infection, food borne intoxications Detection of food-borne pathogens.

#### Unit IV

Dairy Microbiology: Micro flora of milk, sources of contamination, preservation and spoilage of milk and milk products, Milk borne diseases, Preservation of milk.

#### Unit V

Fermented foods: Sauerkraut, Pickles, Buttermilk, Yogurt and Cheese. Prebiotics, Probiotics and Synbiotics. Food sanitation, food control agencies and their regulations.

#### REFERENCES

1. George Banwart Basic Food Microbiology Springer Science & Business Media 2012
2. M. R. Adams, M. O. Moss Food Microbiology New Age International, 2007
3. W. C. Frazier, D. C. Westhoff Food Microbiology Tata McGraw-Hill 2001
4. Martin R Adams, Maurice Moss Food Microbiology Royal Society of Chemistry 2007
5. <https://aggie-horticulture.tamu.edu/food-technology/food-processing>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	22UMB4NME2	Food and Dairy Microbiology					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(✓) = 45 Relationship: Very High											

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

For the candidates admitted from the academic year 2022-2023 onwards



## SEMESTER- V

Course Code: 22UMB5CC5

Instruction Hours: 5

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Mark: 75

### CORE COURSE 5- MEDICAL MICROBIOLOGY

#### Objective:

- To enlighten students in the area of medical bacteriology, virology, mycology and parasitology

#### Course outcomes:

- Understood the basic concepts of causation of disease by the pathogenic micro organisms.
- Developed a thorough understanding of common bacterial, viral, fungal & parasitic disease of human being.
- Conceptualized the protective role of the immune system of the host.
- Developing efficient vaccines and new drugs.
- Imparting knowledge on human diseases and learn advanced diagnostic tests

#### Unit I

History, 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

#### Unit II

Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections, (b) Staphylococcal infections, (c) Meningitis, (d) Leprosy, (e) Leptospirosis, (f) Respiratory diseases: Tuberculosis

(g) Gastrointestinal disorders: typhoid, cholera, bacillary dysentery, (h) Sexually transmitted diseases: syphilis, gonorrhoea. (i) Anaerobic wound infection – tetanus, gas gangrene.

#### Unit III

Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following viral diseases (a) Respiratory diseases: common cold, influenza, measles. (b) Neurological diseases: Dengue, Rabies (c) Liver diseases: Viral hepatitis (d) Immunodeficiency disease: - AIDS. A brief account on Prion diseases.

#### Unit IV

Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following fungal and protozoan diseases (a) Fungal – superficial and subcutaneous mycoses, (b) Protozoan: Amoebiasis, Malaria (c) Helminths – Filariasis, Ascariasis, Zoonotic diseases, A brief account on nosocomial and community acquired infections.

#### Unit V

Steps in the isolation and identification of pathogens from an infected patient: Collection and transport of various clinical specimens for diagnosis – General methods of isolation and identification of bacterial, fungal and viral pathogens and protozoan parasites.

For the candidates admitted from the academic year 2022-2023 onwards

## REFERENCES

1. Ananthanarayanan R and Jeyaram Paniker CK. Textbook of Medical Parasitology. 5th Ed. and 8th edition. Jay Pee brother's Medical publisher, Pvt. Ltd., New Delhi. 2004.
2. Ananthanarayanan R and Jeyaram Paniker CK. Textbook of Microbiology. 9th Ed. University Press. 2013.
3. Rajan S. Medical Microbiology. MJP Publishers, Chennai. 2007.
4. David Greenwood. Mike Barer, Richard Slack and Will Irving. Medical Microbiology. A Guide to Microbial Infections: Pathogenesis, immunity, Laboratory investigation and Control, 18th edition, Churchill Livingstone. 2012.
5. Panjarathinam R. Textbook of Medical Parasitology. 2nd edition, Orient Longman.2007.
6. <https://www.cdc.gov/hiv/basics/whatishiv.html>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	22UMB5CC5	Medical Microbiology					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(✓) = 44 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- V

Course Code: 22UMB5CC6  
Instruction Hours: 5  
Credits: 5

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

### CORE COURSE 6: ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

#### Objective:

- To enrich the students in the area of microbial ecology, aquatic ecosystems, plant pathology and waste water treatment

#### Course outcomes:

- Have a developed a good knowledge & understanding of different types of environment & habitats where microorganism grow.
- Are able to identify the important role of microorganism in maintaining healthy environment.
- Have understood the significance of COD/BOD & various tests.
- Developed a clean understanding of the multifunction roles of microorganism in soil.
- Imparting a knowledge on waste water treatment

#### Unit I

Microorganisms in the rhizosphere, root surfaces and phylloplane -Biofertilizer

– Advantages over chemical fertilizers, types, production and - quality control of biofertilizers - Isolation, mass inoculum production, field application, importance and marketing of bioinoculants – Rhizobium, Azotobacter, Azospirillum, Frankia, Cyanobacteria, Azolla and phosphate solubilizing microorganisms - Mycorrhizal biofertilizers.

#### Unit II

Plant diseases (Mode of entry of pathogens, Symptoms, Disease cycle and control measures)  
Bacterial disease – Citrus canker - Fungal disease – Rust of wheat- Mycoplasmal disease – Grassy shoot of sugar cane -Viral disease – cauliflower mosaic- Microbial Pesticides – types and applications – *Pseudomonas fluorescens*, *Bacillus thuringiensis*, *Trichoderma viride* and Nuclear Polyhedrosis Virus (NPV).

#### Unit III

Concepts of microbial ecology: Relationship between microorganism and different environments land, water and air. Microorganisms inhabiting extreme environments. Microbiology of air – distribution and sources. Droplet nuclei, aerosol, assessment of air quality. Brief account of air borne transmission of harmful microbes.

#### Unit IV

Types of aquatic ecosystems: fresh water – ponds, lakes, streams. Marine habitats – estuaries, mangroves, deep sea. Zonations – upwelling – eutrophication – food chain. Potability of water – microbial assessment of water quality – water purification – brief account of water borne diseases.

#### Unit V

Types of wastes – characterization of solid and liquid wastes. Solid waste treatment – saccharification – gasification – composting, Utilization of solid wastes for mushroom

For the candidates admitted from the academic year 2022-2023 onwards

production. Liquid waste treatment - Treatment methods – primary and secondary (anaerobic – methanogenesis) aerobic: trickling, activated sludge, oxidation pond – tertiary treatment.

## REFERENCES

1. Agrios AG. Plant Pathology, Elsevier Academic Press, New Delhi. 2006.
2. Baker WC and Herson DS. Bioremediation – McGraw Hill Inc., New York. 2006
3. Burns RC and Slater JH. Experimental Microbial Ecology – Blackwell Scientific Publications, Oxford, London. 2002.
4. Chatterji AK. Introduction to Environmental Biotechnology. Prentice-Hall of India Private Limited. 2005.
5. Gareth M Evans and Judith C Furlong. Environmental Biotechnology- Theory and Application, John Wiley and sons Ltd. 2003.
6. <https://www.conserve-energy-future.com/process-of-wastewater-treatment.php>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	22UMB5CC6	Environmental and Agricultural Microbiology					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											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- V

Course Code: 22UMB5CC7  
Instruction Hours: 6  
Credits: 5

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

### **CORE COURSE 7- MICROBIAL GENETICS AND MOLECULAR BIOLOGY**

#### **Objective:**

- Students will get comprehensive knowledge on Replication, Transcription, Translation and Transformation in molecular biology

#### **Course outcomes:**

- Understood genome organization of micro organisms.
- Developed a good knowledge about 3 well known mechanism with genetic material is transferred among the micro organism.
- Hands on skills of isolation of plasmid DNA from bacterial cells.
- Have acquired knowledge of gene their expression & regulation.
- Imparting knowledge on gene transfer and genetics with its applications

#### **Unit I**

Milestones in history – Definition of nucleic acids - Experimental proofs of DNA as the genetic material (Griffith and Hershey Chase) – Experimental proofs of RNA as the genetic material - Chemistry and molecular structure of DNA double helix - Discovery of DNA structure – Brief account on types and forms of DNA – Types of RNA - Definition of a gene. Organization of DNA in prokaryotes (*E. coli*) and viruses. Brief note on plasmids: structure and types.

#### **Unit II**

DNA Replication in prokaryotes: Meselson and Stahl experiment – Mechanism, enzymes and proteins of replication – Theta replication and Rolling circle replication. Replication of RNA – reverse transcriptase.

#### **Unit III**

DNA Transcription: Definition – Brief account on transcriptional machinery and mechanism of transcription – Genetic code – RNA Translation: Definition – Brief account on translational machinery and mechanisms of translation. Regulation of gene expression in prokaryotes – Operon concept – *lac* and *trp* operons.

#### **Unit IV**

Transformation - Discovery, mechanism of natural competence - Conjugation - Discovery, F+ v/s F-, Hfr+ v/s F- - Transduction – Generalized and specialized transductions.

#### **Unit V**

Definitions of mutations, mutagenesis and mutants - types of mutations; Physical and chemical mutagens. Transposons - Applications of mutations, Carcinogenicity testing. DNA repair mechanisms.

### **REFERENCES**

For the candidates admitted from the academic year 2022-2023 onwards

1. David Frifelder. Molecular Biology, Narosa publishing house, New Delhi. 2nd edition. 2008.
2. Lodish H, Baltimore D, Berk A, Zipsury SL, Matsudaira P, Darnell J. Molecular Cell Biology. Scientific American Books.6<sup>th</sup> Edition 2018.
3. George M Malacinski. Freifelder's Essentials of Molecular Biology. 4th edition. Narosa Publishing House. 2008.
4. Stanly R Maloy, John E Cronan Jr. and David Freifelder. Microbial Genetics, 2nd edition, Narosa publishing house, New Delhi. 2006.
5. Karp G. Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley and Sons. Inc. 2010.
6. <https://www.thoughtco.com/dna-replication>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	22UMB5CC7	Microbial Genetics and Molecular Biology					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(✓) = 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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- V

Course Code: 22UMB5CP5  
Instruction Hours: 3  
Credits: 2

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

### **CORE PRACTICAL 5 - MEDICAL MICROBIOLOGY, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY & MICROBIAL GENETICS AND MOLECULAR BIOLOGY (P)**

#### **Objective:**

- Students will get practical exposure on isolation of bacteria from clinical samples, rhizosphere and isolation of bacterial genome

#### **Course outcomes:**

- The students able to know general and specific mechanisms by which an infectious agent causes disease.
- Know on the different aspects of waste management and sewage treatment systems.
- Hands on skills of isolation of plasmid DNA from bacterial cells and its visualization by performing gel electrophoresis.
- Acquiring practical skills on medical microbiology and clinical testing
- Good exposure on microbial assessments

#### **Medical Microbiology**

- Isolation of bacterial flora of skin by swab method.
- Isolation of bacteria from urine, stool and sputum
- Identification of Gram positive organisms (using laboratory strains): *Streptococcus pneumoniae*, *Staphylococcus aureus* and *Bacillus* sp. and Gram negative organisms (using laboratory strains): *Escherichia coli*, *Proteus* sp. and *Klebsiella pneumoniae* on the basis of microbiological, cultural and biochemical characteristics.
- Saline and iodine wet mount to demonstrate protozoan parasites
- Giemsa staining for the demonstration of blood parasites
- KOH and Lactophenol cotton blue mount to demonstrate fungi.
- Germ tube technique to identify *Candida albicans*.
- Antibacterial sensitivity test – Kirby- Bauer method.
- Observation of symptoms of diseases caused by bacterial, fungal, viral and protozoan pathogens using photographs.

#### **Agricultural and Environmental microbiology**

- Water analysis by MPN technique – presumptive coliform test – confirmed coliform test and completed coliform test.
- Microbial assessments of air quality – open plate method and air sampler- technique.
- Isolation and counting of faecal bacteria from water.
- Soil Analysis -pH, chlorides, nitrate, calcium, magnesium and total phosphorus.
- Isolation of cyanobacteria from water (any two)
- Isolation of *Rhizobium* form legume nodule.

For the candidates admitted from the academic year 2022-2023 onwards

- Isolation of phosphobacteria from soil.
- Observation of VAM from plant roots.

### **Microbial genetics and Molecular biology**

- Isolation of chromosomal DNA from bacteria
- Isolation of plasmid DNA from bacteria
- Quantification of DNA by UV visible Spectroscopy method
- Isolation of Auxotrophic mutants.
- Demonstration of bacterial transformation technique.
- Demonstration of Agarose gel electrophoresis (to study DNA/ RNA) and SDS – PAGE (to study proteins).

### **REFERENCES**

1. Rajan S. Manual for Medical Laboratory Technology. Anajanaa Book House, Chennai. 2012.
2. Rajan S and Selvi Christy R. Experimental Procedures in Life Sciences. Anajanaa Book House, Chennai Monica Cheesbrough. District Laboratory Practice in Tropical Countries - Part I and II, 2nd edition, Cambridge University Press, New Delhi. 2011.
3. Mackie and McCartney (2006) Practical Medical Microbiology, South Asia Edition. 14th edition.
4. Paul IA and Clark FE. Soil Microbiology and Biochemistry, 2nd Ed. Academic press. 2000.
5. Rangaswamy G and Bagyaraj DJ. Agricultural Microbiology, 2nd Ed. Prentice Hall of India Pvt. Ltd., New Delhi. 2001.
6. <https://biologylearner.com/isolation-of-plasmid-dna-objective>

Relationship Matrix for COs, POs and PSOs

For the candidates admitted from the academic year 2022-2023 onwards



Semester	Code	Title of the Course					Hours	Credits			
V	22UMB5CP5	Medical Microbiology, Environmental and Agricultural Microbiology & Microbial Genetics and Molecular Biology (P)					3	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(✓) = 41 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- V

Course Code: 22UMB5MBE1:1  
Instruction Hours: 5  
Credits: 4

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

### **MAJOR BASED ELECTIVE- 1 NUTRITION IN HEALTH AND DISEASES**

#### **Objective:**

- Students imparting knowledge on nutritional diseases, digestion and absorption of biomolecules

#### **Course outcomes:**

- Students able to evaluate the relationship between diet, nutrition and disease.
- Incorporate their knowledge and understanding of principles of nutrition to the prevent and treatment of disease.
- Able to apply dietary energy and physical assessment methodologies.
- Understanding the composition of nutrition and diet therapy
- Broad knowledge on nutritional factors and their impacts

#### **Unit I**

Nutrition -Concept -Composition of food -Macro and Micro nutrients and their functions. Plant and animal sources of simple and complex carbohydrates, fats and proteins. National and regional food pattern in India.

#### **Unit II**

Digestion and absorption of carbohydrates, fats, proteins, minerals and vitamins. Care and preservation of foods. Nutritional requirements of infants, children & youth. Nutritional demand in pregnancy, lactation and menopause. Nutrition for old people. Food with increased nutritive value in terms of protein -Calorie. Biological value of proteins

#### **Unit III**

Diseases arising due to protein -Calorie malnutrition and under nutrition (Kwashiorkar and Marasmus diseases) Vitamins (fat and water soluble) deficiency diseases -Mineral deficiency diseases -symptoms and dietary supplementation.

#### **Unit IV**

Dehydration in infants and children and its treatment Diet therapy for under weight and over weight children. Food allergy due to wheat, milk and egg and diet therapy. Atherosclerosis -Symptoms. Low calorie diet and fat controlled dietary pattern. Hypertension (High Blood pressure) -Symptoms. Sodium restricted dietary pattern.

#### **Unit V**

Symptoms of diseases and modification of dietary pattern for patient suffering from fever (Typhoid and Malaria), Jaundice, hyper acidity (Ulcer), moderate and severe diabetes in adults. Diet therapy for patients having kidney diseases due to diabetes and hypertension.

For the candidates admitted from the academic year 2022-2023 onwards

## REFERENCES

1. Lissa Jellum Principles of Nutrition- Text Book Second Edition University System of Georgia 2018
2. Aniraban Sengupta. Principles of Nutrition – Salok Publishers 2018
3. Gyula Mozsik, Maria Figler Nutrition, Health and Disease – A Life span Approach Cooper. John Wiley and Sons 2015
4. <https://study.com/learn/lesson/digestion-and-absorption-of-carbohydrates.html>

### Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	22UMB5MBE1:1	Nutrition in Health and Diseases					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(✓) = 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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- V

Course Code: 22UMB5SBE2:1  
Instruction Hours: 2  
Credits: 2

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

### SKILL BASED ELECTIVE 2 – FUNDAMENTALS OF ENZYMES

#### Objective:

- Students will get comprehensive knowledge on classification, isolation, mechanism, principles and applications of enzymes.

#### Course outcomes:

- Acquired knowledge of nomenclature & classification of enzymes, properties, structure & functions of coenzymes.
- Have developed a good knowledge of isolation & purification of Enzymes.
- Developed a clear understanding of Enzyme kinetics.
- Describing the mechanism of Enzyme action.
- Have understood principles and applications of Enzymes.

#### Unit I

Enzymes: Definition, nomenclature and classification of enzymes, Properties, Structure and functions of coenzymes. Metallo enzymes and metal activated enzymes. Units of enzyme activity, turn over number. Non protein enzymes ribozymes and abzymes.

#### Unit II

Isolation and purification of enzymes: Isolation –Localization and Extraction of Free and membrane bound enzymes. Methods of purification. Separation procedures based on molecular size, solubility difference and electric charge and selective adsorption..

#### Unit III

Enzyme kinetics: Factors influencing enzyme activity, Derivation of Michaelis-Menton equation, Line weaver, Burk plot, Types of inhibition Competitive, noncompetitive, uncompetitive, feedback inhibition and allosteric inhibition.

#### Unit IV

Mechanism of enzyme action Lock and Key model, induced fit hypothesis. Mechanism of enzyme catalysis, enzyme-substrate complex formation, mechanism of bisubstrate reactions.

#### Unit V

Multienzyme complex- pyruvate dehydrogenase, Isoenzymes of lactate dehydrogenase. Immobilized enzymes principles and applications: Enzymes as a marker in clinical diagnosis. Industrial applications of enzymes.

#### REFERENCES

1. Maarten Van Oort, Robert J. Whitehurst Enzymes in Food Technology John Wiley & Sons 2009
2. Fundamentals of Enzymology, Nicholas C Price, Third Edition Oxford University Press 2009
3. S. C. Rastogi Biochemistry Tata McGraw-Hill Education, 2003

For the candidates admitted from the academic year 2022-2023 onwards

4. Fundamentals of Biochemistry. (6th ed.) J.L. Jain, Sanjay Jain and Nitin Jain. New Delhi: S. Chand & company Ltd. 2005
5. <https://teachmephysiology.com/.../molecules-and-signalling/enzyme-kinetics>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	22UMB5SBE2:1	Fundamentals of Enzymes					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(✓) = 40 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- V

Course Code: 22UMB5SBE3:1  
Instruction Hours: 2  
Credits: 2

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

### **SKILL BASED ELECTIVE 3 - ANTIMICROBIAL AGENTS**

#### **Objective:**

- Students can enrich the basic fundamental concept disinfection, antibiotics, and emerging antibiotic resistance.

#### **Course Outcomes:**

- Have developed an understanding of chemical, physical & non pharmaceutical agents.
- Understood action of antibacterial & antiviral agents.
- Developing a good skill of interferon & viral vaccines.
- Understood the mechanism of action of antiprotozoal agent.
- Imparting a knowledge on drug resistance and antimicrobial peptides

#### **Unit I**

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

#### **Unit II**

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

#### **Unit III**

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

#### **Unit IV**

t – mode of action- amphotericin, nystatin and fluorocytosine. Antiprotozoal agents – mechanism of action – (Metronidazole – chloroquine, Paromomycin sulfate, – quinolines).

#### **Unit V**

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

### **REFERENCES**

1. Alan R Hauser. Antibiotics basics for clinicians: choosing the right antibacterial agent. Wolter Kluwer / Lipponcott Williams and Wilkins Publisher, New York. 2007.
2. Cohen MR. Medication errors, American pharmaceutical association, Washington, DC. 2007.
3. Erika J Ernst. Antifungal agent (methods in molecular medicine). Humana Press, New York. 2015.
4. Hellen Geiband, Molly Miller, Petrie, Suraj Pant, Sumanth Gandra, Jordan lewinson, Devra Barter, Andrea White and Ramanan Laxminarayanan. The state of the Worlds antibiotic. CDDEP publisher, Washington, DC. 2015.
5. <https://www.sciencedirect.com/topics/chemistry/antibacterial-agent>

For the candidates admitted from the academic year 2022-2023 onwards

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	22UMB5SBE3:1	Antimicrobial Agents					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(✓) = 42 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- VI

Course Code: 22UMB6CC8  
Instruction Hours: 6  
Credits: 6

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

### CORE COURSE 8- FOOD MICROBIOLOGY

#### Objective:

- Students can learn about food production, food preservation, food contamination, food spoilage and food regulatory practices

#### Course outcomes:

- Are able to describe the role of micro organism in the production of food, its spoilage.
- Are able to identify the role of micro organism in the contamination of the diseases & how to protect against food –borne pathogens.
- Developed experimental skills for testing the milk & different foods for the presence of microorganism.
- Acquiring a knowledge on food spoilage and preservation
- Imparting a knowledge on food regulatory practices, policies and hazards

#### Unit I

Concepts of food and nutrients - Physicochemical properties of foods - Food and microorganisms – Importance and types of microorganisms in food (Bacteria, Mould and Yeasts) - Sources of contamination- Factors influencing microbial growth in food – pH, moisture, Oxidation-reduction potential, nutrient contents and inhibitory substances.

#### Unit II

Food Fermentations – Manufacture of fermented foods - Fermented dairy products (yoghurt and Cheese) - plant products- Bread, Sauerkraut and Pickles - Fermented beverages- Beer. Brief account on the sources and applications of microbial enzymes – Terminologies - Prebiotics Probiotics and synbiotics. Advantages of probiotics.

#### Unit III

Contamination, spoilage and preservation of cereals and cereal products - sugar and sugar products -Vegetables and fruits- meat and meat products- Spoilage of canned food.

#### Unit IV

Food borne diseases and food poisoning – Staphylococcus, Clostridium, Vibrio parahaemolyticus and Campylobacter jejuni. Escherichia coli and Salmonella infections, Hepatitis, Amoebiasis. Algal toxins and Mycotoxins.

#### Unit V

Food preservations: principles- methods of preservations-Physical and chemical methods- food sanitations- Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, EPA, HACCP, ISI. HACCP – Food safety- control of hazards.



## REFERENCES

1. Chris Bell, Paul Neaves, Anthony P. Williams. Food Microbiology and Laboratory Practicals 2nd edition, Blackwell Scientific Publishers, UK. 2006.
2. Frazier WC and Westhoff DC. Food Microbiology, Sixth edition, Tata McGraw-Hill Publishing Ltd., New Delhi. 2005.
3. Khetarpaul Neelam. Food Processing and Preservation, Daya Publishing House, Delhi. 2005.
4. Sinha and Sharma. Food Microbiology, Oxford Book Company, New Delhi. 2012.
5. Lund BM, Baird Parker AC and Gould GW. The Microbiological Safety and Quality of foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD. 2000.
6. <https://www.sciencedirect.com/topics/food-science/food-preservation>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	22UMB6CC8	Food Microbiology					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(✓) = 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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- VI

Course Code: 22UMB6CC9  
Instruction Hours: 6  
Credits: 6

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

### CORE COURSE 9 - INDUSTRIAL MICROBIOLOGY

#### Objective:

- To enlighten the students towards industrial process and they can understand the pharmaceutical and industrial value of microbial products

#### Course outcomes:

- Are capable of describing a large number of substrate that are used for fermentation process.
- Have developed an understanding of different types of reactors used for fermentation process.
- Have acquired a detailed knowledge of number of products with are produced by industrial fermentation process.
- Acquiring a knowledge on pharmaceutical and industrial value of microbial products
- Developing analytical skill towards industrial products

#### Unit I

Historical development of Industrial Microbiology, Industrially important microorganisms, sources and characters; Primary and secondary screening and preservation of industrially important strains, Major classes of products and processes. Strain improvement.

#### Unit II

Fermenter - Design, types and basic functions. Characteristics of production media, Fermentation media - formulation strategies, economical means of providing energy, carbon, nitrogen, vitamin and mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams. Sterilization of fermentation equipment, air and media. Types of fermentation.

#### Unit III

Downstream processing - recovery and purification of fermentations products (intracellular and extracellular), cell disruption, precipitation, filtration, centrifugation, solvent recovery, chromatography, Ultrafiltration and drying, Quality assurance (QC) of finished product. Immobilization of cell and enzymes.

#### Unit IV

Microbial products of pharmaceutical value – raw materials, organism and industrial processes involved in the production of Penicillin, Streptomycin, Vitamin B12, Riboflavin and rabies vaccine.

#### Unit V

Microbial products of industrial value – raw materials, organism and industrial processes involved in the production of ethanol, vinegar, amylase, protease, glutamic acid. Recycling and disposal of industrial wastes through microbes.

## REFERENCES

1. Glazer NA and Nikaido H. Microbial Biotechnology: Fundamentals of applied Microbiology 2<sup>nd</sup> edition, Cambridge University Press. 2007.
2. Pandey A, Soccol RC and Larroche C. Current Developments in Solid-state Fermentation. Springer Verlag. 2008.
3. Pepler HJ and Pearlman D. Microbial Technology – Fermentation Technology. Vol.1 and 2, 2<sup>nd</sup> edition, Academic Press, London. 2004.
4. Prescott LM, Harley JP and Helin DA, Microbiology, fifth edition, McGraw Hill, New Delhi. 2002.
5. Sivakumar PK, Joe MM and Sukesh K. An introduction to Industrial Microbiology. First edition, S. Chand and Company Ltd, New Delhi. 2010.
6. <https://microbiologynote.com/fermentation>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	22UMB6CC9	Industrial Microbiology					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(✓) = 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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- VI

Course Code: 22UMB6CP6  
Instruction Hours: 6  
Credits: 4

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

### **CORE PRACTICAL - 6** **FOOD MICROBIOLOGY AND INDUSTRIAL MICROBIOLOGY (P)**

#### **Objective:**

- Students will get practical exposure on food microbiology and industrial product preparation

#### **Course outcomes:**

- Students know to identify standard methods for the isolation and identification of microorganisms in food sample.
- Students understand the microbial principle relating to the production of fermented food.
- Acquiring a knowledge on industrial product preparation
- Demonstrate about antibiotic and industrial production
- Imparting a knowledge on food samples and their analysis

#### **FOOD MICROBIOLOGY AND INDUSTRIAL MICROBIOLOGY (P)**

1. Assessment of milk quality by methylene blue reduction test
2. Performance of phosphatase test for pasteurized milk.
3. Isolation of bacteria from food by Standard Plate Count
4. Isolation of Yeast from grapes.
5. Wet mount preparation of spoiled bread, tomato, grapes, potato.
6. Observation of food samples to study *Leuconsostoc*, *Lactobacillus*, *Streptococcus lactis* and *Saccharomyes*.
7. Immobilization of yeast cell using sodium alginate
8. Alcohol fermentation by *Saccharomyces cerevisiae*.
9. Estimation of alcohol using Potassium Di-chromate method.
10. Production of Citric acid using *Aspergillus niger*
11. Starch (Amylase), casein (Protease) and lipid ( Lipase) hydrolyses tests

#### **DEMONSTRATION**

1. Preparation of fermented food – Yoghurt and cheese
2. Screening of bacteria and actinobacteria for antibiotic production
3. Screening of bacteria and actinobacteria for enzyme production

#### **REFERENCES**

1. Aneja KR. Experiments in Microbiology, Plant pathology and Biotechnology. 4th edition, New Age International Publishers, Chennai. 2005.
2. James G Cappuccino and Natalie Sherman, Microbiology: A laboratory manual. 6th edition, Published by Pearson Education. 2004.
3. Kannan N, Handbook of laboratory culture media, Reagents, Stains and buffers. Panima Publishing Corporation, New Delhi. 2003.
4. Ponmurugan P, Nithya R and Fredinose M, Experimental Procedure in Bioprocess Technology and Downstream Processing. Anjana Book House. Chennai. 2012.
5. Rajan S and Selvi Christy. Experimental procedures in life sciences. Anjana Book House,

publishers and distributors, Chennai 2011.

6. <https://www.sciencedirect.com/topics/chemistry/immobilization>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	22UMB6CP6	Food Microbiology and Industrial Microbiology (P)					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(✓) =45 Relationship: Very High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- VI

Course Code: 22UMB6MBE2:1  
Instruction Hours: 6  
Credits: 5

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

### MAJOR BASED ELECTIVE 2- RECOMBINANT DNA TECHNOLOGY

#### Objective:

- Students can learn about the methods in genetic engineering and importance of rDNA technology

#### Course outcomes:

- Have acquired a good knowledge on tools and methods of genetic engineering.
- Have acquired a good understanding of how these tools & methods are employed in the lab.
- Understanding the importance of rDNA technology and transfer mechanisms
- Imparting a good knowledge on methods in gene transfer techniques.
- Acquiring a good analytical skills about rDNA and genetic engineering

#### Unit I

Milestones in rDNA technology - Definition of gene manipulation - Major steps involved in gene cloning - Isolation and Purification of Chromosomal and Plasmid DNA, Isolation and Purification of RNA - Chemical Synthesis of DNA, Genomic Library and cDNA Library - applications.

#### Unit II

Restriction endonucleases: Discovery, Type I, II and III and Mode of action, Applications of type II restriction endonucleases, Ligases, DNA polymerases, DNA modifying enzymes and topoisomerases.

#### Unit III

Cloning vectors: Definition and properties – Plasmid based vectors: Natural vectors (pSC101, pSF2124, pMB1), Artificial vectors (pBR322 and pUC) - Phage based vectors-  $\lambda$  (Lamda) phage vectors and its derivatives - Hybrid Vectors- Phagemid and Cosmid, BAC and YAC – Expression systems – *E. coli*.

#### Unit IV

Gene/ DNA transfer techniques: Physical – Biolistic Method (Gene gun), Chemical- Calcium chloride and DEAE Methods, Biological *in vitro* packaging method in viruses - Selection and Screening of recombinants: Direct Method: Selection by Complementation, Marker inactivation methods - Indirect methods: Immunological and Genetic methods.

#### Unit V

Blotting (Southern, Western, Northern and North- eastern) techniques – PCR - basic steps in DNA amplification, RAPD, RFLP and their applications – DNA finger printing - DNA microarray analysis – Applications of recombinant DNA technology.

For the candidates admitted from the academic year 2022-2023 onwards

## REFERENCES

1. Brown TA. Gene Cloning and DNA Analysis, 7th edition, Wiley Blackwell. 2015.
2. Primrose SB and Twyman RM. Principles of Gene Manipulation and Genomics, Wiley Blackwell, 7th edition. 2006.
3. Old RW and Primrose SB. Principle of Gene Manipulation, 5th edition. Blackwell Scientific Publication, Boston. 2013.
4. Julia Lodge, Peter Lund and Steve Minchin. Gene Cloning – Principles and Applications. Taylor and Francis, UK. 2006.
5. <https://microbenotes.com/restriction-enzyme-restriction-endonuclease>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	22UMB6MBE2:1	Recombinant DNA Technology					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(✓) = 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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- VI

Course Code: 20UMB6MBE2:1  
Instruction Hours: 6  
Credits: 5

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

### MAJOR BASED ELECTIVE 2- RECOMBINANT DNA TECHNOLOGY

#### Course outcomes:

- Have acquired a good knowledge on tools and methods of genetic engineering.
- Have acquired a good understanding of how these tools & methods are employed in the lab.
- Understanding the importance of rDNA technology and transfer mechanisms
- Imparting a good knowledge on methods in gene transfer techniques.
- Acquiring a good analytical skills about rDNA and genetic engineering

#### Unit I

Milestones in rDNA technology - Definition of gene manipulation - Major steps involved in gene cloning - Isolation and Purification of Chromosomal and Plasmid DNA, Isolation and Purification of RNA - Chemical Synthesis of DNA, Genomic Library and cDNA Library - applications.

#### Unit II

Restriction endonucleases: Discovery, Type I, II and III and Mode of action, Applications of type II restriction endonucleases, Ligases, DNA polymerases, DNA modifying enzymes and topoisomerases.

#### Unit III

Cloning vectors: Definition and properties – Plasmid based vectors: Natural vectors (pSC101, pSF2124, pMB1), Artificial vectors (pBR322 and pUC) - Phage based vectors-  $\lambda$  (Lamda) phage vectors and its derivatives - Hybrid Vectors- Phagemid and Cosmid, BAC and YAC – Expression systems – *E. coli*.

#### Unit IV

Gene/ DNA transfer techniques: Physical – Biolistic Method (Gene gun), Chemical- Calcium chloride and DEAE Methods, Biological *in vitro* packaging method in viruses - Selection and Screening of recombinants: Direct Method: Selection by Complementation, Marker inactivation methods - Indirect methods: Immunological and Genetic methods.

#### Unit V

Blotting (Southern, Western, Northern and North- eastern) techniques – PCR - basic steps in DNA amplification, RAPD, RFLP and their applications – DNA finger printing - DNA microarray analysis – Applications of recombinant DNA technology.

For the candidates admitted from the academic year 2022-2023 onwards



## REFERENCES

6. Brown TA. An introduction to Gene Cloning, 3rd edition, Chapman and Hall. 1995.
7. Brown TA. Gene Cloning and DNA Analysis, 7th edition, Wiley Blackwell. 2015.
8. Primrose SB and Twyman RM. Principles of Gene Manipulation and Genomics, Wiley Blackwell, 7th edition. 2006.
9. Old RW and Primrose SB. Principle of Gene Manipulation, 5th edition. Blackwell Scientific Publication, Boston. 1995.
10. Julia Lodge, Peter Lund and Steve Minchin. Gene Cloning – Principles and Applications. Taylor and Francis, UK. 2006.
11. Winnecker ED. From gene to clones, Introduction to Gene Technology, VCH Publication, FRG. 1987.
12. Glick BR and Pasternak JJ. Molecular Biotechnology. Principles and Application of recombinant DNA, ASM Press, Washington. 1994.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UMB6MBE2:1	Recombinant DNA Technology					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(✓) = 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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- VI

Course Code: 20UMB6MBE2:2  
Instruction Hours: 6  
Credits: 5

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

### MAJOR BASED ELECTIVE 2 - ENTREPRENEURIAL MICROBIOLOGY

#### Course outcomes:

- Students able to evaluate the concept of entrepreneur.
- Identify personal attributes that enable best use of entrepreneurial opportunities.
- Understand the function of the entrepreneur in the successful, commercial application of innovations.
- Students can develop their own skills towards entrepreneurship activities
- Develop their life skills and enhance themselves to become a good entrepreneur

#### Unit I

Evolution of the concept of entrepreneur -Entrepreneurship: Definitions- concept of Entrepreneurship, development- needs – role of resource, talent and spirit – process of Entrepreneurship to socio-economic gains.

#### Unit II

Institutions and schemes of Government of India – Schemes and programmes, Department of Science and Technology schemes, Nationalized banks – other financial institutions – SIDBI, NSIC, NABARD, IDBI, IFCI and ICICI.

#### Unit III

Skills for entrepreneurs - Communication skills, problem solving skills; Business plan development; Market need- Market research, SWOT analysis, identifying competitors. Financial plan – Financial support for business, business insurance, Marketing – Mix-product, distribution, price, promotion and market goal setting.

#### Unit IV

Project – idea generation – Sources of idea generation – Trade Fairs and Exhibitions – Project identification – classification – project formulation – project appraisal. Composting of domestic, agricultural and industrial wastes, vermicomposting. SCP production; Mushroom cultivation.

#### Unit V

Biofertilizers and biopesticides. Production of teaching kits (plasmid DNA isolation, serum electrophoresis) and diagnostic kits (Widal test kits, ABO blood grouping kits). Marketing strategies.

#### REFERENCES

1. Nagendra S., (2008) Entrepreneurship and management Sanguine technical publishers
2. Bhatia, B.S. and G.S Batra, (2003) Entrepreneurship and small business management. Deep and deep publications
3. Naidu, N.V.R, (2008) Management and entrepreneurship. I.K. International Pvt. Ltd.
4. Greene, (2000) Entrepreneurship ideas in action. Thomson learning

For the candidates admitted from the academic year 2022-2023 onwards

5. Tilak, K.V.B.R., (1990). Bacterial Biofertilizers. IARI Publications, New Delhi.
6. Venkataraman, G.S. (1972). Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's Printers and Publishers, New Delhi.
- 7.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UMB6MBE2:2	Entrepreneurial 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(✓) = 43 Relationship: High											

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

## SEMESTER- VI

Course Code: 20UMB6MBE2:3  
Instruction Hours: 6  
Credits: 5

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

### MAJOR BASED ELECTIVE 2 - BIOSAFETY AND BIOETHICS

#### Course outcomes:

- To gain knowledge of working in a microbiology lab taking all safety measures, handling of microorganism etc.
- Developed knowledge of basic concepts related to stem cell research
- Acquiring a knowledge on animal rights and gene therapy
- Understanding about the biosafety levels for various biological research
- Learn about the biosafety guidelines and regulations

#### Unit I

General Ethical Concerns - Reducing Genetic Diversity - Biological Warfare - Public perception of Science - Medical Ethics - Hippocratic tradition - Profession and Philanthropy - Adoption to the oath by western medicine.

#### Unit II

Status of Human Embryo - Human Embryonic Development - Scientific Research on Human Embryos - Experimental goals of Human Embryo Research. Stem cell research.

#### Unit III

Animal Rights: Making New Strains of Animal - Ethical limits of Animal use -Religious and Philosophical views of Animal status - Human Gene therapy - Ethics of Somatic Cell Gene Therapy – Humanized mouse - Safety of Transferred Genes – Applications of gene therapy

#### Unit IV

Introduction: biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

#### Unit V

Biosafety guidelines and regulations: Operation of biosafety guidelines and regulations of Government of India - Definition of GMOs and LMOs - Roles of IBC, RCGM, GEAC - GMO applications in food and agriculture - Environmental release of GMOs - Risk Analysis; Risk Assessment; Risk management and communication - Cartagena Protocol.

#### REFERENCES

1. Ethics in engineering, Martin. M.W. and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.
2. Nancy, S. Jecker., Albert R. Johnson, Robert A. Pearlman. Bioethics: An Introduction to history, methods and practice (1997).
3. Sudbury, M.A.; Jones and Barlett Publishers. Tom, L. Beauchamp., Childress, F. Principles of biomedical ethics, 5th Edition, Oxford Univerisity Press. 2000.

For the candidates admitted from the academic year 2022-2023 onwards

4. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UMB6MBE2:3	Biosafety and Bioethics					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(✓) = 34 Relationship: Moderate											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- VI

Course Code: 20UMB6MBE3:1  
Instruction Hours: 5  
Credits: 5

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

### MAJOR BASED ELECTIVE 3 - CANCER BIOLOGY

#### Course Outcomes:

- Know about characteristics, sign and symptoms, types and risk factors of cancers
- Understand the concept of tumor suppressor and oncogenes.
- To learn the mechanism of spread of cancer cells, biology of cell death.
- Learn about clinical examination of cancer by blood tests, pap smear test and biopsy.
- Acquiring knowledge on biomedical applications of nano technology

#### Unit I

Normal vs. Cancer cell. Characteristics of cancer and cancer cells. Sign and symptoms of cancers. Risk factors of cancer -Life style and dietary factors. Benign and malignant tumors. Types of cancers. Epidemiology of breast, cervical, oral and lung cancers.

#### Unit II

Carcinogenesis: Carcinogens and carcinogenesis. Environmental carcinogens. Oxidative stress and Cancer. Concept of tumor suppressor and oncogenes.

#### Unit III

Pathology: Tumor formation -Initiation, promotion and progression. Spread of cancer cells. Biology of cell death. Common myths and misconceptions of cancer

#### Unit IV

Prediction and Diagnosis: Clinical examination -Blood Tests, Pap smear test and Biopsy. Radiological examination -X-rays, CT scan, MRI and Mammography. Applications of Computational tools in cancer prediction

#### Unit V

Prevention and therapy: General principles of cancer therapy. Biomedical applications of nanotechnology in cancer prevention. Concept of cancer vaccine. Antioxidants and dietary fibre in cancer prevention.

#### REFERENCES

1. Molecular Pathology and Diagnostics of Cancer (Cancer Growth and Progression), Domenico Coppola, Springer.
2. An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical publications.
3. The Biology of Cancer, Janice Gabriel, John Wiley & Sons Ltd., 2<sup>nd</sup> Ed.
4. Cancer Biology, Raymond W. Ruddon, Oxford University Press, Inc., 4<sup>th</sup>Ed.
5. Introduction to Cancer Biology, Momna Hejmadi, Ventus Publishers. Molecular Biology of Human Cancers, Wolfgang Arthur Schulz, Springer Science, Business Media, Inc

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UMB6MBE3:1	Cancer Biology					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(✓) = 36 Relationship: High											

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

For the candidates admitted from the academic year 2022-2023 onwards

## SEMESTER- VI

Course Code: 20UMB6MBE3:2  
Instruction Hours: 5  
Credits: 5

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

### MAJOR BASED ELECTIVE 3 - ETHNO MEDICINE

#### Course outcomes:

- Understand the scope and history of ethnobotany
- Students able to know about the importance of medicinal plants in health care
- Understand important interaction between cultural practices ecosystem and modern science
- Acquiring traditional knowledge on utility of medicinal plants
- Imparting a knowledge on nutritive and medicinal value of fruits and vegetables

#### Unit I

Ethnomedicine – definition, history and its scope –Inter disciplinary approaches in ethnobotany – Collection of ethnic information.

#### Unit II

Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

#### Unit III

Tribal medicine – methods of disease diagnosis and treatment – Plants in folk religion – Aegle marmelos, Ficus benghalensis, Curcuma domestica, Cyanodon dactylon and Sesamum indicum.

#### Unit IV

Traditional knowledge and utility of some medicinal plants in Tamilnadu –Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathoda vasica, Azadirachta indica, Gloriosa superba, Eclipta alba, Aristolochia indica, Phyllanthus fraternus and Boerhaavia diffusa.

#### Unit V

Plants in day today life – Ocimum sanctum, Centella asiatica, Solanum trilobatum, Cassia auriculata, Aloe vera. Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and vegetables -Greens (Moringa, Solanum nigrum) Cabbage.

#### REFERENCES

1. Ethnobiology – R.K.Sinha & Shweta Sinha – 2001. Surabhe Publications – Jaipur.
2. Tribal medicine D.C. Pal & S.K. Jain 1998, Naya Prakash, 206, Bidhan Sarani, Calcutta
3. Contribution to Indian ethnobotany – S.K. Jain 1995, 3<sup>rd</sup> edition, Scientific publishers, P.B.No. 91, Jodhpur, India.
4. A Manual of Ethnobotany – S.K.Jain, 1995, 2<sup>nd</sup>edition.



Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UMB6MBE3:2	Ethnomedicine					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(✓) = 39 Relationship: High											

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

SEMESTER- VI

For the candidates admitted from the academic year 2022-2023 onwards

Course Code: 20UMB6MBE3:3  
Instruction Hours: 5  
Credits: 5

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

### **MAJOR BASED ELECTIVE 3 - MEDICAL BIOCHEMISTRY**

#### **Course outcomes:**

- Developed a very good understanding of disorders of carbohydrates & lipids
- Gain knowledge of abnormalities in nitrogen metabolism
- Have acquired knowledge in haematology
- Facilitating about the composition of blood and its functions
- Acquiring a knowledge on blood disorders

#### **Unit I**

Disorders of carbohydrate metabolism – Diabetes mellitus, Glucose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia

#### **Unit II**

Disorders of lipids- Plasma lipo proteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's, ketone bodies,  $\beta$ -lipoproteinemia

#### **Unit III**

Disorders of liver and kidney- Jaundice, fatty liver, normal and abnormal functions of liver and kidney, inulin and urea clearance

#### **Unit IV**

Abnormalities in nitrogen metabolism- Uremia, hyperurecemia, porphyria and factors affecting nitrogen balance

#### **Unit V**

Blood –composition and functions, properties and functions of haemoglobin. Blood clotting-disturbances in blood clotting mechanisms- haemorrhagic disorders, haemophilia, purpura, thrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombin complex disorders, circulating anticoagulants.

#### **REFERENCES**

1. Fundamentals of biochemistry. A. C. Deb. 8<sup>th</sup> edition. New central book agency (p)ltd. India
2. Textbook of biochemistry with clinical correlations. Thomas M Deblin. 4<sup>th</sup> edition. A John Wiley and sons, Inc., publications., New York.
3. Biochemistry. U. Sathyanarayana. 2<sup>nd</sup> edition. Books and allied pvt ltd.
4. Fundamental of Biochemistry for medical students. Ambika Shanmugam. Revised edition(2003). Published by the Author, 17. III Cross street, west CIT nagar, Chennai-35

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UMB6MBE3:3	Medical Biochemistry					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(✓) = 37 Relationship: High											

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

- strategies

For the candidates admitted from the academic year 2022-2023 onwards

## **LEARNING OUTCOME**

- Students able to evaluate the concept of entrepreneur.
- Identify personal attributes that enable best use of entrepreneurial opportunities.
- Understand the function of the entrepreneur in the successful, Commercial application of innovations.

### **Unit I - Introduction**

Evolution of the concept of entrepreneur – Entrepreneurship: Definitions – concept of Entrepreneurship, development

– need – role of resource, talent and spirit – process of Entrepreneurship to socio-economic gains.

### **Unit II – Organizations and schemes**

Institutions and schemes of Government of India – Schemes and programmes, Department of Science and Technology schemes, Nationalized banks – other financial institutions – SIDBI, NSIC, NABARD, IDBI, IFCI and ICICI.

### **Unit III - Skills for entrepreneurs**

Skills for entrepreneurs – Communication skills, problem solving skills; Business plan development; Market need – Market research, SWOT analysis, identifying competitors. Financial plan – Financial support for business, business insurance, Marketing – Mix-product, distribution, price, promotion and market goal setting.

### **Unit IV – Projects implementations**

Project – idea generation – Sources of idea generation – Trade Fairs and Exhibitions – Project identification – classification – project formulation – project appraisal. Composting of domestic, agricultural and industrial wastes, vermicomposting. SCP production; Mushroom cultivation.

### **Unit V – Production and marketing**

Biofertilizers and biopesticides. Production of teaching kits (plasmid DNA isolation, serum electrophoresis) and diagnostic kits (WIDAL test kits, ABO blood grouping kits). Marketing strategies.

### **References**

8. Nagendra S., (2008) Entrepreneurship and management Sanguine technical publishers
9. Bhatia, B.S. and G.S Batra, (2003) Entrepreneurship and small business management. Deep and deep publications
10. Naidu, N.V.R., (2008) Management and entrepreneurship. I.K. International Pvt. Ltd.
11. Greene, (2000) Entrepreneurship ideas in action. Thomson learning
12. Tilak, K.V.B.R., (1990). Bacterial Biofertilizers. IARI Publications, New Delhi.
13. Venkataraman, G.S. (1972). Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's Printers and Publishers, New Delhi

## SEMESTER- VI

**Course Code: 20UMB6MBE2:3**  
**Instruction Hours: 6**  
**Credits: 5**

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

### BIOSAFETY AND BIOETHICS

#### OBJECTIVES

- .To know about the biosafety guidelines and regulations with biosafety levels and cabinets.
- To provide the knowledge about Bioethics.

#### LEARNING OUTCOMES

- To gain knowledge of working in a microbiology lab taking all safety measures, handling of microorganism etc.
- Developed knowledge of basic concepts related to IPR.
- Developed knowledge of patent filling.

#### Unit I - Bioethics

General Ethical Concerns - Reducing Genetic Diversity - Biological Warfare - Public perception of Science - Medical Ethics – Hippocratic tradition – Profession and Philanthropy - Adoption to the oath by western medicine - Retaining the Hippocratic Oath.

#### Unit II – Human Embryonic Research

Status of Human Embryo - Human Embryonic Development - Ethics through Embryo Development – Fertilization - Scientific Research on Human Embryos - Experimental goals of Human Embryo Research. Stem cell research.

#### Unit III – Animal Rights

Animal Rights: Making New Strains of Animal - Ethical limits of Animal use -Religious and Philosophical views of Animal status - Human Gene therapy - Ethics of Somatic Cell Gene Therapy – Humanized mouse - Safety of Transferred Genes – Applications of gene therapy

#### Unit IV - Biosafety

Introduction: biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

#### Unit V - Biosafety Guidelines

Biosafety guidelines and regulations: Operation of biosafety guidelines and regulations of Government of India - Definition of GMOs and LMOs - Roles of IBC, RCGM, GEAC - GMO applications in food and agriculture - Environmental release of GMOs - Risk Analysis; Risk Assessment; Risk management and communication - Cartagena Protocol.

#### REFERENCE

5. Ethics in engineering, Martin. M.W. and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.
6. Nancy, S. Jecker., Albert R. Johnson, Robert A. Pearlman. Bioethics: An Introduction to history, methods and practice (1997).

For the candidates admitted from the academic year 2022-2023 onwards

7. Sudbury, M.A.; Jones and Barlett Publishers. Tom, L. Beauchamp., Childress, F. Principles of biomedical ethics, 5th Edition, Oxford Univerisity Press. 2000.
8. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.

**SEMESTER- VI**  
**Course Code: 20UMB6MBE3:1**  
**Instruction Hours: 5**  
**Credits: 5**

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

## **CANCER BIOLOGY**

### **Objectives**

- To study the characteristics, sign and symptoms, types and risk factors of cancers and epidemiology of breast, cervical, oral and lung cancers.
- To identify different types of carcinogens and understand mechanism of carcinogenesis.

### **Learning Outcome:**

- Know about characteristics, sign and symptoms, types and risk factors of cancers
- Understand the concept of tumor suppressor and oncogenes.
- To learn the mechanism of spread of cancer cells, biology of cell death.
- Learn about clinical examination of cancer by blood tests, pap smear test and biopsy.

### **UNIT I**

Normal vs Cancer cell. Characteristics of cancer and cancer cells. Sign and symptoms of cancers. Risk factors of cancer -Life style and dietary factors. Benign and malignant tumors. Types of cancers. Epidemiology of breast, cervical, oral and lung cancers.

### **UNIT II**

Carcinogenesis: Carcinogens and carcinogenesis. Environmental carcinogens.Oxidative stress and Cancer.Concept of tumor suppressor and oncogenes.

### **UNIT III**

Pathology:Tumor formation -Initiation, promotion and progression. Spread of cancer cells. Biology of cell death. Common myths and misconceptions of cancer

### **UNIT IV**

Prediction and Diagnosis:Clinical examination -Blood Tests, Pap smear test and Biopsy. Radiological examination -X-rays, CT scan, MRI and Mammography. Applications of Computational tools in cancer prediction

### **UNIT V**

Prevention and therapy:General principles of cancer therapy. Biomedical applications of nanotechnology in cancer prevention. Concept of cancer vaccine. Antioxidants and dietary fibre in cancer prevention.

### **REFERENCES:**

- 1.Molecular Pathology and Diagnostics of Cancer (Cancer Growth and Progression), Domenico Coppola, Springer.
- 2.An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical publications.
- 3.The Biology of Cancer, Janice Gabriel, John Wiley & Sons Ltd., 2<sup>nd</sup> Ed.
- 4.Cancer Biology, Raymond W. Ruddon, Oxford University Press, Inc., 4thEd.
- 5.Introduction to Cancer Biology, Momna Hejmadi, Ventus Publishers. Molecular Biology of Human Cancers, Wolfgang Arthur Schulz, Springer Science, Business Media, Inc

## SEMESTER- VI

**Course Code: 20UMB6MBE3:2**  
**Instruction Hours: 5**  
**Credits: 5**

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

### ETHNO MEDICINE

#### OBJECTIVES

- Basic concepts of disciplinary approaches in ethanobotany.
- To learn traditional knowledge of medicinal plants.
- To study plants in day today life.

#### LEARNING OUTCOMES

- Understand the relationship between cultures and plants.
- Students able to identify the medicinal plants.
- Understand important interaction between cultural practices ecosystem and modern science.

#### Unit I

Ethnomedicine – definition, history and its scope –Inter disciplinary approaches in ethnobotany – Collection of ethnic information.

#### Unit II

Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

#### Unit III

Tribal medicine – methods of disease diagnosis and treatment – Plants in folk religion – Aegle marmelos, Ficus benghalensis, Curcuma domestica, Cyanodon dactylon and Sesamum indicum.

#### Unit IV

Traditional knowledge and utility of some medicinal plants in Tamilnadu –Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathoda vasica, Azadirachta indica, Gloriosa superba, Eclipta alba, Aristolochia indica, Phyllanthus fraternus and Boerhaavia diffusa.

#### Unit V

Plants in day today life – Ocimum sanctum, Centella asiatica, Solanum trilobatum, Cassia auriculata, Aloe vera. Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and vegetables -Greens (Moringa, Solanum nigrum) Cabbage.

#### Reference:

- 1.Ethnobiology – R.K.Sinha & Shweta Sinha – 2001. Surabhe Publications – Jaipur.
- 2.Tribal medicine – D.C. Pal & S.K. Jain 1998, Naya Prakash, 206, Bidhan Sarani, Calcutta – 700 006.
- 3.Contribution to Indian ethnobotany – S.K. Jain 1995, 3<sup>rd</sup> edition, Scientific publishers, P.B.No. 91, Jodhpur, India.
- 4.A Manual of Ethnobotany – S.K.Jain, 1995, 2ndedition.

For the candidates admitted from the academic year 2022-2023 onwards



## SEMESTER- VI

**Course Code: 20UMB6MBE3:3**  
**Instruction Hours: 5**  
**Credits: 5**

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

### MEDICAL BIOCHEMISTRY

#### OBJECTIVES

- To learn disorder of carbohydrate, lipids disorders.
- To learn about haematology.

#### LEARNING OUTCOMES

- Developed a very good understanding of disorders of carbohydrates & lipids.
- Gain knowledge of abnormalities in nitrogen metabolism.
- Have acquired knowledge in haematology.

#### UNIT I

Disorders of carbohydrate metabolism – Diabetes mellitus, Glucose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia

#### UNIT II

Disorders of lipids- Plasma lipo proteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's, ketone bodies,  $\beta$ -lipoproteinemia

#### UNIT III

Disorders of liver and kidney- Jaundice, fatty liver, normal and abnormal functions of liver and kidney, inulin and urea clearance

#### UNIT IV

Abnormalities in nitrogen metabolism- Uremia, hyperurecemia, porphyria and factors affecting nitrogen balance

#### UNIT V

Blood –composition and functions, properties and functions of haemoglobin. Blood clotting- disturbances in blood clotting mechanisms- haemorrhagic disorders, haemophilia, purpura, thrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombin complex disorders, circulating anticoagulants.

#### REFERENCE

5. Fundamentals of biochemistry. A. C. Deb. 8<sup>th</sup> edition. New central book agency (p)ltd. India
6. Textbook of biochemistry with clinical correlations. Thomas M Deblin. 4<sup>th</sup> edition. A John Wiley and sons, Inc., publications., New York.
7. Biochemistry. U. Sathyanarayana. 2<sup>nd</sup> edition. Books and allied pvt ltd.
8. Fundamental of Biochemistry for medical students. Ambika Shanmugam. Revised edition(2003). Published by the Author, 17. III Cross street, west CIT nagar, Chennai-35

## SEMESTER-III

**Course Code: 20UMB3NME1**

**Instruction Hours: 2**

**Credits:2**

**Exam Hours:3**

**Internal Marks:25**

**External Mark:75**

### MUSHROOM AND VERMITECHNOLOGY

#### OBJECTIVES

- To facilitate self-employment
- To know the nutrient value of mushroom
- To know about the vermicomposting and its agricultural value

#### LEARNING OUTCOME

- Develop knowledge in cultivating the mushrooms.
- To gain Knowledge in composting and its value.
- Have developed a very good understanding of nutritional aspects and commercial use of mushrooms for human consumption.

#### Unit I – Introduction of Mushroom

Edible and non-edible mushroom (Historical account, most commonly cultivated mushrooms in the world, distribution and production in various countries). Cultivation of button mushroom -morphology raising a pure culture & spawn preparation. Cultivation of oyster and paddy straw mushroom - preparation of pure culture & spawn cultivation methods, harvest.

#### Unit II – Cultivation

Preparation of compost & cultivation of *Agaricus bisporus*, *Pleurotus flabellatus*, harvest. Pests and diseases of Edible mushrooms (Environmental, fungal, bacterial, viral, insect pests and Nematode diseases and competitor moulds).

#### Unit III – Earthworms

Soil biota -Earthworms -Ecological classification of earth worms as Epigeics -Introduction to earthworm biology - physical and chemical effects of earth worms on soils - Role of earthworms in soil -classification of earthworms based on ecological strategies- Burrowing activity of earthworms- Drilospheres -Microorganisms and their relationship with earthworms. Composing - anaerobic composing, aerobic composing, types of composing, vermicompost- earthworm species used in vermicompost production - endemic species, exotic species.

#### Unit IV – Vermicomposting

Vermicompost -setting up vermicompost quality N, P, K, C, N, Microbial quality applications - vermiculture – vermiwash - role of vermicompost in organic farming - its quality and advantages over chemical inputs. Earthworms in Bio-reclamation of soil. Problems in vermiculture units - remedial suggestions.

#### Unit V – Applications of Mushroom and Vermicomposting

Antiviral value, antibacterial effect, antifungal effect, anti-tumour effect, haematological value cardiovascular & renal effect, in therapeutic diets, adolescence, for aged persons & diabetes mellitus. Delicious recipies of mushroom- Economic importance of mushrooms. Vermicomposting as a tool for solid waste management - a small scale industry and it's economics.

#### REFERENCES

For the candidates admitted from the academic year 2022-2023 onwards

6. Brady, C.N, 1974 "The Nature and Properties of soils" Macmillan publishing Co. New York, London.
7. Edwards, C.A., and Bohlen, P.J., 1996. Biology and Ecology of Earthworms, Chapman and Hall, London
- Ismail, S.A., 1997, Vermicology: The Biology Earth worm Orient Longman.
8. Chang. T. W.A. Haynes 1978. "Biology and cultivation of Mushrooms" Acad Press.N.Y.
9. Zadrazil. F & K. Grabbe 1983 "Edible Mushroom, Biotechnology" Vol. 3, Weinheim: Verlag Chemie, Berlin.
10. Kannaiyan. 2001. Handbook of Edible Mushrooms" TNAU Publication.

## SEMESTER- IV

**Course Code: 20UBM4NME2**

**Instruction Hours: 2**

**Credits: 2**

**Exam Hours:3**

**Internal Marks:25**

**External Mark:75**

### BIOFERTILIZER

#### OBJECTIVES

- The aim of the course is to make the student to learn importance of biofertilizers in agriculture
- To know about field application and production technologies.

#### LEARNING OUTCOME

- Have developed a very good understanding of practical aspects of production of biofertilizers.
- Have developed a very good understanding of practical aspects of production of biopesticides & bioinsecticides.
- Know the production & field application of VAM.

#### Unit I

Definition and types, importance of biofertilizers in agriculture, Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings. National and Regional Biofertilizers Production and Development centers. Biofertilizers – carrier materials - storage, shelf life, foliar applications, quality control and marketing.

#### UNIT II

Isolation, identification, characterization, mass multiplication, formulation, field application and benefits of *Rhizobium*, Cyanobacteria and *Frankia*.

#### UNIT III

Isolation, identification, characterization, classification, mass cultivation, formulation, field application and benefits of *Azospirillum* and *Azotobacter*.

#### UNIT IV

Phosphate solubilizing bacteria - isolation, identification, characterization, mass cultivation, formulation, field application and benefits.

#### UNIT V

Mycorrhizae – Ecto and Endo (Arbuscular mycorrhizae). Isolation, identification, characterization, mass cultivation, formulation, field application and benefits.

#### REFERENCES

For the candidates admitted from the academic year 2022-2023 onwards

1. Dinesh K Maheswari. Bacteria in Agrobiolgy, Springer Heidelberg, New York. 2012.
2. Kannaiyan S. Biotechnology of biofertilizers, Narosa publishing house, New Delhi. 2002. Kannaiyan S. Biotechnology of biofertilizers, CHIPS, Texas. 5<sup>th</sup> edition, McGraw Hill, New York. 2003.
3. Mahendra K Rai. Hand book microbial biofertilizers. 9<sup>th</sup> edition. The Haworth press, Inc. New York. 2015.
4. Ramesh Chandra and Raverkar KP. Bioresources for sustainable plant nutrient management, scholars world publishers, New Delhi. 2014.
5. Reddy SMLV, Gangwane P, Prakash and Kunwar IK. Bioinoculants for sustainable agriculture and forestry. Scientific publishers, Jodhpur. 2002.