

# HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai)  
(Re-Accredited at "A" Grade by NAAC, Bangalore)

UTHAMAPALAYAM - 625533



## DEPARTMENT OF MICROBIOLOGY BACHELOR OF SCIENCE - MICROBIOLOGY SYLLABUS

**(Effect from the Academic Year 2017 – 2018 Onwards)**

### **PROGRAMME SPECIFIC OUTCOMES:**

- PSO1. Understand the basic concepts of microorganisms
- PSO2. Elicit analytical and practical skills in basic and applied microbiological techniques
- PSO3. Illustrate guidelines for quality control in various industries such as food, pharmaceutical and diagnosis of infectious diseases
- PSO4. Demonstrate skills for self employment in the areas of mushroom cultivation, production of bio fertilizer and establishment of a diagnostic centre

# HAJEE KARUTHA ROWTHER HOWDIA COLLEGE (AUTONOMOUS)

## UTHAMAPALAYAM

### Choice based credit system

B.Sc., Microbiology (Semester)

Programme Scheme & of Scheme of Examinations

(Effective from the academic year 2017-2018 onwards)

**Qualification** : Passed in H. Sc., or any other Examination accepted by the Syndicate as Equivalent

**Duration of the course** : B.Sc., Microbiology-3 Academic Years (6 Semesters)

### **SUBJECTS OF STUDY:**

- Part I : Tamil/Arabic/Malayalam
- Part II : English
- Part III : I) Core subject-Microbiology  
II) Allied subjects
- Part IV : I) Non- major elective subjects  
II) Skill based subjects  
III) Environmental studies  
IV) Value Education
- Part V : Extension Activities

### **EVALUATION:**

**Theory:** Internal – 25 marks  
External – 75 marks  
Total – 100 marks

**Practical:** Internal – 40 marks  
External – 60 marks  
Total – 100 marks

### **Internal 25 marks will be as follows:**

#### **Pattern of Continuous Internal Assessment Examinations (CIAE)**

Average of Two Internal Tests (each 20 marks) - 20 Marks

Assignments - 05 Marks

Total - 25 Marks

### **External 75 marks will be as follows:**

**Section A – 10 x 1 = 10 (Objective type – Multiple choice.  
Two questions from each Unit)**

**Section B – 5 x 7 = 35 (Either A (or) B ,from all five units.)**

**Section C – 3 x 10 = 30 (Three out of five questions – one from each unit)**

**External Examination: 75 Marks - Time: 3 hours.**

The pattern of External Examination Question Paper for **Part I, Part III and IV** will be as follows :

**Section – A** ( 10 X 1 = 10 Marks)

Question numbers 1 to 10 - Answer all questions. (multiple choice)

Two questions from each unit.

Four choices in each question.

**Section – B** ( 5 X 7 = 35 Marks)

Question numbers 11 to 15.

Answer all questions choosing either A or B.

One question from each unit.

11 A or 11 B

12 A or 12 B

13 A or 13 B

14 A or 14 B

15 A or 15 B

**Section – C** ( 3 X 10 = 30 Marks)

Question numbers 16 to 20.

Answer any three out of five.

One question from each unit.

The pattern of External Examination Question Paper for **Part II** will be as follows :

**Section – A:** Prose 16 Marks.

**Section – B:** Poetry 11 Marks.

**Section – C:** Short Story 13 Marks.

**Section – D:** Grammar 19 Marks.

**Section – E:** Composition 16 Marks.

The pattern of External Examination Question Paper for **Part IV Environmental Studies and Value Education** will be as follows :

**Section – A:** ( 5 X 6 = 30 Marks)

Question numbers 1 to 5 – Answer all questions choosing either (a) or (b).

One question from each unit.

Descriptive Type – 100 words each.

**Section – B** ( 3 X 15 = 45 Marks)

Question numbers 6 to 10.

Answer any three out of five.

One question from each unit.

Descriptive and Analytical Type – 250 words each.

SEM	PART	COURSE CODE	COURSE CATEGORY	Title of the Course	Hours	credits	Marks allotted		
							Internal	External	Total
			SEMESTER I						
I	I	17UTAL11/ 17UARL11/ 17UMLL11	Language I	Tamil / Arabic / Malayalam - Paper I	6	3	25	75	100
	II	17UENL11	Language II	English – Paper I	6	3	25	75	100
	III	17UMBC11	Core	Core I :General Microbiology	4	4	25	75	100
			Core	Core Lab I : Major Practical I	4*	—	—	—	—
			Allied	Allied I : Chemistry I	4	4	25	75	100
			Allied	Allied lab I: Chemistry practical I	2*	—	—	—	—
	IV	17UMBS11	SBS	SBS-I Diagnostic Microbiology	2	2	25	75	100
		17UMBN11	NME	NME-I Mushroom Technology	2	2	25	75	100
			Total		30	18	150	450	600
	SEMESTER II								
II	I	17UTAL21/ 17UARL21/ 17UMLL11	Language I	Tamil /Arabic / Malayalam – Paper II	6	3	25	75	100
	II	17UENL21	Language II	English – Paper II	6	3	25	75	100
	III	17UMBC21	Core	Core II : Biochemistry	4	4	25	75	100
		17UMBC2P	Core	Core Lab : Major Practical I	4	4	40	60	100
		17UCHA21	Allied	Allied II :Chemistry II	4	4	25	75	100
		17UCHA2P	Allied	Allied lab: Chemistry practical I	2	1	40	60	100
	IV	17UMBS21	SBS	SBS-II Dairy Technology	2	2	25	75	100
		17UMBN21	NME	NME-II Food and Dairy microbiology	2	2	25	75	100
			Total		30	23	230	570	800

SEM	PART	COURSE CODE	COURSE CATEGORY	Title of the Course	hours	credits	Marks allotted		
							Internal	External	Total
	SEMESTER III								
III	I	17UTAL31/ 17UARL31/ 17UMAL31	Language I	Tamil /Arabic/ Malayalam Paper III	6	3	25	75	100
	II	17UENL31	Language II	English–Paper III	6	3	25	75	100
	III	17UMBC31	Core	Core III - Molecular Biology and Microbial Genetics	4	4	25	75	100
			Core	Core lab II: Major Practical II	2*	—	—	—	—
		17UCHA31	Allied	Allied I : Chemistry III	4	4	25	75	100
			Allied	Allied lab I: Chemistry practical II	2*	—	—	—	—
		17UMBA31	Allied	Allied II - General Biology	4	4	25	75	100
			Allied	Allied lab II - Biology Practical-I	2*	—	—	—	—
		Total		30	18	125	375	500	
		SEMESTER IV							
IV	I	17UTAL41/ 17UARL41/ 17UMAL41	Language I	Tamil/Arabic/ Malayalam – Paper IV	6	3	25	75	100
	II	17UENL41	Language II	English–Paper IV	6	3	25	75	100
	III	17UMBC41	Core	Core IV - Immunology	4	4	25	75	100
		17UMBC4P	Core	Core lab - Major Practical II	2	2	40	60	100
		17UCHA41	Allied	Allied I : Chemistry IV	4	4	25	75	100
		17UCHA4P	Allied	Allied lab I: Chemistry practical II	2	1	40	60	100
		17UMBA41	Allied	Allied II- Cell biology	4	4	25	75	100
		17UMBA4P	Allied	Allied lab II - Biology Practical-I	2	1	40	60	100
V		EA	Extension activities		2		-	100	
		Total		30	24	245	555	800	

SEM	PART	COURSE CODE	COURSE CATEGORY	Title of the Course	hour	credits	Marks allotted		
							Internal	External	Total
I			SEMESTER V						
	PART III	17UMBC51	Core	Core V - Medical Microbiology	4	4	25	75	100
		17UMBC52	Core	Core VI Agriculture and Environmental microbiology	4	4	25	75	100
		17UMBE51	Elective	Elective –I- Bioinformatics	4	4	25	75	100
		17UMBE52	Elective	Elective-II Microbial Physiology					
			Core	Core lab III - Major practical III	8	—	—	—	—
		17UMBA51	Allied	Allied II-Genetics and Biostatistics	4	4	25	75	100
			Allied	Allied lab II - Biology Practical-II	2*	—	—	—	—
	PART IV	17UMBS51	SBS	SBS V : Bio chemical Techniques	2	2	25	75	100
		17UEVS51	EVS	Environmental Studies	2	2	25	75	100
				Total	30	20	150	450	600
				SEMESTER VI					
	PART III	17UMBC61	Core	Core VII– Recombinant DNA Technology	6	6	25	75	100
		17UMBE61	Elective	Elective III – Industrial & Food Microbiology	6	6	25	75	100
		17UMBE62	Elective	Elective IV- Medical Lab Technology					
		17UMBC6P	Core	Core lab III - Major practical III	-	8	40	60	100
		17UMBC6Q	Core	Core lab III - Major practical IV	8	8	40	60	100
		17UMBA61	Allied	Allied II- Environmental Biology	4	4	25	75	100
		17UMBA6P	Allied	Allied lab II - Biology Practical-II	2	1	40	60	100
	PART IV	17UMBS61	SBS	SBS VI –Enzymology and Enzyme technology	2	2	25	75	100
		17UVED61	VE	Value education	2	2	25	75	100
				Total	30	37	345	555	900
				Grand total	180	140	1245	2955	4200

## GENERAL MICROBIOLOGY

**Programme : B.Sc., Microbiology**

**Semester : I**

**Course Code : 17UMBC11**

**Part : III Core - I**

**Hours : 4**

**Credits: 4**

### Course outcomes:

CO1: To understand the basic concepts in Microbiology.

CO2: To understand the basic structure and features of microbes.

### Unit I

Introduction – Definition, scope and history of Microbiology. Contributions of Leeuwenhoek, Jenner, Spallanzani, Louis Pasteur, John Needham and Robert Koch. Classification of microorganisms - Difference between the prokaryotic and eukaryotic microorganisms.– general principles and nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept.

### Unit II

Microscopy – simple, compound microscope, dark field microscope, electron and phase contrast microscopes – parts, functions and applications- Resolving power, Numerical aperture etc.,

### Unit III

Prokaryotes – bacteria, archaea, actinomycetes, structure and functions of cell and cellular components, slime, capsule, pili, flagella, cell wall, cytoplasmic membrane, mesosomes, ribosome, nucleoid and other cytoplasmic inclusions.

### Unit IV

Salient features of Algae, structure and reproduction of *Chlamydomonas*, *Chlorella*, *Euglena*. Salient features of fungal morphology, structures and reproduction; *Rhizopus*, *Penicillium* and *Saccharomyces*,

### Unit V

Salient features of Bacteria: *Bacillus*, *E. coli*, *Salmonella*, and *Streptomyces* Viruses: T4, TMV, and HIV. Protozoa: *Plasmodium*.

### References

1. Prescott, Harley and Klein. 2006. Microbiology 6/e. The McGraw-Hill Companies.
2. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 1993. Microbiology. Tata McGraw Hill Publishing Co., Ltd., New Delhi.
3. Schlegel, H.G.1993. General Microbiology. Cambridge University Press, Cambridge.
4. Stainer, R.Y., Ingraham, Wheelis, M.G. and Paintor, P.R.1986. The Microbial World. Prentice Hall, New Jersey.

## MAJOR PRACTICAL – I -LAB

**Programme : B.Sc., Microbiology**

**Semester : I**

**Course Code :**

**Part: III Core Lab-I**

**Hours : 4**

**Credits: 4**

### Course outcome

CO1: To introduce the basic handling techniques in Microbiology.

CO2: To understand the basics techniques in biochemistry.

### Basic Microbiology

1. Parts, working principle and applications of compound microscope
2. Sterilization methods: moist heat, dry heat, filtration, disinfectants
3. Isolation of bacteria and fungi from environmental samples
4. Measurement of bacterial size by micrometry method
5. Pure culture techniques: streak, spread and pour plate methods
6. Observation of bacterial motility by hanging drop method
7. Staining methods: Gram-staining, endospore-staining

### Biochemical tests for bacterial identification

1. Carbohydrate fermentation
2. IMVIC tests
3. Catalase test
4. Oxidase test
5. Starch and Protein hydrolysis.

### Reference

1. P.Gunasekaran, Microbiology: A Laboratory manual, New Age international publishers,1996.
2. N.Kannan, A Laboratory manual in general microbiology,Panima publishers, 2002.
3. P.Palanivelu, Analytical Biochemistry & Separation Techniques, 3<sup>rd</sup> edition – 21<sup>st</sup> century publications ,Palkalai nagar, Madurai.
4. J.Jayaraman,Laboratory manual in Biochemistry, 5/e,New age international publishers,1996.



## ANCILLARY CHEMISTRY PAPER -I

### Organic, Inorganic and Physical chemistry

**Programme : UG**

**Semester : I**

**Course code : 17UCHA11**

**Part : III**

**Hours : 4**

**Credits: 4**

#### Course outcomes

**CO1:** To Explain about the fundamentals & states of matter.

**CO2:** To knows about the way of bond breaking & making. How which leads to the formation of various types of biologically & economically important compounds.

#### Unit I

**a) HYDROGEN:** Isotopes of hydrogen-preparation, properties and uses of heavy hydrogen- ortho and para hydrogen-hydrides-definition-classification-examples.

**b) Oxides:** Definition-classification-examples.

**c) Water:** Hardness of water-types of hardness-removal of hardness – removal of hardness – industrial implications of hardness in water-estimation by EDTA method (outline only) –units of hardness of water.

#### Unit II

**a)** Detection of nitrogen and halogen in organic compounds – empirical formula - molecular formula –structural formula – simple calculation.

**b)** Nature of valency of carbon in organic compounds – tetrahedral arrangement of valency of carbon – bond breaking and bond forming in organic reaction – hemolytic cleavage – heterolytic cleavage – reaction intermediates – formation, stability and reactions of carbocation, carbanion and free radicals.

**c) Nucleophiles – Electrophiles:** Definition, types and examples.

**d) Types of reaction:** Substitution – addition – elimination - rearrangement and polymerization – illustration with examples.

#### Unit III

**a) Gaseous state:** Postulates of kinetic theory of gases – derivation of expression for pressure for an ideal gas on the basis of kinetic theory – deducing the basic gas laws.

**b) Deviation of real gases** from ideal behavior – reasons for deviation – derivation of vander walls equation – explanation of behavior of real gases on the basis of vander walls equation.

**c) Liquefaction of gases:** critical phenomenon – modern methods – Joule-Thomson effects – Inversion temperature.

#### Unit IV

**a) Bonding:** V.B Theory – postulates of V.B Theory – application to the formation of simple molecules like  $H_2$  and  $O_2$  – overlap of atomic orbitals – s-s , s-p and p-p overlap – principle of hybridization –  $sp$ ,  $sp^2$  and  $sp^3$  hybridization – VSEPR theory.

**b) M.O Theory:** Formation of M.O's – bonding, anti-bonding and non-bonding M.O's – M.O diagram for  $H_2$ , He and  $F_2$ .

## **Unit V**

### **Colloids**

**a)** Colloidal state of matter – various types – classification.

**b)** Sols – dialysis – electro-osmosis – electrophoresis – stability of colloids – protective action – Hardy-schulze law – gold number.

**c)** Emulsion: Types of emulsion – emulsifiers with examples.

**d)** Gels: Classification, preparation.

**e)** Application of colloids.

### **BOOKS RECOMMENDED:**

1. Essential of physical chemistry: ArunBhal, B.S.Bhal, G.D.Tuli (revised edition, S.Chand,2010)
2. Principles of physical chemistry: Puri, Sharma, Pathania (revised edition, Vishal pub.,2010)
3. Modern Inorganic chemistry: R.D Madan (Revised edition, S.Chand,2010)
4. A Text book of organic chemistry: ArunBhal, B.S.Bhal, G.D.Tuli (revised edition, S.Chand, 2010).

## ANCILLARY CHEMISTRY PRACTICAL-I

### Inorganic Quantitative Analysis

**Programme : UG**

**Semester : I**

**Course code :**

**Part : III**

**Hours : 2**

**Credits: 2**

#### Course outcomes

**CO 1** Gain the knowledge about fundamental formulas, calculations for Normality, Molarity, equivalent weights.

**CO 2** Different types of titrations using external indicators & self indicators.

#### a. ACIDIMETRY AND ALKALIMETRY

1. Titration between a strong acid and strong base
2. Titration between a strong acid and weak base
3. Titration between a weak acid and strong base.

#### b. PERMANGANIMETRY

1. Titration between permanganate with oxalic acid, Ferrous sulphate and ferrous ammonium sulphate(Mohr's salt)

#### c. IODOMETRY

1. Titration of sodium thiosulphate with potassium permanganate and potassium dichromate.

## **DIAGNOSTIC MICROBIOLOGY**

**Programme : B.Sc., Microbiology**

**Semester : I**

**Course Code : 17UMBS11**

**Part : IV SBS - I**

**Hours : 2**

**Credits: 2**

### **Course outcomes:**

CO1: To introduce laboratory principles and safety methods to the students

CO2: To familiarize the students about clinical diagnosis of diseases.

### **Unit I**

Role of Microbiology Lab-safety regulations. Types, collection and handling of specimens. Preparation of serum and plasma.

### **Unit II**

Laboratory identification of infectious agents. Staining techniques: simple, Gram, acid-fast and spore staining.

### **Unit III**

Diagnosis of mycotic infection- skin infection and parasitic infection-amoebiasis.

### **Unit IV**

Microbiological analysis of different types of clinical specimens: urine, stool, pus and throat swab.

### **Unit V**

Determination of minimal inhibitory concentration (MIC) of antibiotics. Antimicrobial susceptibility tests

### **References:**

Mukherjee, KL., 1988, Medical Laboratory Technology Volumes-I to III, Tata McGraw-Hill Publishing Company Limited, New Delhi

## MUSHROOM TECHNOLOGY

**Programme : B.Sc., Microbiology**

**Semester : I**

**Course Code : 17UMBN11**

**Part : IV NME - I**

**Hours : 2**

**Credits: 2**

### Course outcomes:

CO1: To create awareness among the students about mushroom cultivation

CO2: To promote the mushroom production in student communities through training, spawn production.

### Unit I

History of mushrooms- Major genera of edible mushrooms – Structure and key for identification of mushrooms.

### Unit II

Food values of mushroom – Medicinal values of mushrooms- Economic importance of mushroom.

### Unit III

Substrate for mushroom production-composting methods-long and short time method-Methods of cultivation of mushrooms-oyster mushroom and paddy straw mushroom.

### Unit IV

Diseases of mushroom-Fungal diseases- soft mildew, brown plaster mold, white plaster mold, olive green mold, inky cap, truffle disease, bubble disease, brown spot disease - Insect pest of mushroom – sciarids, phorids, spring tails, cecid,mites and nematodes .

### Unit V

Poisonous mushrooms – *Amanita*, *Boletus*, *Clitocybe*, and *Coprinus* -Identification of Poisonous mushrooms.

### References

1. Nitabhal, Mushroom Technology,orient longman publications.
2. Pathak V.N ,Nagendra Yadav and Maneesh Gaur,Mushroom production and processing technology /Vedams Ebooks Pvt Ltd,NewDelhi(2000)

## **BIOCHEMISTRY**

**Programme : B.Sc., Microbiology**  
**Semester : II**  
**Course Code : 17UMBS21**

**Part : III-Core**  
**Hours : 2**  
**Credits: 2**

### **Course outcomes:**

CO1: To create awareness about the importance of Biomolecules.

CO2: To understand the importance of different pathway.

#### **Unit I**

Water and Life – pH and Buffers. Oxidation and reduction reactions, redox potential, free energy and reaction, ATP energetics.

#### **Unit II**

Carbohydrates-Classification-Monosaccharides (glucose, fructose), Disaccharides (lactose, sucrose) Polysaccharides (starch, cellulose). Metabolism - Embden-Meyerhof-Parnas, Entner-Doudoroff, Pentose Phosphate pathways - TCA cycle.

#### **Unit III**

Lipids: Physical and Chemical properties of fatty acids- Nomenclature of fatty acids- Phospholipids- Spingolipids- Lipoproteins, Oxidation of fatty acids ( $\beta$ -Oxidation)

#### **Unit IV**

Proteins: Structure, Classification, properties of proteins. Primary, secondary, tertiary and quaternary structures of proteins.

#### **Unit V**

Nucleic acids: Components, Double helical structure- Nucleic acid denaturation- Classes of nucleic acids.

### **References:**

1. Lehninger, AL., Principles of Biochemistry. 1993, 2<sup>nd</sup> edition, CSB Publishers.
2. Conn, E.E., Stumpf, P.K , Bruening, G and Doi, Outlines of Biochemistry, 5/e –R.H, John Wiley & Sons (1987)
3. Voet, D and Voet, JG, Biochemistry, 1990, John Wiley & Sons, NY.
4. Stryer, L., Biochemistry, 2/e, 1998, W.H. Freeman and Company, NY.
5. P. Palanivelu, Enzymes, Ribozymes and DNazymes, 2007, Twentyfirst Century Publications, Palkalai Nagar, Madurai - 625 021.

## MAJOR PRACTICAL – I

**Programme : B.Sc., Microbiology**

**Semester : II**

**Course Code : 17UMBC2P**

**Part : IV CORE-II**

**Hours : 4**

**Credits: 4**

### Course outcomes:

CO1: To introduce the basic handling techniques in Microbiology.

CO2: To understand the basics techniques in biochemistry.

### Basic Microbiology

8. Parts, working principle and applications of compound microscope
9. Sterilization methods: moist heat, dry heat, filtration, disinfectants
10. Isolation of bacteria and fungi from environmental samples
11. Measurement of bacterial size by micrometry method
12. Pure culture techniques: streak, spread and pour plate methods
13. Observation of bacterial motility by hanging drop method
14. Staining methods: Gram-staining, endospore-staining

### Biochemical tests for bacterial identification

6. Carbohydrate fermentation
7. IMVIC tests
8. Catalase test
9. Oxidase test
10. Starch and Protein hydrolysis.

### Reference

5. P.Gunasekaran, Microbiology: A Laboratory manual, New Age international publishers,1996.
6. N.Kannan, A Laboratory manual in general microbiology,Panima publishers, 2002.
7. P.Palanivelu, Analytical Biochemistry & Separation Techniques, 3<sup>rd</sup> edition – 21<sup>st</sup> century publications ,Palkalai nagar, Madurai.
8. J.Jayaraman,Laboratory manual in Biochemistry, 5/e,New age international publishers,1996.

## ANCILLARY CHEMISTRY PAPER -II

### Organic, Inorganic and Physical chemistry

**Programme : UG**

**Semester : II**

**Course code : 17UCHA21**

**Part : III**

**Hours : 4**

**Credits: 4**

### Course outcomes

**CO 1:** Explain the fundamentals & states of matter.

**CO 2:** To know about the way of bond breaking & making. How which leads to the formation of various types of biologically & economically important compounds.

### Unit I

**a) HYDROGEN:** Isotopes of hydrogen-preparation, properties and uses of heavy hydrogen- ortho and para hydrogen-hydrides-definition-classification-examples.

**b) Oxides:** Definition-classification-examples.

**c) Water:** Hardness of water-types of hardness-removal of hardness – removal of hardness – industrial implications of hardness in water-estimation by EDTA method (outline only) –units of hardness of water.

### Unit II

**a) Detection of nitrogen and halogen in organic compounds – empirical formula - molecular formula –structural formula – simple calculation.**

**b) Nature of valency of carbon in organic compounds – tetrahedral arrangement of valency of carbon – bond breaking and bond forming in organic reaction – hemolytic cleavage – heterolytic cleavage – reaction intermediates – formation, stability and reactions of carbocation, carbanion and free radicals.**

**c) Nucleophiles – Electrophiles:** Definition, types and examples.

**d) Types of reaction:** Substitution – addition – elimination - rearrangement and polymerization – illustration with examples.

### Unit III

**a) Gaseous state:** Postulates of kinetic theory of gases – derivation of expression for pressure for an ideal gas on the basis of kinetic theory – deducing the basic gas laws.

**b) Deviation of real gases from ideal behavior – reasons for deviation – derivation of vander walls equation – explanation of behavior of real gases on the basis of vander walls equation.**

**c) Liquefaction of gases:** critical phenomenon – modern methods – Joule-Thomson effects – Inversion temperature.

### Unit IV



**a) Bonding:** V.B Theory – postulates of V.B Theory – application to the formation of simple molecules like  $H_2$  and  $O_2$  – overlap of atomic orbitals – s-s , s-p and p-p overlap – principle of hybridization –  $sp$ ,  $sp^2$  and  $sp^3$  hybridization – VSEPR theory.

**b) M.O Theory:** Formation of M.O's – bonding, anti-bonding and non-bonding M.O's – M.O diagram for  $H_2$ , He and  $F_2$ .

## **Unit V**

### **Colloids**

- a)** Colloidal state of matter – various types – classification.
- b)** Sols – dialysis – electro-osmosis – electrophoresis – stability of colloids – protective action – Hardy-schulze law – gold number.
- c)** Emulsion: Types of emulsion – emulsifiers with examples.
- d)** Gels: Classification, preparation.
- e)** Application of colloids.

### **BOOKS RECOMMENDED:**

5. Essential of physical chemistry: ArunBhal, B.S.Bhal, G.D.Tuli (revised edition, S.Chand,2010)
6. Principles of physical chemistry: Puri, Sharma, Pathania (revised edition, Vishal pub.,2010)
7. Modern Inorganic chemistry: R.D Madan (Revised edition, S.Chand,2010)
8. A Text book of organic chemistry: ArunBhal, B.S.Bhal, G.D.Tuli (revised edition, S.Chand, 2010).

## ANCILLARY CHEMISTRY PRACTICAL-I

### Inorganic quantitative analysis

**Programme : UG**

**Part : III**

**Semester : II**

**Hours : 2**

**Course code : 17UCHA2P**

**Credits: 2**

#### Course outcomes:

**CO 1** Gain the knowledge about fundamental formulas, calculations for Normality, Molarity, equivalent weights.

**CO 2** Different types of titrations using external indicators & self indicators.

#### **d. ACIDIMETRY AND ALKALIMETRY**

4. Titration between a strong acid and strong base
5. Titration between a strong acid and weak base
6. Titration between a weak acid and strong base.

#### **e. PERMANGANIMETRY**

2. Titration between permanganate with oxalic acid, Ferrous sulphate and ferrous ammonium sulphate(Mohr's salt)

#### **f. IODOMETRY**

2. Titration of sodium thiosulphate with potassium permanganate and potassium dichromate.

## **DAIRY TECHNOLOGY**

**Programme : B.Sc., Microbiology**

**Semester : II**

**Course Code : 17UMBS21**

**Part : IV SBS -II**

**Hours : 2**

**Credits: 2**

### **Course outcomes:**

CO1: To encourage and promote the students in the field of dairy technology for their career.

CO2: To promote and participate the students in every way in the economic development of dairy industry.

### **Unit I**

Milk-Physiochemical properties of milk-microbiology of milk-Factors affecting composition of milk-food and nutritive value of milk.

### **Unit II**

Special Milk-Homogenized milk, flavoured milk and fermented milk-Flavour defects in milk, their causes and prevention.

### **Unit III**

Dried Milk-milk drying system-cold treatment, Drum drying system, spray drying system.

### **Unit IV**

Cheese –Types-Preparation of Swiss cheese, cheddar cheese-defects in cheese causes and prevention.

### **Unit V**

Indian dairy products-Kheer, Khoa, Panir, Ghee- preparation and preservation-quality analysis of dairy products-various agencies in Quality management-FDA,WHO,AGMARK,ISI-HACCP,GMP.

### **Reference**

1.Sukumar De.,1997 Outlines of Dairy technology,Oxford university press.

2.William C Frazier et al,Food Microbiology 4<sup>th</sup> edition Tata McGraw-Hill publications.

## **FOOD AND DAIRY MICROBIOLOGY**

**Programme : B.Sc., Microbiology**

**Semester : II**

**Course Code : 17UMBN21**

**Part : IV NME -II**

**Hours : 2**

**Credits: 2**

### **Course outcomes:**

CO1: To create awareness among the students about Food and Dairy Microbiology

CO2: To promote the importance of Food preservation and Spoilage.

### **Unit I**

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

### **Unit II**

Contamination of cereals, milk, egg by microorganisms. Features of food spoilage like fruits, vegetables, milk and milk products.

### **Unit III**

Milk sterilization techniques, Phosphatase test- Spoilage of bread and cereals, meat, fish and poultry.

### **Unit IV**

Food preservation by removal of microorganisms, low temperature, high temperature, irradiation and chemical methods.

### **Unit V**

Food borne infection, food borne intoxications. Detection of food-borne pathogens.

### **References**

1. Adams. MR and Moss, MO. 2005. Food Microbiology, New age International Pvt. Ltd publications.
2. Frazier, WC and Westhoff DC. 2003. Food Microbiology, 4<sup>th</sup> edition, McGrawHill, NewYork.
3. Hobbs BC and Roberts D 1993. Food Poisoning and Food Hygiene. Edwards Arnold, London.
4. Yousef, AE and Carlstrom C. 2003. Food Microbiology-A Laboratory manual, Wiley Interscience.
5. Jay JM, 2000. Modern Food Microbiology, Aspen Publishers.
6. Robinson, R.K.1990. Dairy Microbiology, Elsevier Applied Science, London.

## MOLECULAR BIOLOGY & MICROBIAL GENETICS

**Programme : B.Sc., Microbiology**

**Semester : III**

**Course Code : 17UMBC31**

**Part :III CORE-III**

**Hours : 4**

**Credits : 4**

### Course outcomes:

CO1: To make the students understand the central dogma of life.

CO2: To familiarize the basic concepts of Molecular Biology & Microbial Genetics.

### Unit I

Structural aspects of DNA and RNA - double helical model- various forms of DNA- tRNA-rRNA- Genome organization - Eukaryotes.

### Unit II

Replication- Semi conservative mode of replication- Enzymology of Replication- The processes of DNA replication-Eukaryotic replication

### Unit III

Transcription - prokaryotes and Eukaryotes - Enzymology of Transcription- process of transcription in prokaryotes and Eukaryotes – initiation, elongation and termination- factors involved.

### Unit IV

Translation- Translation in prokaryotes - Enzymology of Translation- process of translation in prokaryotes – initiation, elongation and termination- factors involved. The triplet nature of genetic codon

### Unit V

Transformation –Griffith experiment-conjugation ( $F^+$  x  $F^-$ ,  $Hfr^+$  x  $F^-$ ) Transduction –generalized and specialized.

### References

1. Benjamin Lewin, Gene VII, 2000: Oxford University Press.
2. Watson, Hopkins, Roserts, Steits and Weiner, Molecular biology of the Gene,4/e, 1987, The Benjamin/Cumming Publishing Company, Inc.
3. Larry Snyder and Wendy Champness, Molecular Genetics of Bacteria,2/e, , 2003. ASM press, Washington DC.
4. David Friefelder, Molecular Biology, 1987, Narosa Publishing House.

## MAJOR PRACTICAL-II

**Programme : B.Sc., Microbiology**

**Semester : III**

**Course Code :**

**Part:III CORE-LAB**

**Hours : 2**

**Credits: 2**

### Course outcomes:

CO1: To familiarize the students in molecular biological techniques.

CO2: To understand the basics techniques in immunology.

1. pH meter- principle and measurements
2. Estimation of Carbohydrates
3. Estimation of Proteins (Lowry's method)
4. Separation of amino acids by Paper chromatography
5. Isolation of DNA from *E.coli*.
6. Separation of DNA by Agarose gel electrophoresis.
7. Separation of Proteins by SDS-PAGE.
8. Separation of serum/plasma.
9. Blood cell count: RBC count, WBC count – total and differential
10. Blood typing: ABO, Rh.
11. Agglutination tests: Widal test.
12. Precipitation: Ouchterlony's double immune diffusion.
13. Immuno electrophoresis

## ANCILLARY CHEMISTRY PAPER – III

### Organic, Inorganic and Physical chemistry

**Programme : B.Sc.Microbiology**  
**Semester : IV**  
**Course code : 17UCHA41**

**Part : III- Allied-**  
**Hours : 4**  
**Credits: 4**

#### Course outcomes

**CO 1:** Amplification of essential conditions required for the photo induced chemical reactions & the crum application of photo physical phenomenon.

**CO 2:** Clear sectioning of applied chemistry for smoothen life & know about natural sources available for those chemical grounding.

#### Unit I

**a) Adsorption:** Definition – differences between adsorption and absorption – adsorbate, adsorbent – physical adsorption – chemical adsorption – differences between these two types – factor influencing adsorption – adsorption isotherm – Langmuir isotherm (no derivation statement only) – adsorption of gases on solid surface.

#### Unit II

**a) Catalysis:** Definition – different types of catalysis – acid-base catalysis – surface catalyzed reactions – definition and examples of auto catalyst – catalytic poisoning – promoters – enzyme catalysis – characteristics.

**b) Polymers:** Definition – classification of polymers – properties of polymers – addition and condensation polymerization reactions with examples – natural rubber – isoprene unit – vulcanization of rubber – preparation and applications of polystyrene, urea-formaldehyde resin, Teflon and buna-s rubber.

#### Unit III

**a) Photochemistry:** Comparison of thermal and photochemical reactions – definition of photochemical reactions – laws of photochemistry – Grothu's- Draper law quantum efficiency – reasons for low and high quantum yield with examples – consequences of light absorption by atoms and molecules – Jablonski diagram – fluorescence – phosphorescence – photosensitization – chemiluminescence – bioluminescence – application of photo chemistry.

#### Unit IV

**a) Coordination compounds:** Definition – nomenclature - definition of various terms involved in coordination chemistry – Werner's theory – EAN rule – VB theory (outline only) – Nickel carbonyls - chelates.

#### Unit V

**Fertilizers:** Plant Nutrient – Role of NPK in plant growth – classification of fertilizers – natural and chemical fertilizers – urea – super phosphate – triple super phosphate – potassium nitrate – potassium chloride – ammonium nitrate – calcium ammonium nitrate (CAN) and complex fertilizers – fertilizer industry in India.

**BOOKS RECOMMENDED:**

1. Essential of physical chemistry: ArunBhal, B.S.Bhal, G.D.Tuli (revised edition, S.Chand,2010)
2. Principles of physical chemistry: Puri, Sharma, Pathania (revised edition, Vishal pub.,2010)
3. Modern Inorganic chemistry: R.D Madan (Revised edition, S.Chand,2010)
4. A Text book of organic chemistry: ArunBhal, B.S.Bhal, G.D.Tuli (revised edition, S.Chand, 2010).



## ANCILLARY CHEMISTRY PRACTICALS-II

### Organic analysis

**Programme : B.Sc.Microbiology**  
**Semester : IV**  
**Course code : 17UCHA4P**

**Part : III**  
**Hours : 2**  
**Credits: 2**

#### Course outcome:

**CO 1** To know the detection of special elements, functional groups identification in organic compounds.

Analysis of organic compound containing one / two functional groups and conformation by the preparation of a solid derivative / colour reactions – acids, phenols, aldehydes, esters, amines(primary, secondary and tertiary), amides, anilides, aliphatic diamide and monosaccharide.

## GENERAL BIOLOGY

**Programme : B.Sc., Microbiology**

**Semester : III**

**Course Code : 17UMBA31**

**Part: IV ALLIED-II**

**Hours : 4**

**Credits: 4**

### Course outcomes:

CO1: To introduce about the classification and physiology of plants.

CO2: To understand the physiology of human system.

### Unit –I

Basis of classification-units of classification-Species, Genus, Family-Nomenclature-Binomial system.Bentham and hooker system of classification of plants.

### Unit-II

Morphology,structure and reproduction of plants.Algae-General characters and classification-sargassum as an example.Fungi- General characters and classification-Yeast as an example.Bryophytes-General characters and classification-Funaria as an example.

### Unit III

Pteridophytes-selaginella,heterospory and seed habit.Gymnosperm-Pinus-economic uses of gymnosperm. Angiosperm-Monocot plant-Allium sp, Dicot plant-Tribulus terrestris.

### Unit IV

Human physiology-Structure and function of Digestive system-Respiratory system-circulatory system-Blood and their properties-Excretory system.

### Unit V

Muscular system-Nervous system-Endocrine glands-Reproductive system- Hormones-menstrual cycle.

### References:

- 1.A.C Dutta,Botany for Degree students,Oxford university press.
- 2.W.T.tailor and R.J.Wehe-General Biology,East West press pvt ltd.
- 3.E.L.Jordan and verma.Invertebrate Zollogy,S.Chandra &Co,New Delhi.
4. E.L.Jordan and verma.Chordate Zollogy,S.Chandra &Co,New Delhi.

## ANCILLARY BIOLOGY PRACTICAL –I

**Programme : B.Sc.Microbiology**  
**Semester : III**  
**Course code : 17UMBA3P**

**Part : III**  
**Hours : 2**  
**Credits: 2**

### Course outcome

CO1: To introduce about the basic structure of cell.

CO2: To understand the mechanism of various cell regulation.

### Botany

1. Vegetative structure and reproductive structure in sargassum, yeast, funaria, seleginella and pinus (section cutting of sargassum and seleginella, pinus stem and needles)
- 2.structure of monocot flower-*Allium cepa*
- 3.structure of Dicot flower-*Tribulus terrestris*

### Zoology

1. Cockroach-external and digestive system, reproductive system and nervous system.
2. Frog-External, digestive system, urogenital system and brain (spotters only) .
- 3.Morphology of the representative for each phylum spotters only- Amoeba, Euglena, paramecium, Hydra,Planaria,Liverfluke,Teania,Ascaris,earthworm,Prawn,Pila,Starfish,Shark,Mugil,pigeon,rat.
4. Blood cells of man and blood vessels.
- 5.Study of mitosis by smear technique of *Allilum cepa* root.
6. Demonstration of Histochemical staining methods.
7. Determination of blood groups & Rh factors.
8. Determination of haemoglobulin.

## IMMUNOLOGY

**Programme : B.Sc.Microbiology**  
**Semester : IV**  
**Course code : 17UMBC41**

**Part: III-CORE-IV**  
**Hours : 4**  
**Credits: 4**

### Course outcomes:

CO1: To understand the structure and functions of immune system.

CO2: To promote the knowledge of Auto immune diseases.

### Unit I

Elements of Immunity: Overview of the Immune system- Basic concepts in immunology (History), principles of innate and acquired immunity - Cells and organs of the immune system.

### Unit II

Antigen – structure, characters, types. Antibody structure: Classification and characterization, agglutination, complement system, immune tolerance.

### Unit III

Humoral and cell mediated immune response: B-cell maturation. Activation and differentiation, Major Histocompatibility complex (MHC) - antigen processing and presentation T and B cell maturation, activation and differentiation.

### Unit IV

Hypersensitivity-Type I, II, III, and IV reactions. Different types of auto immunity, T, B cell, Phagocyte and NK cell associated diseases.

### Unit V

Transplantation immunology: Basics of graft rejection, Tissue typing, Clinical transplantation, Tumor antigen, Immune response to tumor.

### References

1. Roitt, I.M., Essential of immunology, 1998., ELBS, Blackwell scientific publication.
2. Kuby, J., Immunology, 3/e, 1997.. W.H.Freeman and company, NY.
3. Travers. J., Immunobiology, The immune system in health and disease-3/e - 1997 - Garland publishers, NY.
4. Ananthanarayanan R. & Jayaram Panicker, C.K. Textbook of Microbiology, Orient Longman, 2005.

## MAJOR PRACTICAL-II

**Programme : B.Sc.Microbiology**  
**Semester : IV**  
**Course code : 17UMBC4P**

**Part:III-CORE-Lab**  
**Hours : 2**  
**Credits: 2**

### Course outcomes:

CO1: To familiarize the students in molecular biological techniques.  
CO2: To understand the basics techniques in immunology.

14. pH meter- principle and measurements
15. Estimation of Carbohydrates
16. Estimation of Proteins (Lowry's method)
17. Separation of amino acids by Paper chromatography
18. Isolation of DNA from *E.coli*.
19. Separation of DNA by Agarose gel electrophoresis.
20. Separation of Proteins by SDS-PAGE.
21. Separation of serum/plasma.
22. Blood cell count: RBC count, WBC count – total and differential
23. Blood typing: ABO, Rh.
24. Agglutination tests: Widal test.
25. Precipitation: Ouchterlony's double immune diffusion.
26. Immuno electrophoresis

## ANCILLARY CHEMISTRY PAPER – IV

### Organic, Inorganic and Physical chemistry

**Programme : B.Sc.Microbiology**  
**Semester : IV**  
**Course code : 17UCHA41**

**Part : III-Allied**  
**Hours : 4**  
**Credits: 4**

#### Course outcomes

**CO 1:** Amplification of essential conditions required for the photo induced chemical reactions & the crum application of photo physical phenomenon.

**CO 2:** Clear sectioning of applied chemistry for smoothen life & know about natural sources available for those chemical grounding.

#### Unit I

**a) Adsorption:** Definition – differences between adsorption and absorption – adsorbate, adsorbent – physical adsorption – chemical adsorption – differences between these two types – factor influencing adsorption – adsorption isotherm – Langmuir isotherm (no derivation statement only) – adsorption of gases on solid surface.

#### Unit II

**a) Catalysis:** Definition – different types of catalysis – acid-base catalysis – surface catalyzed reactions – definition and examples of auto catalyst – catalytic poisoning – promoters – enzyme catalysis – characteristics.

**b) Polymers:** Definition – classification of polymers – properties of polymers – addition and condensation polymerization reactions with examples – natural rubber – isoprene unit – vulcanization of rubber – preparation and applications of polystyrene, urea-formaldehyde resin, Teflon and buna-s rubber.

#### Unit III

**a) Photochemistry:** Comparison of thermal and photochemical reactions – definition of photochemical reactions – laws of photochemistry – Grothu's- Draper law quantum efficiency – reasons for low and high quantum yield with examples – consequences of light absorption by atoms and molecules – Jablonski diagram – fluorescence – phosphorescence – photosensitization – chemiluminescence – bioluminescence – application of photo chemistry.

#### Unit IV

**a) Coordination compounds:** Definition – nomenclature - definition of various terms involved in coordination chemistry – Werner's theory – EAN rule – VB theory (outline only) – Nickel carbonyls - chelates.

#### Unit V

**Fertilizers:** Plant Nutrient – Role of NPK in plant growth – classification of fertilizers – natural and chemical fertilizers – urea – super phosphate – triple super phosphate – potassium nitrate – potassium chloride – ammonium nitrate – calcium ammonium nitrate (CAN) and complex fertilizers – fertilizer industry in India.

**BOOKS RECOMMENDED:**

1. Essential of physical chemistry: ArunBhal, B.S.Bhal, G.D.Tuli (revised edition, S.Chand,2010)
2. Principles of physical chemistry: Puri, Sharma, Pathania (revised edition, Vishal pub.,2010)
3. Modern Inorganic chemistry: R.D Madan (Revised edition, S.Chand,2010)
4. A Text book of organic chemistry: ArunBhal, B.S.Bhal, G.D.Tuli (revised edition, S.Chand, 2010).

## ANCILLARY CHEMISTRY PRACTICALS-II

### Organic analysis

**Programme : B.Sc.Microbiology**  
**Semester : IV**  
**Course code : 17UCHA4P**

**Part : III-Allied**  
**Hours : 2**  
**Credits: 2**

#### Course outcome:

**CO 1** To know the detection of special elements, functional groups identification in organic compounds.

Analysis of organic compound containing one / two functional groups and conformation by the preparation of a solid derivative / colour reactions – acids, phenols, aldehydes, esters, amines(primary, secondary and tertiary), amides, anilides, aliphatic diamide and monosaccharide.



## CELL BIOLOGY

**Programme : B.Sc.Microbiology**  
**Semester : IV**  
**Course code : 17UMBA41**

**Part:III-Allied**  
**Hours : 4**  
**Credits: 4**

### Course outcomes:

CO1: To introduce about the basic structure of cell.

CO2: To understand the mechanism of various cell regulation.

### Unit-I

Cell structure-Prokaryotic and eukaryotic-Plant and Animal cell-Plasma membrane-chemistry and ultra structure-Fluid mosaic model-Protoplasm-chemistry and organization-microtubules and microfilaments

### Unit-II

Cytoplasmic organelles in Eukaryotes -ER, Golgi complex, lysosomes, Mitochondria, Chloroplast, Ribosomes, mesosomes

### Unit-III

Nucleus-structure and functions, chromatin-Eu and Hetero chromatin, chemistry-chromosome-kinds-functions, nucleolus-structure-functions-mechanism of photosynthesis and generation of ATP.

### Unit-IV

Cell cycle-mitosis and meiosis-interphase and division phase-Cell growth-normal and cancerous.

### Unit-V

Microscopy-Types-Light-Electron and Phase contrast microscope structure and function.

### References:

1. Albert, Bray, D. Lewis, J. Raff, M. Roberts. K and Watson, J. D-Molecular biology of the cell, New York, Garland 1983
2. De Robertis E. D. P., F. A. Saez and De Robertis E. M. F-cell biology, 1990.
3. K. V. Krishnamoorthy-methods in plant histochemistry, S. Viswanathan publications 1988.
4. P. S. Verma and V. K. Agarwal. Text book of cytology. S. Chand & Co., New Delhi 1995.
5. P. S. Verma and V. K. Agarwal. Text book of Cell biology, Genetics, Evolution and Ecology. S. Chand & Co., New Delhi.

## **ANCILLARY BIOLOGY PRACTICAL - I**

**Programme : B.Sc.Microbiology**  
**Semester : IV**  
**Course code : 17UMBA4P**

**Part:III-Allied-Lab**  
**Hours : 2**  
**Credits: 1**

### **Course outcomes:**

- CO1: To introduce about the basic structure of cell.
- CO2: To understand the mechanism of various cell regulation.

### **Botany**

- 1.vegetative structure and reproductive structure in sargassum,yeast,funaria,seleginella and pinus(section cutting of sargassum and seleginella, pinus stem and needles)
- 2.structure of monocot flower-Alliumcepa
- 3.structure of Dicot flower-Tribulus terrestris
4. Study of mitosis by smear technique of Allium cepa root.

### **Zoology**

1. Cockroach-external and digestive system,reproductive system and nervous system.
2. Frog-External, digestive system, urogenital system and brain (spotters oniy) .
- 3.Morphology of the representative for each phylum spotters only- Amoeba, Euglena, paramecium, Hydra,Planaria,Liverfluke,Tania,Ascaris,earthworm,Prawn,Pila,Starfish,Shark,Mugil,pigeon,rat.
4. Blood cells of man and blood vessels.
5. Demonstration of Histochemical staining methods.
6. Determination of blood groups & Rh factors.
7. Determination of haemoglobin.

## MEDICAL MICROBIOLOGY

**Programme : B.Sc.Microbiology**  
**Semester: V**  
**Course code : 17UMBC51**

**Part:III-Core**  
**Hours : 4**  
**Credits: 4**

### Course outcomes:

CO1: To create awareness about the infectious diseases.

CO2: To familiarize the various methods of diagnosis and treatment.

### Unit I

The History of Infectious Diseases: Human – microbe interactions – epidemiology of infectious diseases – mechanism of pathogenesis-Host-defense mechanisms.

### Unit II

Diagnosis and control of microbial diseases – Collection and identification of pathogens from the specimen of Urine, sputum and throat swab. -Antimicrobial chemotherapy and susceptibility testing. Mechanism of action of  $\beta$ -lactams (penicillin & cephalosporin) - drugs affecting protein synthesis (Tetracycline and amino glycoside) and Sulfa drugs – Mode of action of antiviral and antifungal drugs.

### Unit III

Bacterial diseases: Transmission, diagnosis, clinical symptoms and treatment for bacterial diseases-plague, tuberculosis, cholera, typhoid, and Staphylococcal diseases.

### Unit IV

Viral diseases: Epidemiology, prophylaxis, clinical symptoms and treatment for human viral diseases. rabies, viral hepatitis, poliomyelitis, AIDS.

### Unit V

Fungal and protozoan diseases: Cutaneous mycoses, systemic mycoses, opportunistic mycoses. Life cycle, diagnosis and treatment of following protozoan diseases – amoebiasis, malaria,

### References

1. Jawetz, E. Melnic, JL, & Adelberg, EA. Medical microbiology 22/e McGraw Hill Companies, 2004.
2. Mims, C. Playfair, J Roitt, I, Wakelin, D. & Williams, R. Medical Microbiology, 3/e Mosby publications, 2004.
3. Prescott, Harley and Klein, Microbiology, 6/e The McGraw-Hill Companies, 2008.
4. Ananthanarayanan R. & Jayaram Panicker, C.K. Textbook of Microbiology, Orient Longman, 2005.

## AGRICULTURE & ENVIRONMENTAL MICROBIOLOGY

**Programme : B.Sc.Microbiology**  
**Semester : V**  
**Course code : 17UMBC52**

**Part:III-CORE**  
**Hours : 4**  
**Credits: 4**

### Course outcomes:

CO1: To understand the role of microbes in agriculture and environment.

CO2: To create awareness about biofertilizers and disease management.

### Unit I

Soil microbes: Bacteria, Fungi and Actinomycetes (distribution) – Microbial interaction: mutualism, amensalism and commensalisms - Soil enzymes – Plant microbial interactions- N<sub>2</sub> fixation, symbiotic and free living- phosphate solubilization– Mycorrhizal association; ecto and endomycorrhizae.

### Unit II

Plant microbe interactions - pathogenesis, mechanism of pathogen establishment and symptoms. Plant diseases caused by Bacteria, *Xanthomonas*, *Mycoplasma*, Fungi, *Pyricularia*, *Fusarium* and Viruses, TMV.

### Unit III

Disease control- Fungicides, Pesticides, Biological control mechanisms - Production of bioinsecticides, bacterial.

### Unit IV

Biofertilizers: production and methods of application – Rhizobium biofertilizer, BGA biofertilizer, Azolla- Anabaena biofertilizer - microbial herbicides – Biotechnology in Agriculture: Bt. cotton and herbicide tolerant plants. PGPR.

### Unit V

Role of microorganisms in biogeochemical cycles (N, P and C cycles) – Biodegradation of xenobiotics (chlorinated pesticides) – MEOR - bioleaching of metals – microbes in waste treatment: solid waste (sanitary land fill and composting) and liquid waste – sewage treatment.

### References

1. Rangasami G and Bagyaraj DJ. 1993. Agricultural Microbiology 2/e Prentice- Hall publications.
2. Ronald Atlas, Bartha, Richard, 1987. Microbial ecology 2/e Benjamin-Cummings publications.
3. Prescott, Harley and Klein, 2006. Microbiology. The McGraw Hill companies.
4. Madigan, M.T., Martinko, J.M. and Parker, J., 1997, Brock Biology of Microorganisms 8/e. Prentice-Hall Inc.

## **BIOINFORMATICS**

**Programme : B.Sc.Microbiology**  
**Semester : V**  
**Course code : 17UMBE51**

**Part:III-ELECTIVE-I**  
**Hours : 4**  
**Credits: 4**

### **Course outcomes:**

CO1: To promote the basics of computer.

CO2: To understand the applications of computer in life science.

#### **Unit I**

Components of computers input/output devices, Storage devices, Graphic devices, Operations system- MS DOS & WINDOWS - Networks-HTTP, HTML, Internet.

#### **Unit II**

Use of commercial software: MS word, Windows, Power Point, MS Excel.

#### **Unit III**

Biological databases- DNA databases-NCBI, DDBJ and protein databases –PIR, SWISS PROT. Collection and downloading information from databases –SRS.

#### **Unit IV**

DNA sequencing methods-Maxam gilbert and sanger coulson methods. Pattern,motifs and profiles.

#### **Unit V**

Sequence alignment –Pairwise and multiple sequence alignment, FASTA, BLAST and CLUSTAL. Phylogenetic analysis.

### **References**

1. Christopher J Rawlings, Software Directory for molecular Biologists Stockton Press, Mac Millan Publishers, 1986.
2. A directory – DBT, Data basis in life sciences and Biotechnology: Govt. of India, March 1995.
3. R.M.Kamp, T. Choli-Papadaopoulou B. Witman Liebold., Protein Structure Analysis – Springer Lab Manual.
4. T.N. Bryant, JWT Wimpenny, Computer in microbiology- a practical approach. IRL, Press, 1989.
5. By Zar, Bio-Statistics Analyses. Second Edition. Prentice Hall International Englewood Cliffs, New Jersey.

## MICROBIAL PHYSIOLOGY

**Programme : B.Sc.Microbiology**  
**Semester : V**  
**Course code : 17UMBE52**

**Part:III-ELECTIVE-II**  
**Hours : 4**  
**Credits: 4**

### Course Outcomes:

CO1: To create awareness among the students about Microbial Physiology.

CO2: To understand the importance of Microbial Metabolism and Bacterial life cycle.

### Unit I

Generation of Energy – Entropy, generation of ATP – substrate level phosphorylation, oxidative phosphorylation, proton motive force.

### Unit II

Photosynthesis and inorganic metabolism – Photosynthesis in bacteria. Assimilation of inorganic phosphorus, sulfur and nitrogen in bacteria – sulfate reduction pathway, ammonia assimilation pathway, nitrogenase and nitrogen fixation.

### Unit III

Transport of sugars and metabolites – active, passive and facilitated transport systems, chemiosmosis, ion gradients. Secretion in bacteria – type of secretion systems.

### Unit IV

Bacterial cell division and differentiation – Cell wall synthesis and cell division in Bacteria, life cycle of *Bacillus*, stages of endospore formation, germination and outgrowth-Growth curve .

### Unit V

Morphology and life cycles -*Hyphobacterium* and *Caulobacter*. Gliding bacteria and gliding motility, life cycle of fruiting bacteria – Myxobacteria. Sporulation in fungi.

### References

1. Prescott, Harley and Klein. 2006. Microbiology 6/e. The McGraw-Hill Companies.
2. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 1993. Microbiology. Tata McGraw Hill Publishing Co., Ltd., New Delhi.
3. Schlegel, H.G.1993. General Microbiology. Cambridge University Press, Cambridge.
4. Moat AG, Foster JW and Spector MP, Microbial Physiology, 4/e Wiley-Liss,2002.

## MAJOR PRACTICAL III

**Programme : B.Sc.Microbiology**  
**Semester : V**  
**Course code : 17UMBC5P**

**Part:III-CORE-Lab**  
**Hours : 8**  
**Credits: 8**

### Course outcome

- CO1: To skill the students towards clinical microbiological techniques.  
CO2: To understand about the various testing of environmental samples.

### Medical Microbiology

1. Antibiotic susceptibility test: disc diffusion method
2. Measurement of minimal inhibitory concentration (MIC) and minimal lethal concentration (MLC)
3. Isolation and identification of *Staphylococcus*, *Streptococcus*.
4. Collection and processing of medical samples

### Agriculture & Environmental Microbiology

1. Isolation and characterization of soil microbes
2. Serial dilution method for enumeration of soil bacteria
3. Identification of microbial pathogen in paddy and vegetable crops (field study).
4. Isolation of symbiotic nitrogen fixing bacteria from root nodules - *Rhizobium*
5. Isolation of free-living nitrogen fixing bacteria from rhizosphere - *Azotobacter*
6. Isolation of phosphate solubilizing bacteria – *Pseudomonas*
7. Examination of mycorrhizae – VAM
8. Potability testing of water (MPN test)

## GENETICS AND BIOSTATISTICS

**Programme : B.Sc.Microbiology**  
**Semester : V**  
**Course code : 17UMBA51**

**Part:III-Allied**  
**Hours : 4**  
**Credits: 4**

### Course outcomes:

- CO1: To introduce the importance of statistics in life science.  
CO2: To understand the basics of Mendel genetics.

### Unit-I

Mendelian Genetics-Mendel's works, experiments, observations and results-Mendel's laws-terms-Back cross, Test cross-complete and incomplete dominance-co dominance

### Unit-II

Allelic interaction-Multiple Alleles-blood group inheritance-Rh factor-Multiple gene inheritance-genes and chromosomes-crossing over and linkage.

### Unit-III

Biostatistics-Introduction-Data collection-Types of data –primary and secondary data-sampling and sampling designs-random and non random sampling.

### Unit-IV

Representation of data-Diagrammatic-simple bar diagram, Pie diagram-graphical representation-Histogram, frequency curve, cumulative frequency curve-Measures of central tendency-Explanation-Types of average-Arithmetic mean-median-Mode-Continuous series-discrete series.

### Unit –V

Measures of dispersion-Explanation-Types-range-Mean deviation-Standard deviation-Variance-correlation and regression.

### References

- 1.Principles of Genetics-Edmund.W.Sinnot,Dunn,L.C
- 2.Molecular Biology-David Frifielder.
- 3.An introduction to Biostatistics.2005.N.Gurumani
- 4.Statistics.Pillai.R.S.N and bhagavathi 2003



## **ANCILLARY BIOLOGY PRACTICAL –II**

**Programme : UG**

**Semester : V**

**Course code : 17UMBA5P**

**Part : III**

**Hours : 2**

**Credits: 2**

### **Course outcome**

CO1: To introduce about the basic of genetics.

CO2: To understand about the testing of various environmental sample.

1. Survey of mendelian traits in man.
2. Law of probability.
3. Estimation of dissolved Oxygen in different water samples.
4. Estimation of salinity in different water samples.
5. Estimation of alkalinity in different water samples.
6. Soil testing for pH, alkalinity, nitrate and phosphates.
7. Problems in Measures of central tendencies-Mean, median and Mode.
8. Problems in Measures of dispersion-Standard deviation.

## **BIO CHEMICAL TECHNIQUES**

**Programme : B.Sc.Microbiology**  
**Semester : V**  
**Course code : 17UMBS51**

**Part:III-SBS-V**  
**Hours : 2**  
**Credits: 2**

### **Course outcomes:**

- CO1: To introduce the basic principles and applications of various techniques.
- CO2: To understand the working mechanisms of the instruments.

### **Unit-I**

Chromatography-Column, Paper,TLC, gel filtration and Affinity.

### **Unit II**

Advanced biochemical Techniques-GC, HPLC, Ion exchange and Dialysis.

### **Unit-III**

Electrophoresis-Principle and application of electrophoresis-Agarose, SDS-PAGE.

### **Unit IV**

Centrifugation-Principle and application-Types of centrifugation.

### **Unit-V**

Principles and applications of PCR, Spectrophotometric-Simple and UV.

### **Reference.**

- 1.Palanivelu.P,Analytical Biochemistry and separation Techniques,21<sup>st</sup> century publications, Palkalai nagar,Madurai.
- 2.Practical Biochemistry-Willson&Wilson.

## **ENVIRONMENTAL STUDIES**

**Programme : B.Sc.Microbiology**  
**Semester : V**  
**Course code : 17UEVS51**

**Part:IV**  
**Hours : 2**  
**Credits: 2**

### **Course Outcomes:**

CO1: Demonstrate basic knowledge about environment and its allied problems  
CO2: Acquire skills to help individuals in identifying and solving problems  
CO3: Motivate public to participate in public environment

### **UNIT – I - EARTH AND ITS ENVIRONMENT**

Earth – Formation and Evolution of Earth overtime – Structure of Earth and its components  
– Atmosphere, Lithosphere, Hydrosphere and Biosphere Resources – Renewable and Non-renewable resources

### **UNIT – II – ECOLOGY AND ECO - SYSTEM CONCEPTS**

Ecology – Definition – Eco-system: Definition, Structure and Function – Energy flow- food chain and food web – one example for an eco system Bio-geo chemical cycles – Nitrogen, Carbon, Phosphorous and Water

### **UNIT – III – BIO-DIVERSTY OF INDIA**

Introduction – Definition – Values of Bio-diversity – Threat to bio-diversity conservation of bio-diversity Bio-diversity of India – as a mega diversity nation – bio-geographical distribution hotspots of bio-diversity – national bio-diversity conservation board and its function

### **UNIT – IV – POLLUTION AND GLOBAL ISSUES**

Definition, Causes, Effects and Control Measures of Air, Water, Soil, Marine, Noise, Thermal and Nuclear Pollution Global Issues – global warming and ozone layer depletion

### **UNIT – V – DEVELOPMENT AND DISASTER MANAGEMENT**

Sustainable Development – Sustainable Agriculture – Organic Farming – Irrigation Water Harvesting and Waste recycling – cyber waste and management Disaster Management – Flood and Draught – Earthquake and tsunami – landslides and avalanche cyclones and hurricanes – precautions, warnings, rescue and rehabilitation.

### **BOOKS RECOMMENDED**

Environmental Studies - Published by Madurai Kamaraj University, Madurai.

## RECOMBINANT DNA TECHNOLOGY

**Programme : B.Sc.Microbiology**  
**Semester : VI**  
**Course code : 17UMBC61**

**Part:III-Core-VIII**  
**Hours : 6**  
**Credits: 6**

### Course outcomes:

- CO1: To understand about the basics of gene cloning.  
CO2: To promote the applications of gene cloning in various fields.

### Unit I

General Strategies of cloning –Gene cloning enzymes Restriction enzymes and types,DNA ligase,Taq polymerase,Klenow,Terminal nucleotide transferase,Alkaline phosphatase,linkers and adopters.

### Unit II

Vectors- Plasmids- constructed plasmids, pBR322, pUC18 - Lambda phage derived vectors, cosmids and their applications. BAC and YAC as vectors.

### Unit III

Methods of gene transfer –Transformation, Transduction, Transfection, microprojectile bombardment, Southern,Northern and Western blotting techniques.

### Unit IV

Transgenic animals, transgenic mice and sheep. - Agrobacterium mediated gene transfer mechanism - Markers and Reporter genes and their applications - Transgenic plants – insecticide resistance, herbicide and drought tolerance. Production of Insulin- Growth hormone (STH)- Interferons, etc.

### Unit V

Intellectual property rights, patent,forms of patents, process of patenting, Indian and international agencies involved in patenting, patenting biological materials.

### References

1. Brown, T.A., Genetics – A Molecular Approach, Chapman Hall, London, 2004.
2. Darnell, J. Lodish, H., and Baltimore, D., Molecular Cell Biology, Scientific American Books Inc., Iowa. 2006
3. Glick,B.R. and Pasternak, J.J.,2006, Molecular Biotechnology- Principles and Applications of Recombinant DNA technology, ASM press, Washington.

## **INDUSTRIAL & FOOD MICROBIOLOGY**

**Programme : B.Sc.Microbiology**  
**Semester : VI**  
**Course code : 17UMBE61**

**Part:III-Elective-III**  
**Hours : 6**  
**Credits: 6**

### **Course outcomes:**

CO1: To encourage and promote the students in the field of Industrial Microbiology.

CO2: To promote the applications of microbes in various industries.

### **Unit I**

Fermentor-Basic design, parts and function. Types of fermentor-Batch, CSTF, Tower fermentor and packed bed bioreactor. Computer applications in fermentation technology.

### **Unit II**

Screening of industrially important microbes-Primary and screening techniques. Strain development, preservation-mineral oil and lyophilization. Inoculum preparation, Inoculum build-up.

### **Unit III**

Ideal production medium-raw materials-Carbon sources-molasses, cheese whey, sulfate waste liquor, Lipid source-hydrocarbons and vegetable oils-Nitrogen sources-corn steep liquor, soya bean meal.

### **Unit IV**

Fermentation-Types: aerobic fermentation( Penicillin, Vitamin B12), anaerobic (Ethanol) and solid state(Gibberellic acid). biological assays.

### **Unit V**

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

### **References**

1. Crueger, W. and A. Crueger (2000), Biotechnology, A Text book of Industrial Microbiology, Panima Publishers, New Delhi.
2. Nandari, H., (2005), Industrial Biotechnology, Dominant Publications and Distributors, New Delhi.
3. Stanbury, O.F., Whitakar, A., and Hall, S.J., (1997), Principles of Fermentation Technology, Aditya Books (P) Ltd., New Delhi
4. Patel, A.H , Industrial Microbiology, The Tata McGraw-Hill Companies, 2008.
5. Frazier, WC and Westhoff DC. 2003. Food Microbiology, 4<sup>th</sup> edition, McGrawHill, New York.

## **MEDICAL LAB TECHNOLOGY**

**Programme : B.Sc.Microbiology**  
**Semester : VI**  
**Course code : 17UMBE62**

**Part:III-Elective-IV**  
**Hours : 6**  
**Credits: 6**

### **Course Outcomes:**

CO1: To create awareness about the importance of Hematology

CO2: To understand the importance of Clinical Biochemistry.

### **Unit I**

Anticoagulants. Components of blood and their functions-erythrocytes, leukocytes, lymphocytes, monocytes, and thrombocytes. Preparation of blood collecting containers with anticoagulant.

### **Unit II**

Blood collection by venipuncture, Blood collection by capillary puncture,. Preparation of serum and plasma. RBC and WBC counts, Study of stained blood smear- differential count.

### **Unit III**

Routine haematological tests- determination of haemoglobin concentration, Reticulocyte count-ESR- Eosinophils count- Platelet count. Maintenance of laboratory records.

### **Unit IV**

Clinical Biochemistry- Routine biochemical tests-Blood sugar, urea, creatinine and cholesterol.

### **Unit V**

Routine procedures in blood bank-ABO blood grouping and Rh typing-AHG test-compatibility testing or cross-matching.

### **Book Recommended:**

Mukherjee, KL., 1988, Medical Laboratory Technology Volumes-I to III, Tata McGraw-Hill Publishing Company Limited, New Delhi.

## MAJOR PRACTICAL III

**Programme : B.Sc.Microbiology**  
**Semester : VI**  
**Course code : 17UMBC6P**

**Part:III-Core-Lab**  
**Hours : 8**  
**Credits: 8**

### Course outcomes:

- CO1: To skill the students towards clinical microbiological techniques.  
CO2: To understand about the various testing of environmental samples.

### Medical Microbiology

1. Antibiotic susceptibility test: disc diffusion method
2. Measurement of minimal inhibitory concentration (MIC) and minimal lethal concentration (MLC)
3. Isolation and identification of *Staphylococcus*, *Streptococcus*.
4. Collection and processing of medical samples

### Agriculture & Environmental Microbiology

9. Isolation and characterization of soil microbes
10. Serial dilution method for enumeration of soil bacteria
11. Identification of microbial pathogen in paddy and vegetable crops (field study).
12. Isolation of symbiotic nitrogen fixing bacteria from root nodules - *Rhizobium*
13. Isolation of free-living nitrogen fixing bacteria from rhizosphere - *Azotobacter*
14. Isolation of phosphate solubilizing bacteria – *Pseudomonas*
15. Examination of mycorrhizae – VAM
16. Potability testing of water (MPN test)

## MAJOR PRACTICAL IV

**Programme : B.Sc.Microbiology**  
**Semester : VI**  
**Course code : 17UMBC6Q**

**Part:III-Core-Lab**  
**Hours : 8**  
**Credits: 8**

### Course outcomes:

- CO1: To skill the students towards Advanced microbiological techniques.
- CO2: To motivate the students in the field of industry oriented career.

### **Recombinant DNA TECHNOLOGY**

1. Isolation of chromosomal DNA from microbial cells.
2. Separation of DNA by agarose gel electrophoresis
3. Determination of purity and quantification of DNA
4. Isolation and purification of a plasmid DNA
5. Restriction Digestion Analysis
6. Ligation
7. Transformation of *E. coli* using plasmid (pUC18/19)
8. Blue-white Selection of transformants

### **Industrial Microbiology**

1. Isolation of amylase and protease producing bacteria and fungi
2. Crowded plate technique for antibiotics producing microbes
3. Alcohol (ethanol) production
4. Immobilization of yeast

### **Food Microbiology**

1. Enumeration of microbial population in food samples meat, pickles, ice cream, fruit juices
2. Milk quality test-MBRT



## ENVIRONMENTAL BIOLOGY

**Programme : B.Sc.Microbiology**  
**Semester : VI**  
**Course code : 17UMBA61**

**Part:III-Allied**  
**Hours : 4**  
**Credits: 4**

### Course outcomes:

- CO1: To introduce the importance of Environment in life.
- CO2: To understand the basics of ecosystem.

### Unit-I

Environmental biology and its relevance to human civilization- environmental factors-Physical, chemical and biological –and their influence in living system-population explosion and its consequences-Deforestation and its consequences.

### Unit-II

Ecosystem and flow energy and nutrients-Concept of ecosystem, biosphere and types of ecosystem-biotic and abiotic factors-primary and secondary productivity-food chain and food web-ecological pyramids-biogeochemical cycles.

### Unit-III

Resource and conservation-Natural resources-aquatic and terrestrial resources-renewable and non renewable energy (introduction)-Aquatic resources-sewage treatment-fish culture and management-Terrestrial resources-Agriculture-soil fertility and nitrogen fixation-biofertilizers.

### Unit-IV

Environmental pollution and management-Types of pollution-Air, Water, Soil and Noise-sources, effect and control measures-environmental pollution management and environmental education.

### Unit-V

Population biology-Population parameters and their estimation-life table-reproductive effort-evolution of demographic traits-population growth models-species interaction and competition-population-regulation-density dependent and independent.

### References:

- 1.Dasmann,R.,environmental Conservation-II Ed.
- 2.J.Kormondy,Concepts of Ecology-II Ed.
- 3.Odum,E.P.Fundamentals of Ecology-1980.
- 4.Ehrlich,P.R.,J.P.Holdreh and R.W.Kolm,Man and Ecosphere,1989.
- 5.Verma.P.S and V.K Agarwal.,environmental Biology,S.Chand&Co.,NewDelhi,1995.

## **ANCILLARY BIOLOGY PRACTICAL**

**Programme : B.Sc.Microbiology**  
**Semester : VI**  
**Course code : 17UMBA6P**

**Part:III-Allied**  
**Hours : 2**  
**Credits: 1**

### **Course outcomes:**

CO1: To introduce about the basic of genetics.  
CO2: To understand about the testing of various environmental sample.

9. Survey of mendelian traits in man.
10. Law of probability.
11. Estimation of dissolved Oxygen in different water samples.
12. Estimation of salinity in different water samples.
13. Estimation of alkalinity in different water samples.
14. Soil testing for pH, alkalinity,nitrate and phosphates.
15. Problems in Measures of centrel tendencies-Mean,median and Mode.
16. Problems in Measures of dispersion-Standard deviation.

## ENZYMOLGY & ENZYME TECHNOLOGY

**Programme : B.Sc. Microbiology**  
**Semester : VI**  
**Course code : 17UMBS61**

**Part: IV-SBS-VI**  
**Hours : 2**  
**Credits: 2**

### Course outcomes:

- CO1: To introduce about the Enzymes and co factors.
- CO2: To understand the application of enzymes in various fields.

### *Unit- I*

Nomenclature and Classification of enzymes (with examples)-General properties of enzymes (Optimum pH, Optimum Temp & Substrate Concentration).

### Unit II

Steady state kinetics and derivation of Michaelis-Menten, Lineweaver-Burk, equations and their plots-Activation energy-Enzyme specificity

### Unit- III

Extraction of enzymes-Purification of enzymes-Enzyme inhibitors.

### Unit- IV

Mechanism of enzyme catalysis- Coenzymes-NAD, FAD- Metal ions in enzyme catalysis.

### Unit V

Application of enzymes (Clinical & Industrial)-Immobilization of enzymes.

### References

1. Palanivelu, P., Enzymes, Ribozymes and DNAzymes., 21<sup>st</sup> century publications, Palkalai nagar, Madurai.
2. T. Palmer, Enzymes-Biochemistry, Biotechnology, Clinical chemistry-EastWest press, New Delhi.
3. Conn, E.E., Stumpf, P.K., Bruening, G and Doi, R.H., John Wiley & Sons. Outlines of Biochemistry.

## VALUE EDUCATION

**Programme : B.Sc.Microbiology**  
**: VI**  
**Course code : 17UVED61**

**Part:IV**      **Semester**  
**Hours : 2**  
**Credits: 2**

### **Course Outcomes:**

CO1: Develop the overall personality including physical, mental, emotional and spiritual aspects

CO2: Demonstrate good manners and cooperative citizenship

CO3: Develop respect for the dignity of individual and society

### **UNIT – I – VALUES AND THE INDIVIDUAL**

Values Meaning – The Significance of Values – Classification of Values – Need of Value Education – Values and the Individual : Self- Discipline, Self- Confidence, Self- Initiative, Empathy, Compassion, Forgiveness, Honesty and Courage.

### **UNIT – II – VALUES AND RELIGION**

Karma Yoga in Hinduism – Love and Justice in Christianity – Brotherhood in Islam – Compassion in Buddhism – Ahimsa in Jainism – Courage in Sikhism – Need for Religious Harmony

### **UNIT – III – VALUES AND SOCIETY**

Definition of Society – Democracy – Secularism – Socialism – Gender Justice – Human Rights – Socio- Political Awareness – Social Integration – Social Justice

### **UNIT – IV – PROFESSIONAL VALUES**

Definition – Accountability – Willingness to Learn – Team Spirit – Competence Development – Honesty – Transparency – Respecting Others – Democratic Functioning – Integrity and Commitment

### **UNIT – V – ROLE OF SOCIAL INSTITUTIONS IN VALUE FORMATION**

Role of Family – Peerhood – Society – Educational Institutions – Role Models, and Mass Media in Value Formation

### **BOOKS RECOMMENDED**

Value Education, Published by Madurai Kamaraj University, Madurai.→