J.J. College of Arts and SCIENCE (Autonomous),

Sivapuram Post, Pudukkottai – 622 422

Syllabus – U.G.

(2022-2023 onwards)

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P.G. and Research Department of Microbiology

Programme Outcome (PO) – B.Sc.

PO – 1: Acquire theoretical and practical knowledge and enhance the employability skills of the Graduates.

PO-2: Identify and analyze the problem and formulate solutions with appropriate consideration for the public Health, Safety, Security and Sustainable Environment.

PO-3: Acquire the responsibility to contribute for the personal development, the development of the community and to respect the ethical values, social responsibilities and diversity.

PO-4: Function as an individual and as a member, leader in diverse teams and in multidisciplinary settings.

PO-5: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcome (PSO) – B.Sc.

At the end of the Programme the student will be able to

PSO-1: Understand the knowledge of Microbiology in the domain of Life Sciences.

PSO-2: Acquire analytical skills using latest techniques and tools along with required practical skills in the field of Microbiology.

PSO-3: Realize the applicability and significance of microbes in the field of Health, Food, Industry, Agriculture and Environment.

PSO-4: Carry out standard Laboratory techniques in the areas of Biochemistry, Bioinformatics and Molecular Biology.

PSO-5: Exploit the potentiality of microorganisms for the welfare of human beings.

Programme Educational Objectives (PEO) – B.Sc.

- To make learners aware of the diachronic and synchronic dimensions of their chosen area of specialization
- To introduce learners to the latest developments in the chosen area
- To give learners a frame of reference that will help them see issues in their interrelation with related fields or lend them a focus on particular areas and approaches
- To give learners a practical orientation in the skills acquired in their areas through Major-Based and Skill-Based Optionals
- To promote an inter-disciplinary approach to put their areas of specialization in relation to other relevant domains of knowledge
- To cultivate in learners the skills and methodologies specific to their areas
- To promote citizenship qualities by sensitizing learners to issues of the environment, gender and socio-ethical values
- To promote a concern for society through suitable extension activities
- To promote man-making education through extra-curricular activities like Sports, Fine-Arts and Cultural Programmes
- To contribute to the formation of character and personality through socialization activities and leadership training through Association and Club Activities.

PRINCIPLES OF MICROBIOLOGY

Course Code: U1R2MBCC1	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives

- To know the historical background and the progress of this field to the modern times.
- To learn the characteristics of Prokaryotes and Eukaryotes.
- To operate Microscopy.
- To get knowledge of Sterilization.
- To understand the Cultivation and preservation of microbes.

Unit I: History and Scope **12 hrs**

History and Scope of Microbiology – Spontaneous Generation Theory – Contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner and Elie Metchnikoff. Microbial Classfication System - Haeckel's three kingdom concept, Whittaker's five kingdom concept.

Unit II: Microscopy and Staining Methods **12 hrs**

Bright field, Dark field, Phase-Contrast, Fluorescence, Scanning Electron Microscopy and Transmission Electron Microscopy. Preparation and Staining of Specimens – Simple Staining, Differential Staining – Gram Staining and Acid Fast Staining.

Unit III: Morphology & Structure of Microbes **12 hrs**

Structure and Function of Prokaryotic and Eukaryotic Cells - General characteristics of Archaebacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirocheates, Actinomycetes, Protozoa, Algae, Fungi and Viruses.

Unit IV: Control of Microbes **12 hrs**

Sterilization methods – Physical methods – Dry Heat, Moist heat, Radiation, Filtration – Chemical methods – Alcohols, Aldehydes, Dyes, Halogens, Phenols, Gases, Surface active agents and Metallic agents.

Unit V: Culture Media and Preservation of Microbes **12 hrs**

Introduction - Types of culture media – Liquid, Solid, Simple, Complex, Synthetic or Defined Media – Special Media – Enriched, Enrichment, Selective, Indicator, Differential, Transport Media. Methods of maintenance and preservation of microbes.

Text Books

1. Brock TD, Smith DW and Madigan NT, 1987, Biology of Microorganisms edn, Eniglcwood Cliffs, NJ Prentice Hall K.

2. Dubey RC and Maheswari DK, 2012, A text of Microbiology (Revised edition). S.Chand and Company Ltd., New Delhi.

Reference Books:

3. GeetaSumbali and Mehrotra RS, 2009, Principles of Microbiology. First edition, Tata McGraw Hill P.Ltd., New Delhi.

4. John L. Ingraham, Catherine A. Ingraham, 2000, Introduction to Microbiology – Second Edition. Published by Brooks/Cole.

5. Nester EW Roberts CV and Nester N7T, 1995, Microbiology A Human Perspectives Iowa USA.

6. Pelczer J. Chen ECS. Krieg NR, 1986, Microbiology, MC Grow Hill Company.

7. Powar CB and Daginawala H F 2005, General Microbiology volume 1 and 2. Eighth edition, Himalaya publishing house, Mumbai

8. Prescott, Harley, Klein, 2003, Microbiology International Edition, fifth Edition, Published by McGraw-Hill Education.

9. Stainer R Y. Ingraham JL Wheels ML. Painter PR, 1999, General Microbiology MacMillan Educational Ltd, London.

10. Tortora, Funke, Case, Microbiology an Introduction, twelfth Edition, Published by Pearson Education.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course outcome	Knowledge level
CO1	Describe about history and scope of Microbiology	K2
CO2	Operate Microscope	K3
CO3	Differentiate structure of Microorganisms	K2
CO4	Explain sterilization techniques	K4
CO5	Classify different types of Culture media	K4

Title of the Course: Principles of Microbiology						**Course Code:**U1R2MBCC1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	1	3	1	1	3	2	2	2	3	2.1
CO2	3	3	3	2	2	3	2	3	2	3	2.6
CO3	3	2	2	2	3	3	3	3	3	3	2.7
CO4	3	3	3	2	3	3	3	3	3	3	2.9
CO5	3	2	2	2	3	3	3	3	3	3	2.7
	Mean Overall Score										**2.6**
	Result										**High**

MAJOR PRACTICAL I - PRINCIPLES OF MICROBIOLOGY

Course Code: U1R2MBCC2P

Course Objectives:

- To learn the Laboratory precautions
- To study the principles of microscopy
- To learn the sterilization techniques and staining procedures
- To prepare different types of media for the cultivation of bacteria
- To learn pure culture techniques for the isolation of bacteria from different samples

1. Laboratory Precautions, Safety and Glassware Cleaning
2. Microscopy: Use of Bright Field Microscope - Demonstration
3. Sterilization principles and methods: Dry heat, moist heat and filtration methods
4. Media preparation: Liquid medium, Solid medium: Agar slants & Agar plates, Agar deeps
5. Preparation of Selective Media: EMB Agar and Differential Media: MacConkey Agar
6. Pure culture techniques – Serial Dilution – Pour Plate method and Spread Plate Method.
7. Streak plate method – Single line, Quadrant, T-streak, Continuous
8. Determination of Motility – Hanging drop method
9. Staining techniques: Smear preparation: Heat fixation. Simple staining procedure.
10. Differential staining procedure: Gram's staining
11. Endospore staining.
12. Capsular Staining: Positive staining and Negative staining.
13. Identification of organisms from permanent slides – Algae (Anabena, Nostoc, Spirullina,), Fungi (Saccharomyces, Penicillium, Aspergillus,) and Protozoa (Entamoebahystolytica)
14. Micrometry: measuring the size of a microorganism.
15. Maintenance and Preservation of Microorganisms.

References:

1. Atlas R.M., A.E.Brown and L.C. Parks, Mosby, St. Louis , 1995, Laboratory Manual of Experimental Microbiology

2. Cappuccino J.G. and N. Sherman 2002, Microbiology: A Laboratory Manual, Addison-Wesley.

3. Holt J.G, N.R.Krieg, 2000, Bergey's Manual of Determinative Bacteriology. Ninth edition, Lippincott Williams &Wilkin Publishers.

4. Kannan N, 2002, Laboratory Manual in General Microbiology, Panima Publishers.

5. Sundararaj T, 2003, Microbiology Laboratory Manual, 2nd Edition, A. Sundararj No.5, I cross street, Thirumalai Nagar, Perungudi, Chennai 600 096.

Course Outcomes:
After completion of this course, students would be able to

S.No.	Course outcome	Knowledge level
CO1	Label the components of Microscopes	K1
CO2	Identify the Microorganisms	K3
CO3	Utilize the sterilization techniques and filtration procedures	K3
CO4	Analyze the different staining techniques	K4
CO5	Explain the preparation of various media for cultivation of microorganisms	K4

Title of the Course: Major Practical I						**Course Code:** U1R2MBCC2P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	2	3	3	3	3	3	3	3	2.9
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	2	3	3	3	3	3	3	3	2.9
										Mean Overall Score	**2.9**
										Result	**High**

BIOCHEMISTRY

Course Code: U1R2MBAC1	**Credit: 3**
Category: Allied Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To provide knowledge on carbohydrates
- To know the structural organization of amino acids
- To learn the characteristics of proteins.
- To know Types of DNA and RNA
- To acquire knowledge on lipids.

Unit I: Chemistry of Carbohydrates **12 hrs**

Occurrence, Definition, structure: linear and ring forms (Haworth formula), classification of carbohydrates; Monosaccharides (Glucose, Fructose), Disaccharides (Lactose and Sucrose), Physical properties – Muta rotation, stereo isomerism and optical isomerism chemical properties-oxidation, reduction and osazone formation. Polysaccharides: starch and cellulose-structure and functions.

Unit II: Aminoacids **12 hrs**

Aminoacids- structure and classification based on structure. Standard and non-standard amino acids, essential and non-essential amino acid. Physical properties: Acid base properties; isoelectric points and zwitter ions. General reactions of amino acids – Edman's reaction, Sanger's reaction, reaction with Dansyl chloride, Van Slyke reaction and Ninhydrin reaction.

Unit III: Chemisrty of Proteins **12 hrs**

Definition, classification of proteins based on size, solubility, chemical composition functions, structure of proteins- peptide bond, primary, secondary, tertiary and quaternary structure of proteins, factors that determine conformation of protein structure..

Unit IV: Chemistryof Nucleic Acids **12 hrs**

Definition, Nucleic acid- Nitrogenous bases, Nucleosides and Nucleotides, phosphodiester linkage; Nucleic acid types –DNA and RNA; structure- double helical structure of DNA; Denaturation, Tm and hyperchromicity, structure of RNA; tRNA, mRNA and rRNA.

UNIT V: Chemistry of Lipids **12 hrs**

Definition and classification of lipids- simple, compound (phospholipids) and derived lipids (cholesterol). Classification of fatty acids – saturated fatty acids and unsaturated fatty acids. Physical property- emulsification. Chemical properties- saponification number, Rancidity, acid number, Iodine number and Reichert – Meissl number.

Text Books:

1. Sathyanarayana,U and Charapani,C.(2010).Biochemistry. Books and allied (P) Ltd
2. Deb,A.C., (1989). Fundamentals of Biochemistry (3rd Edition). New central agency.
3. Jain, J.L., (2005). Fundamentals of Biochemistry (6th Edition), S.Chand Publications
4. Ashokan.P. (2006) Enzymes .Chinna Publications
5. Freifelder, D. (2008) Molecular Biology, IV Edition, Narosa Publishing House, New Delhi.

Reference Books:

6. David E. Metzler and Carol M. Metzler (2001). Biochemistry-The chemical reactions of Living cells- Vol1&2. (2nd edition).Harcourt/Academic press, Newyork.
7. DonaldVoet and Judith G. Voet (1995). Biochemistry – Second Edition. John Willey and Sons, Inc.
8. Leninger,A.L., Nelson, D.L., Cox, M.M., (1993). Principles of Biochemisry, (2nd Edition).CBS Publishers,
9. Geofferey, L and Zubay (1998). Biochemsitry. (Fourth Edition) Wm. C. Brown Publishers.
10. Stryer, L. (1995). Biochemistry. 4th Ed. W.H. Freeman and Company, New York

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course outcome	Knowledge level
CO1	Explain about Carbohydrates	K2
CO2	Define Amino acids and its structure	K1
CO3	Classify the proteins	K4
CO4	Compare the nucleic acids	K4
CO5	Interpret the Lipids and its types	K2

Title of the Course: Biochemistry						**Course Code:**U1R2MBAC1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	2	2	2	3	3	2	3	1	2.4
CO2	3	3	2	2	2	3	3	2	3	1	2.4
CO3	3	3	2	2	2	3	3	2	3	1	2.4
CO4	3	3	2	2	2	3	3	2	3	1	2.4
CO5	3	3	2	2	2	3	3	2	3	1	2.4
	Mean Overall Score										**2.39**
	Result										**High**

ALLIED PRACTICAL – BIOCHEMISTRY

Code: U1R2MBAC2P

Course Objectives:

- To learn the qualitative and quantitative estimation of Carbohydrates
- To know the qualitative and quantitative estimation of amino acids
- To perform the qualitative and quantitative estimation of proteins
- To understand the qualitative and quantitative estimation of lipids
- To analyze the qualitative and quantitative estimation of nucleic acids

1. Qualitative and quantitative estimation

a. Carbohydrates

b. Amino acids

c. Proteins

d. Lipids

e. Nucleic acids.

2. Estimation of ascorbic acid (from biological sample)

References:

1. Keith Wilson and John Walker. (1995). Principles & Techniques of Practical Biochemistry. (4th edition).Cambridge University press, Britain.

2. Oser, B.L.Hawks, (1965). Physiological Chemistry, TATA Mc Graw Hill.

3. Shawn O' Farrell and Ryan T. Ranallo. (2000). Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia.

4. Strolv, B.A. Makavora, V.C. (1989). Laboratory manual in Biochemistry. MIR Publisher.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course outcome	Knowledge level
CO1	Learn qualitative and quantitative estimation of Carbohydrates	K1
CO2	Explain qualitative and quantitative estimation of amino acids	K2
CO3	Examine the qualitative and quantitative estimation of proteins	K4
CO4	Estimate the qualitative and quantitative of lipids	K5
CO5	Determine the qualitative and quantitative estimation of nucleic acids	K6

Title of the Course: Allied Practical – Biochemistry						**Course Code:** U1R2MBAC2P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	3	1	2.8
CO2	3	3	3	3	3	3	3	3	3	1	2.8
CO3	3	3	3	3	3	3	3	3	3	1	2.8
CO4	3	3	3	3	3	3	3	3	3	1	2.8
CO5	3	3	3	3	3	3	3	3	3	1	2.8
	Mean Overall Score										**2.8**
	Result										**High**

MICROBIAL PHYSIOLOGY AND METABOLISM

Course Code: U2R2MBCC3	**Credit:** 5
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives

- To acquire with basic knowledge of microbial nutrition and growth
- To familiarize with the enzymes
- To understand the energy production
- To know the details of Membrane transport system
- To have a detailed knowledge about anaerobic respiration and microbial fermentation.

Unit I –Microbial Nutrition **15 hrs**

Microbial nutrition: Nutritional requirements – macro and micronutrients – growth factors. Classification of microorganisms based on their nutritional requirements - Transport of nutrients– Simple and facilitated diffusion, group translocation and active transport. Siderophores.Osmosis.

Unit II Microbial Growth **15 hrs**

Different phases of growth - growth curve - generation time - Diauxy- factors influencing microbial growth - temperature, pH, pressure, salt concentration, nutrients, oxygen - synchronous growth and batch & continuous culture. Sporogenesis in Bacillus sp.

Unit III – Metabolism **14 hrs**

Aerobic: EMP, HMP, ED and TCA cycles. Bacterial photosynthesis - CO2 fixation – methanogenesis – Bioluminescence. Beta oxidation. Electron transport Chain and Oxidative Phosphorylation.

Unit IV – Enzymes **14 hrs**

Bacterial enzymes – IUB classification - oxidoreductase, transferase, hydrolase, lyase, isomerase and ligase, properties, coenzymes and cofactors, isozymes. Mechanism of enzyme action, conditions affecting enzyme activity.

Unit V – Anaerobic respiration and Microbial Fermentation **14hrs**

Anaerobic Respiration – Nitrate, sulphate & methane respiration – Fermentations: alcoholic, Propionic, mixed acid, lactic acid fermentation and butanol fermentation.

Text Books:

1. Albert G. Moat & John W. Foster, 2007, Microbial physiology, A John Wiley and sons, INC publications, New York.

2. Caldwell D.R., 1995, Microbial Physiology and Metabolism, Brown Publishers.

3. Dubey R.C &MaheshwariD.K, 2009, A text book of microbiology, Chand & Company Ltd. New Delhi.

Reference Books:

4. GeetaSumbali and Mehrotra RS, 2009, Principles of Microbiology. First edition, Tata McGraw Hill P.Ltd., New Delhi.

5. Geoffrey M. Cooper, 2007, the cell, A molecular approach, 3rd Edition - ASM press, Washington.

6. MillianMeenakumariS, 2006, Microbial physiology, MJP. Publishers, Chennai.

7. Moat G, John W. Foster and Michael P. Spector, 2002. Microbial physiology.Fourth edition, A John Wiley sons, Inc. publication. New Delhi.

8. PelczarJr.M.J,Chan E.C.S.&Kreig N.R, 2007,Microbiology, 5thEditionMc.Graw Hill.

9. Robert F Boyd, 1984, General Microbiology. Times mirror / Mosby college publishers.

10. Rose A.H, Advances in Microbial Physiology. Volumes.Edited by Academic Press, New York.

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Describe about microbial nutritional requirements	K2
CO2	Classify bacterial growth	K4
CO3	Explain metabolism	K3
CO4	Differentiate types of enzymes	K4
CO5	Discuss about anaerobic respiration	K2

Title of the Course: Microbial Physiology and Metabolism						**Course Code:**U2R2MBCC3					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	2	3	3	3	3	3	3	2.9
CO2	3	2	2	2	3	3	3	3	3	3	2.5
CO3	3	2	2	2	3	3	3	3	3	3	2.7
CO4	3	3	2	2	3	3	3	3	3	3	2.8
CO5	3	3	2	2	3	3	3	3	3	3	2.8
										Mean Overall Score	**2.74**
										Result	**High**

MAJOR PRACTICAL II – MICROBIAL PHYSIOLOGY AND METABOLISM

Code: U2R2MBCC4P

Course Objectives:

- To Understand the growth requirements
- To know the parameters for growth and bacterial characteristics
- To aid identification of microorganisms by various biochemical test
- To become familiar with biochemical test
- To isolate microorganisms from the environment

1. Measurement of bacterial growth-turbidity method
2. Effect of environmental factors on bacterial growth – pH, temperature
3. IMVIC - Test
4. Carbohydrate fermentation
5. Mixed acid fermentation
6. Butanediol fermentation
7. Oxidase test
8. Catalase test
9. Nitrate reduction test
10. Starch hydrolysis
11. Casein hydrolysis
12. Urea hydrolysis
13. Gelatin liquefaction
14. H2S production
15. Citrate utilization

References:

1. Atlas R.M., A.E.Brown and L.C. Parks, Mosby, St. Louis, 1995, Laboratory Manual of Experimental Microbiology

2. Cappuccino J.G and N. Sherman, 2002, Microbiology: A Laboratory Manual, Addison-Wesley.

3. Holt J.G, N.R. Krieg, Lippincott, 2000, Bergey's Manual of Determinative Bacteriology. Ninth edition, Williams &Wilkin Publishers.

4. Kannan N, 2002, Laboratory Manual in General Microbiology, Panima Publishers.

5. Sundararaj. T, Microbiology Laboratory Manual, 2003, Published by A. Sundararaj No.5, I cross street, Thirumalai Nagar, Perungudi, Chennai 600 096 2nd Edition

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Define the hydrolysis nature of microbes	K1
CO2	Interpret the physiological nature of microbial growth	K2
CO3	Identify the separate biomolecules	K3
CO4	Examine the biochemical test	K4
CO5	Determine the impact of environmental parameters	K5

Title of the Course: Major Practical II						**Course Code:** U2R2MBCC4P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
	Mean Overall Score										**3.0**
	Result										**High**

BIOTECHNOLOGY

Course Code: U2R2MBAC3	**Credit:** 3
Category: Allied Course	**Hrs/Week:** 03, **Total Inst.Hrs:** 36
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To acquire knowledge in the basics of Biotechnology
- To understand the applied areas of Biotechnology
- To inculcate the Pharmaceutical drug formulation and vaccine production
- To equip the students to work in interdisciplinary science industries
- To know the basics of Environmental Biotechnology

Unit I - Basics of Biotechnology **7hrs**

Introduction to Biotechnology, Definitions of Biotechnology, History of Biotechnology, Biotechnology- multidisciplinary tree, Applications of Biotechnology.

Unit II - Plant Biotechnology **8hrs**

Introduction of plant tissue culture - composition of media, Micropropagation, organogenesis, somatic embryogenesis, Callus induction, protoplast isolation and fusion, hybirid and cybrid, Plant Transformation methods - Direct transformation (Electroporation and particle gun bombardment), Indirect-*Agrobacterium* mediated gene transfer. Edible Vaccine.

Unit III - Animal Biotechnology **7hrs**

Cell culture: primary and established culture; organ culture; tissue culture; Disaggregation of tissue and primary culture; cell separation, Slide and coverslip cultures, flask culture, test tube culture techniques, cell synchronization, Preparation of Cell lines and Cell Strains, cryo preservation. Cloning in Animals - Dolly –merits and demerits.

Unit IV - Pharmaceutical Biotechnology **7hrs**

Current status of Pharmaceutical Biotechnology. Biopharmaceutical Production - Hormones - Insulin - HGH, Vaccine - Hepatitis B, DNA Vaccines - Interferons.

Unit V - Environmental Biotechnology **7hrs**

Biodegradation of hydrocarbons, pesticides, xenobiotics. Bioremediation types and applications - Super bug, Bioleaching - Copper, Silver and Gold.

References:

Text Books

1. Razdan, M.K. (2011). Plant tissue culture. Oxford and IBH publishing Company Pvt. Ltd., New Delhi.
2. Chawla, H.S. (2010). Introduction to plant biotechnology. Oxford and IBH publishing Company Pvt. Ltd., New Delhi.

3. Ian Freshney (2010). Culture of animal cells. 6th edition. Wiley-Blackwell publishers.
4. Ralf Portner (2007). Animal cell biotechnology: Methods and protocols. 2nd edition, Humana Press, New Jersey.
5. Harbanslal (2011). Pharmaceuticals biochemistry. CBS Publishers and distributors Pvt. Ltd., Chennai

Reference Books:

6. Carlos A. Guzmán and Giora Z. Feuerstein (2009). Pharmaceutical Biotechnology. 1st edition, Springer.
7. Kayser, O and Muller R.H. (2004). Pharmaceutical Biotechnology, Drug Discovery and Clinical Applications. WILEY-VCH.
8. Leon Shargel, Andrew B.C. Yu, Susanna Wu-Pong, and Yu Andrew B.C. (2004). Applied Biopharmaceutics & Pharmacokinetics. McGraw-Hill Companies·
9. Werner Kalow, Urs A Meyer and Rachel F. Tyndale. (2001). Pharmacogenomics. CPL press.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Describe the significance of biotechnology and its areas	K2
CO2	Explain plant tissue culture methods	K3
CO3	Differentiate animal cell culture and plant tissue culture	K2
CO4	Analyze the importance of biopharmaceuticals and vaccines	K4
CO5	Illustrate biodegradation and bioremediation applications	K3

Title of the Course: Biotechnology						**Course Code:** U2R2MBAC3					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	1	3	1	2	1	2.3
CO2	3	3	3	3	3	1	3	1	2	1	2.3
CO3	3	3	3	3	3	1	3	1	2	1	2.3
CO4	3	3	3	3	3	3	3	3	2	3	2.9
CO5	3	3	3	3	3	3	3	3	2	3	2.9
	Mean Overall Score										**2.54**
	Result										**High**

IMMUNOLOGY

Course Code: U3R2MBCC5	**Credit:** 5
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To acquire with basic knowledge in immunology
- To familiarize with the immunity and immune system
- To understand the antigen antibody reactions
- To study the various allergic reactions
- To get knowledge on transplantation

Unit – I History of Immunology **14hrs**

Introduction: – History of Immunology – Immunohematology, Blood groups – ABO and Rh typing, Blood transfusion – Rh – incompatibilities – immunity – types of immunity – Innate – Anatomical, physiological, phagocytic and inflammatory barriers, Acquired – cell mediated and humoral immunity. Hematopoiesis.

Unit – II Immune System **15hrs**

Cells and organs of Immune system – T Cells, B Cells, Antigen processing cells, lymphocytes, macrophages, mast cells, NK cells. Immunological responses – Primary and Secondary immune responses. Primary lymphoid organs- bone marrow and thymus; Secondary lymphoid tissue – spleen, lymphnodes, MALT and GALT;

Unit – III Antigens and Antibody Molecules **15hrs**

Antigens: Types, properties, immunogen, epitope, paratope, haptens – adjuvants, Vaccines – types - whole organisms vaccine, purified macromolecule vaccine, recombinant vaccine, anti-idiotype vaccine and DNA vaccine – toxoids, antitoxins. Immunization Schedule. Antibody – structure, types and properties. Definition of Monoclonal and Polyclonal Antibodies. Complement pathway- classical and alternate.

Unit – IV Antigen – Antibody Reactions **14 hrs**

in vitro methods; Agglutination – Widal test, Haemagglutination, HAI, and Precipitation – Immunodiffusion and Immunoelectrophoresis, Complement fixation, Immunofluorescence, Enzyme linked immunosorbent assay (ELISA), Radioimmuno assay (RIA) and Fluorescent insitu hybridization (FISH).

Unit – V Hypersensitivity reactions **14 hrs**

Antibody (IgE) mediated - Type I anaphylaxis, Type II – Antibody dependent cellmediated cytotoxicity, Type III – immune complex reactions – respective diseases and immunologic methods of diagnosis – cell mediated immune responses – Lymphokines, Cytokines. Type IV – Hypersensitivity reactions, in vivo methods; Skin tests – immune complex tissue demonstrations, MHC and transplantation.

Text Books:

1. Ivan Roitt. Jonathan Brostoff and David Male. (2007). Immunology(7th edition).Elsevier science Ltd., New York
2. Janis Kuby (1994). Immunology. (2nd edition). W.H. Freeman and company,New York.
3. N.V.Shastri (2005). Principles of Immunology.(5th Edition).Himalaya Publishing House, Mumbai.
4. I.Kannan (2007). Immunology. MJP Publishers.
5. S.C.Rastogi (2008). Elements of Immunology. CBS publishers, New Delhi.

Reference Books:

6. Lydyard, Whelan and Fanger (2002), Instant notes in Immunology, Bios scientific publishers.
7. Charles A. Janeway,Jr. Paul Travers. Mark Walport and Donald Capra,J.(1999). Immunobiology-The immune system in health and disease.(4th edition).Current Biology Publications, London.
8. Richard A., .Goldsby Thomas J. Kindt and Barbera A. Osborne. (2002). Kuby Immunology.(5th edition).W.H. Freeman and company, New York.
9. Abul K. Abbas. Andrew H. Lichtman and Jordan S.Pober.(1994). Cellular and Molecular Immunology.(2nd edition).W.B. Saunders company, Philadelphia.
10. Ian.R.Tizard (2004). Immunology – An introduction.4thEdition.Joshi& Osama (1998). Immunology (Serology, Hematology), Agro Botanica.

Course Outcomes:

After the completion of this Course work students will be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Define immunity and blood grouping	K1
CO2	Differentiate various lymphoid organs	K4
CO3	Acquire Knowledge on antigen and antibody	K5
CO4	Perform antigen antibody reactions *invitro*	K3
CO5	Elaborate allergic reactions and transplantation	K6

Title of the Course: Immunology						**Course Code:**U3R2MBCC5					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	2	2	2.8
CO2	3	3	3	3	3	3	3	3	2	2	2.8
CO3	3	3	3	3	3	3	3	3	2	2	2.8
CO4	3	3	3	3	3	3	3	3	2	2	2.8
CO5	3	3	3	3	3	3	3	3	2	2	2.8
										Mean Overall Score	**2.82**
										Result	**High**

MAJOR PRACTICAL – III – IMMUNOLOGY

Code: U3R2MBCC6P

Course Objectives:

- To know the blood grouping
- To be familiar in identifying Typhoid
- To have knowledge on blood cell count
- To demonstrate the ELISA
- To measure the c-reactive Protein

1. ABO blood grouping
2. Rh Typing
3. WIDAL test (Slide and Tube Agglutination Test)
4. RPR - Rapid Plasma Reagin Test
5. CRP – C-Reactive Protein Test
6. ASO - Anti-Streptolysin O test
7. Total Blood cell count by Haemocytometer
8. Differential WBC count
9. Double Immunodiffusion
10. Demonstration of ELISA

References:

1. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.NewDelhi.

2. Cappuccino J.G. and N. Sherman 2002, Microbiology: A Laboratory Manual, Addison-Wesley.

3. Holt J.G, N.R.Krieg, 2000, Bergey's Manual of Determinative Bacteriology. Ninth edition, Lippincott Williams &Wilkin Publishers.

4. Kannan N, 2002, Laboratory Manual in General Microbiology, Panima Publishers.

Course Outcomes:

After the completion of this Course work students will be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Examine blood grouping	K4
CO2	Analyze the typhoid fever	K4
CO3	Utilize the hemocytometer for blood cell count	K3
CO4	Demonstrate ELISA	K2
CO5	Determine the level of C-reactive protein	K5

Title of the Course: Major Practical – III						**Course Code:** U3R2MBCC6P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
	Mean Overall Score										**3.0**
	Result										**High**

BIOSTATISTICS

Course Code: U3R2MBAC4	**Credit:** 3
Category: Allied Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- *To study on Role of statistics and Limitations*
- *To review the basic concepts and knowledge in collection of Data*
- *Develop the skills pertinent to practice Measures of central tendency*
- *To understand the concepts of Measures of Dispersion*
- To educate the Skewness and Kurtosis

Unit I - Introduction to Biostatistics **15 Hours**

Biostatistics: Definition- Developments - Applications- Role of Statistics - Characteristics -Limitations- Importance.

Unit II - Collection and presentation of data **18 Hours**

Collection of data: Data collection-Primary data - secondary data, Classification

Classification and Tabulation: - Types of classification - Tabulation of data - Parts of a table - types of tabulation.

Diagrammatic representation: Rules, limitations - Bar diagram (Simple, multiple, component / staked, proportional / percentage) - pie diagram.

Graphical representation: rules, limitations - difference between diagram and graphs - histogram - frequency polygon - frequency curve - Ogive curve

Unit III - Measures of Central Tendency **12 Hours**

Measures of central tendency: Introduction - characteristics - Arithmetic mean - Median - Mode - Geometric mean, Harmonic Mean (definition, merits and demerits, problems based on raw, discrete and continuous data) (Direct method only)

Unit IV - Measures of Dispersion **15 Hours**

Measures of dispersion:Definition - Characteristics - Range - Mean derivation - Standard deviation - Coefficient of variation (definition, merits & demerits, problems based on raw data only)

Unit V –Skewness andKurtosis **15 Hours**

Skewness: Definition, Types, Karl Pearson coefficient of Skewness, Bowley's coefficient of Skewness - Related problems, Kurtosis & moments (concept only)

Text Books:

[1] "**Biostatistics"** - P.N. Arora, P.K.Malhan, Himalaya Publishing House.(2014).
[2] "**Fundamentals of Biostatistics**" - Veer BalaRastogi, Ane Books Pvt. Ltd. (2008).
Unit I : Chapter 1, Sec. 1.1 -1.5, 1.11 – 1.13[1]
Unit II: Chapter 1, Sec. 1.8, 1.9 [1]
Chapter 4, Sec. 4.1 - 4.13 [1]
Chapter 5, Pg. no. 65-68 [2]
Chapter 4, Pg. no. 41 – 43 [2]
Unit III: Chapter 5, Sec. 5.1- 5.3, 5.7 – 5.13, 5.15, 5.17– 5.18 [1]
Unit IV: Chapter 7, Page No. 135 – 138, 146-155 [2]
Unit V : Chapter 7, Sec. 7.1, 7.2, 7.5 - 7.9, 7.11, 7.13 [1]

Reference Books:

1. "Introduction to Biostatistics" – SokalandRohlf – Toppan Co. Japan
2. "Primer of Biostatistics" – Stanton A. Clantz – The McGraw Hill Inc. Newyork.

e- Resources:

1. https://youtu.be/OTVk28caCxw
2. https://statisticsbyjim.com/basics/measures-central-tendency-mean-median-mode/

Course Outcomes:

After the completion of this Course work students will be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Understand the basic concept of statistics, and also apply statistical measures which are used to analyze the data.	K2
CO2	Acquire knowledge on measures of central tendency	K1
CO3	Prepare reports to conclude the findings in data analysis	K6
CO4	Apply the concept of Skewness and Kurtosis in Measures of Dispersions	K3
CO5	Evaluate the measures of dispersions	K5

Title of the Course: Biosatistics						**Course Code:**U3R2MBAC4					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	1	3	3	3	3	3	2.8
CO2	3	2	3	3	2	3	3	1	3	3	2.6
CO3	3	2	3	3	2	3	3	2	3	1	2.5
CO4	3	1	3	3	3	3	3	3	3	2	2.7
CO5	3	3	3	3	3	3	3	3	3	2	2.9
	Mean Overall Score										**2.7**
	Result										**High**

MEDICAL MICROBIOLOGY

Course Code: U4R2MBCC7	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- Toinculcateaboutthecharacterizationandpurificationofvirus.
- Toacquireknowledge aboutviraldiseases.
- Toget Knowledgeonclinicallabtechniques
- To focus the pathogenecity of medically important bacterias
- To make aware of various emerging diseases

Unit I: Introduction to Medical Microbiology 12hrs

Normal microbial flora of human body, Host microbe interaction - Examination of Clinical Specimens - Microbiological processing of urine, blood, faeces, cerebrospinal fluid, throat swabs, sputum, pus and wound exudates.

Unit - II Bacteriology 12 hrs

Morphology, pathogenicity, clinical features, laboratory diagnosis and treatment of Staphylococcus species, Streptococcus species. *Escherichia coli*, *Klebsiella* species, *Proteus* species, *Salmonella* species, *Shigella* species, *Vibrio cholerae*, *Mycobacterium tuberculosis*.

Unit - III Mycology 12 hrs

Classification of Medically important Fungi, Superficial Mycoses, Dermatophytic infections: clinical features of various dermatophytic infections, Subcutaneous infection – Mycetoma. Systemic mycosis - *Histoplasma capsulatum* (histoplasmosis), *Coccidioides immitis* (coccidioidomycosis), *Blastomyces dermatitidis* (Blastomycosis), Opportunistic mycosis – Candidiasis, Cryptococcosis, Aspergillosis.

Unit - IV Viral Infections 12 hrs

Morphology, pathogenicity, clinical features, Laboratory diagnosis and treatment of Herpes simplex virus, Hepatitis – B, Rabies, Polio, Influenza, Measles, AIDS.

Unit – V Parasitology 12 hrs

Morphology, life cycle, pathogenicity and laboratory diagnosis of *Entamoeba histolytica, Plasmodium vivax, Ancylostoma duodenale, Ascaris lumbricoides, Wuchereria bancrofti.*

Text Books:

1. LansingM.Prescott.,JohnP.HarleyandDonaldA.Klein.(2003).Microbiology(5th edition)McGraw Hill, New York.
2. ConratHF,KimballPCandLevyJA.(1988).Virology.IIedition.PrenticeHall,EnglewoodCliff,New Jersey.
3. AmithaBiswas(2007). An Introductiontoviruses.VikasPublishers,Delhi.

Reference Books:

4. DimmockN.J.andPrimroseS.B.(1994).IntroductiontoModernVirology.I Vedition.BlackwellscientificPublications, Oxford.
5. Topley andWilson's(1990).PrinciplesofBacteriology,VirologyandImmUnity.VIIIeditio nVol.IVVirology, Edward Arnold,London.
6. AnnGiudiciFettner. (1990).TheScienceofViruses.Quill,WilliamMarrow,NewYork.
7. Prescott L.M; J.P Harley and D.A. Klein. Microbiology 9th Edition, 2014. Wm C.
8. Brown PublishersPatric R Murray, Medical Microbiology, 1990, Mosby Publications
9. Morag,C.Timbury(1994).MedicalVirology.Xedition.Churchill Livingston.
10. Nicklin,J.Greame-CookandKillington,R.(2003).InstantNotesIMicrobiology.(2ndedition).VivaBoo ksprivate limited, New Delhi.
11. RogerHull.2002.Mathews'PlantVirology.(4thEdition).Academicpress-AHarcourtScienceandtechnologycompany, New York.
12. Ananthanarayan&Panikar's, Textbook Of Microbiology. 9th Edition, 2013.
13. Jawetz E, JL Melnie and EA Adelberg, Medical Microbiology, 24th edition, 2007, Tata McGrawa publishing house.

Course Outcomes:

After completion of this course ,students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Examine the clinical specimens	K4
CO2	Define the clinical features of bacterial diseases	K1
CO3	Identify the medically important fungi	K2
CO4	Evaluate and compare the various viral pathogens	K4
CO5	Analyse the various parasitic diseases	K4

Title of the Course: Medical Microbiology						**Course Code:**U4R2MBCC7					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	2	2	3	3	3	3	2	3	2.7
CO2	3	3	2	2	3	3	3	3	2	3	2.7
CO3	3	3	2	2	3	3	3	3	2	3	2.7
CO4	3	3	3	3	3	3	3	3	2	3	2.9
CO5	3	3	3	3	3	3	3	3	2	3	2.9
										Mean Overall Score	**2.78**
										Result	**High**

MAJOR PRACTICAL - IV - MEDICAL MICROBIOLOGY

Code: U4R2MBCC8P

Course Objectives:

- To learn the concentration of Bacteriophages
- To understand the isolation of Bacteriophage
- To Know the difference between gram positive and gram negative bacteria
- To perceive the Germ tube techniques
- To acquire knowledge on Minimum Inhibitory Concentration

1. Observation of selected bacterial, Plant and Animal viruses – T4 phage, M13 Phage, TMV, CaMV, HIV, Influenza, HSV, HBV, Rabies and Blue tongue virus.
2. Isolation of Bacteria from Urine, Stool and Sputum
3. Identification of Gram positive organisms (Using laboratory stains); *Streptococcus pneumonia, Staphylococcus aureus* and *Bacillus* spp. and Gram Negative organisms (Using laboratory stains); *Escherichia coli*, *Proteus* spp and *Klebsiella pneumonia* on the basis of Microbiological, Cultural and Biochemical characteristics.
4. Saline and iodine wet mount to demonstrate Protozoan parasites
5. Geimsa staining for the demonstration of blood parasites
6. KOH and Lactophenol Cotton blue mount to demonstrate fungi
7. Germ tube technique to identify Candida albicans
8. Antibacterial sensitivity test – Kirby – Bauer method
9. Minimal Inhibition Concentration (MIC)

References:

1. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.NewDelhi.

2. Cappuccino J.G. and N. Sherman 2002, Microbiology: A Laboratory Manual, Addison-Wesley.

3. Holt J.G, N.R.Krieg, 2000, Bergey's Manual of Determinative Bacteriology. Ninth edition, Lippincott Williams &Wilkin Publishers.

4. Kannan N, 2002, Laboratory Manual in General Microbiology, Panima Publishers.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Demonstrate the blood parasites	K1
CO2	Interpret the isolation of bacteria	K2
CO3	Identify the gram positive and gram negative bacteria	K3
CO4	Experiment with Germ tube techniques	K3
CO5	Determine Minimum Inhibitory Concentration	K5

Title of the Course: Major Practical - IV						**Course Code:** U4R2MBCC8P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
									Mean Overall Score		**3.0**
									Result		**High**

BIOINFORMATICS

Course Code: U4R2MBAC5	**Credit:** 3
Category: Allied Course	**Hrs/Week:** 04, **Total Inst.Hrs:** 48
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To develop skills of the students in the area of probability and statistics
- To know about the various reliability methods
- To learn the basics of computers
- To provide basic idea of bioinformatics databases and application for the students
- To know the basic knowledge of sequence alignment

Unit I: Basic computer **10hrs**

Introduction to Computers – History of Computers – its developing technology and generation of Computers – Operating Systems – Windows, Unix – Hardware, Software, disc operating systems.

Unit II: Internet **10hrs**

Working of Internet – Local area and wide area network – Types of files – HTML, TXT, PDF –Search engines and its types and applications.

Unit III: Bioinformatics **9 hrs**

Introduction to bioinformatics – its history and its development - Applications of Bioinformatics. Biological databases – NCBI, EMBL, DDBJ, PDB, Swiss Prot. Data retrieval- Entrez and SRS.

Unit IV: Sequence alignment **9 hrs**

Introduction to Sequence alignment. Sequence analysis – pairwise sequence comparison. Database search for similar sequences using FASTA and BLAST Programs. Multiple sequence alignments.

Unit V: Evolutionary analysis **10hrs**

Evolutionary analysis: distances, Cladistic and Phenetic Method. Clustering Methods. Rooted and Unrooted tree representation. Bootstrapping strategies, Uses of Clustal W and PHYLIP, MEGA.

Text Books:

1. Alexis Leon & Mathews Leon. Fundamentals of Information Technology.VikasPublication.Chenai. (Unit I & II)
2. S.C. Rastogi, NamitaMendiratta, ParagRastogi. Bioinformatics – Concepts, Skills, Applications". (Unit III & IV)
3. DubeyR.C (2007) Text Book of Biotechnology. S.Chand& Company Ltd.(Unit –V)
4. Shanmughavel, P. 2005. Principles of Bioinformatics, Pointer Publishers, Jaipur, India.

5. Teresa. K. Atwood and David J. Parry-Smith Introduction to Bioinformatics.

Reference Books:

6. Cynthia Gibas& Per Jambeck (2001). Developing Bioinformatics Computer Skills:Shroff Publishers & Distributors Pvt. Ltd (O'Reilly), Mumbai.
7. HH Rashidi& LK Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London
8. Des Higgins & Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press
9. Baxevanis AD & Ouellette BEF (2001) Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley Interscience – New York
10. Teresa. K. Atwood and David J. Parry-Smith Introduction to Bioinformatics.10BIIA13C.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Gain knowledge on Operating systems	K1
CO2	Infer the concepts of Sequence analysis and the prediction of structure.	K2
CO3	Experiment with the software and its application in research field.	K3
CO4	compare the evolutionary distance between organisms or species.	K4
CO5	Test the FASTA and BLAST programs	K6

Title of the Course: Bioinformatics						**Course Code:** U4R2MBAC5					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2	2	2	3	3	3	2	3	2	2.5
CO2	3	2	2	2	3	3	3	2	3	2	2.5
CO3	3	2	2	2	3	3	3	2	3	2	2.5
CO4	3	2	2	2	3	3	3	2	3	2	2.5
CO5	3	2	2	2	3	3	3	2	3	2	2.5
	Mean Overall Score										**2.5**
	Result										**High**

ALLIED PRACTICAL – BIOSTATISTICS & BIOINFORMATICS
Code: U4R2MBA6P

Course Objectives:

- To provide concepts used in routines in SPSS on the following problems
- Understand how to start SPSS
- Enter, modify and analyze data
- Define a variety of statistical variables
- Work with multiple data sources

Biostatistics

1. Mean, Standard deviation, Variance.
2. Bar diagram, Line diagram, Pie chart and Histogram.
3. Co efficient of correlation.
4. Regression equation of X on Y.
5. Regression equation of Y on X.
6. Application of t-test for one sample problem.
7. Application of t-test for two sample problems.
8. Application of t-test for testing the significance of Correlation Coefficient.
9. One-tailed and Two-tailed tests.
10. Application of analysis of variance.

Bioinformatics

1. BLAST
2. Data Retrieval from NCBI
3. Construction of Phylogenetic Tree

Text Books:

1. **SPSS for You**, A. Rajathi& P. Chandran, MJP Publications, Edition – 2010.

Reference Books:

1. SPSS 17.0 for Researches, Gupta & Hitesh Gupta, International Book Home, Pvt., Ltd., 2014.

e- Resources:

https://youtu.be/cjTgyRUaD1s
https://www.lib.sfu.ca/find/research-tools/spss-resources
https://libguides.marquette.edu/spss#s-lg-box-687220

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Analyze statistical data using measures of central tendency, dispersion and location.	K4
CO2	Calculate and interpret the correlation between two variables	K5
CO3	Interpret results of analysis of variance tests	K2
CO4	Compare the sequence using BLAST	K5
CO5	Construct Phylogenetic tree	K5

Title of the Course: Biostatistics &Bioinformatics						**Course Code:** U4R2MBAC6P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	2	2	3	2	3	3	2	3	3	2.6
CO3	3	2	1	3	2	3	3	2	3	2	2.5
CO4	3	1	3	3	3	2	3	3	3	1	2.5
CO5	3	3	3	3	3	3	3	3	3	1	2.8
	Mean Overall Score										**2.6**
	Result										**High**

MOLECULAR BIOLOGY

Course Code: U5R2MBCC9	**Credit:** 4
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To familiarize with the basic knowledge in genetics
- To understand the replication process
- To know the gene transcription mechanism
- To get knowledge in Translation process
- To study the gene expression

Unit I – Nucleic Acids **15hrs**

Definition and Functions of DNA and RNA - Structure of double helix DNA, different forms of DNA - A DNA, B DNA, Z DNA – Types of RNA – mRNA , rRNA , tRNA- Difference between DNA and RNA.

Unit II – Replication **14 hrs**

DNA replication – Semiconservative - Meselson and Stahl's experiment - enzymology of DNA replication. Bidirectional and unidirectional replication, Various models of DNA Replication– rolling circle model – theta model, D-loop. Replication of RNA – reverse transcriptase.

Unit III – Transcription **15hrs**

Prokaryotic transcription - RNA polymerase - structure and function. Initiation of transcription- promoters - elongation, termination - Rho-dependent and Rho independent process.. Eukayotic Transcription Process. Post transcriptional modifications in Prokaryotes and Eukaryotes.

Unit-IV Genetic code & Translation **14 hrs**

Features of genetic code –translations in prokaryotes-structure of ribosomes - aminoacid activation, charging of t-RNA – initiation of protein synthesis, elongation and termination – Translation in Eukaryotes - post translational modifications in Prokaryotes and Eukaryotes.

Unit V – Gene expression **14 hrs**

Operon concept - lac operon: positive and negative control of gene expression, trp operon-tryptophan's role in negative control, Attenuator control.

Text Books:

1. David Frifelder. (1990). Moleclar Biology, Narosa publishing house, New Delhi.
2. Lansing M. Prescott., John P. Harley and Donald A.Klein. (2003). Microbiology (5^{th} edition) McGraw Hill, New York.

3. MalorSr, Cronan Jr. JE. Freifelds D (1994). Microbial Genetics. Jones and Bartlett Publishers.
4. Daniel L. Hartl and Elizabeth W. Jones. (2001). Genetics-Analysis of Genes and Genomes, Jones and Bartlett publishers, UK.
5. Lewin B. (2000). Genes VII. Oxford University press

Reference Books:

6. Gardner E.J., Simmons M.J., Snustad D.P. (1991). Principles of Genetics. John Wiley & sons.
7. Jeremy M. Dale. (1998). Molecular Genetics of Bacteria (3rd edition).John Wiley and sons,NewYork.
8. Larry Synder and Wendy Champness. (2003). Molecular Genetics of Bacteria (2nd edition).American Society for Microbiology, Washington.
9. Lodish, H., Baltimore, D. Berk, A. Zipsury, S.L., Matsudaira, P. Darnell, J. (1995). Molecular Cell Biology. Scientific American Books.

Course Outcomes:
After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Define about nucleic acids	K1
CO2	Explain replication of DNA and RNA	K2
CO3	Illustrate the transcription in Prokaryotes and Eukaryotes	K2
CO4	Determine the translation process	K5
CO5	Defend the Operon concepts	K5

Title of the Course: Molecular Biology						**Course Code:** U5R2MBCC9					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2	2	3	3	3	3	3	3	3	2.8
CO2	3	2	2	3	3	3	3	3	3	3	2.8
CO3	3	2	2	3	3	3	3	3	3	3	2.8
CO4	3	2	2	3	3	3	3	3	3	3	2.8
CO5	3	2	2	3	3	3	3	3	3	3	2.8
										Mean Overall Score	**2.8**
										Result	**High**

MICROBIAL GENETICS

Course Code: U5R2MBCC10	**Credit:** 4
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To familiarize with the basic knowledge in genetics
- To understand the mutation process
- To know the gene transfer mechanisms
- To get knowledge in Operon concepts
- To apply the gene mechanisms for research and industrial purposes

Unit I – Introduction and History **14 hrs**

Fundamentals of Genetics – Mendelian Laws, Alleles, Crossing over and Linkage. Overview of Prokaryotic and Eukaryotic cells – Cell Division: Mitosis and Meiosis. Genetic Nomenclature

Unit II - Genetic Material **15 hrs**

Organization and functioning of genetic material – Bacterial and Viral. Details of *E.coli* chromosome. DNA as the genetic material: Hershey - Chase Experiment, Griffith's experiment - RNA as the genetic material. Extra chromosomal inheritance: Plasmids - types of plasmids.

Unit III – Gene mutation and repair **14 hrs**

Mutation & types of mutations - physical & chemical mutagenesis - Ames test - Toxicity testing. DNA damage and repair: Excision repair, Photo reactivation, Recombinational repair and SOS repair.

Unit IV - Gene Transfer Mechanism **15 hrs**

Transformation - competence, DNA uptake and mechanism of transformation. Transduction: Generalized and Specialized transduction. Conjugation- F+, Hfr, F' transfer. Transposons - Simple and composite transposon - transposition process.

Unit V – Viral Genetics **14 hrs**

Viral genome structure and their functions. Types of Viral genome. Classifications of Viral genome and its replication. Life cycle of T4 Bacteriophage and Lambda Phage.

Text books:

1. Freifelder, David (1993). Microbial Genetics. Narosa Publishing Ltd.
2. Gardner, Eldon John (2001). Principles of Genetics. Wiley Eastern Publisher.

Reference Books:

3. MalorSr, Cronan Jr. JE. Freifelds D (1994). Microbial Genetics. Jones and Bartlett Publishers.
4. Daniel L. Hartl and Elizabeth W. Jones. (2001). Genetics-Analysis of Genes and Genomes, Jones and Bartlett publishers, UK.
5. Lewin B. (2000). Genes VII. Oxford University press

Course Outcomes:
After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Recall the history of Generics	K1
CO2	Summarize DNA as the Genetic Material	K2
CO3	Determine the Gene mutation	K5
CO4	Explain the Gene transfer mechanism	K5
CO5	Discuss about the viral genome	K6

Title of the Course: Molecular Biology						**Course Code:** U5R2MBCC9					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2	1	2	3	3	3	3	3	3	2.6
CO2	3	2	1	2	3	3	3	3	3	3	2.6
CO3	3	2	1	2	3	3	3	3	3	3	2.6
CO4	3	2	1	2	3	3	3	3	3	3	2.6
CO5	3	2	1	2	3	3	3	3	3	3	2.6
	Mean Overall Score										**2.6**
	Result										**High**

GENETIC ENGINEERING

Course Code: U5R2MBCC11	**Credit:** 4
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs: 72**
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To be aware of the basics about nucleic acid
- To understand the different vectors
- To know the enzymes used in molecular biology
- To familiarize with the gene manipulation
- To understand how these tools are used in research and industries

Unit I: Enzymes **15hrs**

Cutting DNA molecules: Nucleases, Restriction endonucleases. Joining DNA molecules: Ligases – Methylation. DNA Polymerases. Linkers, adaptors, homopolymer tailing.

Unit II: Vectors **14hrs**

Cloning vectors – plasmid: pBR322, pSC101, pUC, Ti-plasmid, phage vector, phagemids and cosmids, Shuttle vectors and expression vectors – Yeast Artificial Chromosome (YAC), Bacterial Artificial Chromosome (BAC), Baculo viral vector.

Unit III: Gene manipulation **15 hrs**

Methods of Gene transfer – Electroporation, Microinjection, Particle Bombardment, Liposome Mediated Gene Transfer. Construction of Genomic Libraries and c-DNA Libraries.

Unit IV: Hybridization techniques **14hrs**

Nucleic acid and protein hybridization technique – Southern, Northern and Western blotting techniques. DNA amplification using polymerase chain reaction (PCR): types and applications of PCR, DNA fingerprinting and its applications.

Unit V: Separation and Sequencing **14hrs**

Separation of Nucleic acids and Proteins: Agarose Gel Electrophoresis, SDS – PAGE. DNA Sequencing – Sanger's method, Maxam and Gilbert's method. DNA Microarrays.

Text Books:

1. DubeyR.C (2017) Text Book of Biotechnology. S.Chand & Company Ltd.
2. Freifelder D. (2008). Molecular Biology. 4th Edition. Narosa Publishing Home.
3. Brown, T.A., (2006), Gene Cloning, Garland science Publications
4. Joghand, S.N., (2016). Gene Biotechnology (4th Edition).Himalaya Publishing company, India.
5. Richard M. Twyman. (2003). Advanced Molecular Biology (1st edition).Viva Books private Ltd, New Delhi.
6. Veer BalaRastogi (2008).Fundmentals of Molecular Biology. Anne Books, India.

Reference Books:

7. James D. Watson. Michael Gilman. Jan Witkowski and MarkZoller. (2001). Recombinant DNA. Scientific American Books, New York.
8. Lewin, B. (2000). Genes VII. Oxford University press.
9. Lodish, H, Baltimore D, Berk A, Zipursky SL, Matsudaira P, Darnell J. (1995). Molecular Cell Biology. Scientific American Books.
10. Michael Blackburn and Michael J. Gait. (1996). Nucleic acids in chemistry and Biology.(2nd edition).Oxford University press.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Define the functions of enzymes	K1
CO2	Explain the vectors and its types	K2
CO3	Analyze the gene transfer techniques	K4
CO4	Determine the blotting techniques	K5
CO5	Discuss about gene sequencing methods	K6

Title of the Course: Genetic Engineering						**Course Code:**U5R2MBCC10					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2	2	3	3	3	3	3	3	3	2.8
CO2	3	2	2	3	3	3	3	3	3	3	2.8
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
	Mean Overall Score										**2.92**
	Result										**High**

MAJOR PRACTICAL- V MOLECULAR BIOLOGY, MICROBIAL GENETICS AND GENETIC ENGINEERING

Code: U5R2MBCC12P

Course Objectives:

- To get knowledge on isolation of auxotrophic mutants
- To become familiar with the isolation of DNA
- To estimate DNA and RNA
- To demonstrate electrophoresis techniques
- To know the assessment of air quality

1. Isolation of Auxotrophic mutants
2. Isolation of Chromosomal DNA from bacteria
3. Isolation of Plasmid DNA from bacteria
4. Isolation of Antibiotic resistance mutants by replica plating
5. Estimation of DNA – Diphenyl method
6. Estimation of RNA – Orcinol method
7. Demonstration of Agarose gel electrophoresis (To study DNA/RNA)
8. Demonstration of SDS – PAGE
9. Demonstration of Transformation, Conjugation and Transduction

References:

1. David M. Sylvia, Jeffry J. Fuhrmann, Peter Hastell, David A. Zuberer, 1st Ed. Prentice Hall.

2. James G. Cappuccino and Natalie Sherman. (1996). Microbiology-A Laboratory Manual (4th edition).The Benjamin publishing company, New York.

3. Russell F. Bey. (2001). Microbiology Laboratory Manual, BROOKS/COLE, Australia.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Recall the isolation of auxotrophic mutants	K1
CO2	Explain the isolation of DNA	K2
CO3	Estimate DNA and RNA	K5
CO4	Apply the electrophoresis techniques	K3
CO5	Demonstrate gene transfer mechanisms	K5

Title of the Course: Major Practical- V						**Course Code:** U5R2MBCC12P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
	Mean Overall Score										**3.0**
	Result										**High**

SOIL AND AGRICULTURAL MICROBIOLOGY

Course Code: U6R2MBCC13	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To know the physico chemical characteristics of soil and role of microbes in improving soil fertility.
- To study about the Positive and Negative interactions among various group of organisms.
- To make students aware of the agricultural importance of microorganisms
- To understand the microbes involved in the mass production of Bacteria, viral and fungal insecticide
- To know the solid and liquid waste management

Unit I: Introduction to Soil Microbiology 12hrs

Introduction – Soil as an environment for microorganisms. Classification of soil, physical and chemical properties of soil, soil stratifications.

Unit II: Population dynamics of various soil microorganisms 12 hrs

Bacteria, Algae, Fungi, Actinomycetes, Protozoans in soil: Distribution and abundance-Environmental influences-function and activity, significance in soil transformations. Autochthonous, Allochthonus and zymogenous microflora.

Unit III: Biogeochemical cycles 12 hrs

Beneficial association of microorganisms in decomposition of organic matter. Mineral transformations and ecological interrelationships of microbes in mediating biogeochemical cycles: Carbon cycle-Phosphorous cycle-Sulphur cycle and Nitrogen cycle.

Unit IV: Biofertilizer 12 hrs

Biofertilizers-definition, importance- types and their application methods-Steps in mass production of bacterial biofertilizers-quality guidelines for biofertilizers. Mass production of blue green algae, Azolla and mycorrhiza. Plant response to biofertilizers application.

Unit V: Microbial Insecticide 12 hrs

Bacterial insecticides: Various bacteria used as insecticides. Various Protozoans and nematodes used as insecticides. Bacterial, fungal, viral biopesticides and their mass production- Advantages and disadvantages of Microbial insectides- Symbiotic association between microbes and insects.

Text Books:

1. Atlas Ronald, M., Bartha, and Richard (2009). Microbial Ecology (4nd Edition). Benjamin/Cummings Publishing Company, California
2. Subba Rao N .S (1995) Soil microorganisms and plant growth, Oxford and IBH publishing co. Pvt. Ltd. New Delhi
3. Ronald M Atlas, Richard Bartha (2007). Microbial Ecology: Fundamentals and applications, 4th Edition, Benjamin Cummings Publication.

Reference Books:

4. Martin Alexander (1997). Introduction to Soil Microbiology. 2nd edition, John Wiley & Sons.
5. SadasivamKannaiyan(2002). Biotechnology of Biofertilizers.Narosa publishing house.

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Describe the soil its associated microbes	K2
CO2	Explain population dynamics of various soil microorganisms	K2
CO3	Interpret the biogeochemical cycles	K2
CO4	Define mass production of biofertilizers	K3
CO5	Manipulate the bioinsecticides mechanisms	K5

Title of the Course: Soil and Agricultural Microbiology						**Course Code:** U6R2MBCC13					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	2	3	2.8
CO2	3	3	3	3	3	3	3	3	2	3	2.8
CO3	3	3	3	3	3	3	3	3	2	3	2.8
CO4	3	3	3	3	3	3	3	3	2	3	2.8
CO5	3	3	3	3	3	3	3	3	2	3	2.8
	Mean Overall Score										**2.8**
	Result										**High**

INDUSTRIAL MICROBIOLOGY

Course Code: U6R2MBCC14	**Credit:** 5
Category: Core Course	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Objectives: The Course aims

- To be aware of the historical background of industrial microbiology and strain improvement methods
- To study the design of the Fomenters and their important products
- To know the Upstream process
- To develop skill in downstream process
- To focus on opportunitiest of ind jobs in such fermentation industries

Unit I: Introduction to Industrial Microbiology **12 Hrs**

History and Scope of Industrial Microbiology. Isolation and production strains – Screening Techniques – Primary and Secondary. Strain Development – Mutation, Protoplast fusion and Recombinant DNA Techniques. Preservation techniques – Preparation of inoculum Development.

Unit II: Production media **12 Hrs**

Introduction – Characteristics of an ideal production medium – Raw Materials. Industrial Sterilization – Principles of Sterilization – Sterilization of equipment – Sterilization of Production Media - Sterilization of Air.

Unit III: Fermenter Design **12 hrs**

Design of fermenters: Aseptic operation and containment – Aeration and Agitation – Types of fermenters: Batch fermenter, Continuous Stirred Tank fermenter, Tower fermenter, Airlift fermenter, Fluidized Bed fermenter.

Unit IV: Down Stream Processing **12 Hrs**

Introduction - Filtration, Centrifugation, Cell Disruption, Liquid – Liquid extraction, Chromatography, precipitation, Drying, Crystallization, Solvent Recovery.

Unit V: Microbial Assay **12 Hrs**

Introduction – Microbiological Assay; Antibiotics (Penicillin, Streptomycin), Vitamins (B2, B12), Enzymes (Amylase, Protease), Solvent (Ethyl Alcohol), Organic acids (Vinegar, Lactic Acid and Citric Acid), Amino acids (L-Glutamic acid, L-Lysine).

Text Books

Stanbury. P.F. Whitaker. A, Hall. S.J. (1995).Principles of Fermentation Technology, 2nd Edition.PergamonPress.(UnitIV,V).

1. PatelA.H.(2016). IndustrialMicrobiology,2nd Edition.RajivBeriforMacMillan IndiaLtd.,NewDelhi.(UnitI,II,III)
2.

asida,J.R(2012).IndustrialMicrobiology.Newageinternational(P)Limited.

3. alaichelvan, P T. & Arul Pandi (2007) Bioprocess Technology. MJP PublishersChennai.

Reference Books:

4. ateeshM.K,(2008).BioethicsandBio-safety.I.K. International publishinghousePvt.Ltd.
5. lick,B.R.Pasternak,J.J.(1994)MolecularBiotechnology–ASMPress.
6. emainA.L.Solomon N.A.(1986) ManualofIndustrialMicrobiologyandBiotechnology ASMPress.
7. rave,P.Faust,V.Sitting,W.,Sukatsch.D.A.(1987)FundamentalsofBiotechnologyAS M Press.
8. eed.G.(1982)PrescottandDunn'sIndustrialMicrobiology.MacmillanPublishers.
9. ikyta.B. (1983)Methodsin IndustrialMicrobiology.EllisHorwoodlimited.

Course Outcomes:

After completion of this course, students would be able to

Sl.No	Course Outcomes	Knowledge Level
CO1	Describe on historical background of industrial microbiology	K1
CO2	Explain media formulation strategies	K3
CO3	Operate the different Fermenters	K3
CO4	Develop expertise on downstream process	K6
CO5	Manipulate the industrial products and their environments	K3

Title of the Course: Industrial Microbiology						**Course Code:** U6R2MBCC14					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2	2	2	2	3	2	3	2	2	2.3
CO2	3	3	2	3	3	3	3	3	2	3	2.8
CO3	3	3	2	3	3	3	3	3	2	3	2.8
CO4	3	3	2	3	3	3	3	3	2	3	2.8
CO5	3	3	2	3	3	3	3	3	2	3	2.8
									Mean Overall Score		**2.7**
									Result		**High**

MAJOR PRACTICAL - VI (COVERING - CC - IV) SOIL AND AGRICULTURAL MICROBIOLOGY, INDUSTRIAL MICROBIOLOGY AND FOOD MICROBIOLOGY

Code: U4R2MBCC8P

Course Objectives:

- To analyze the availability of soil nutrients
- To observe the VAM from plant roots
- To assess the quality of milk
- To produce citric acid
- To estimate the alcohol

1. Soil Analysis – pH, chlorides, nitrate, calcium, magnesium and total phosphorus.
2. Isolation of cyanobacteria from water.
3. Isolation of Azospirillum, Azotobacter from soil.
4. Isolation of Rhizobium form legume nodule.
5. Observation of VAM from plant roots.
6. Isolation and enumeration of soil microorganism.
7. Assessment of milk quality by methylene blue reduction test
8. Performance of Phosphatase test for pasteurized milk
9. Isolation of bacteria from food by standard plate count
10. Wet mount preparation of spoiled bread, tomato, grapes, potato.
11. Immobilization of yeast cell using Sodium Alginate.
12. Production of Citric acid using *Aspergillus niger.*
13. Alcohol fermentation by *Saccharomyces cerevisae*
14. Estimation of Alcohol using Potassium Di-chromate method
15. Starch (Amylase), Casein (Protease) and Lipid (Lipase) Hydrolyses test

References:

1. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.New Delhi.

2. R.C.Dubey (2002). Microbiology practical manual. S.Chand and Company LTD.

3. Kannan.N (2002) Lab manual in General Microbiology. Panima Publishing Corporation.

Course Outcomes:

After completion of this course, students would be able to

Sl.No	Course Outcomes	Knowledge Level
CO1	Analyze the availability of soil nutrients	K4
CO2	Identify the VAM from plant roots	K2
CO3	Assess the quality of milk	K5
CO4	Determine the production of citric acid	K5
CO5	Estimate the amount of alcohol	K5

Title of the Course: Major Practical - VI						**Course Code:** U4R2MBCC8P					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
	Mean Overall Score										**3.0**
	Result										**High**

MICROBIAL BIOTECHNOLOGY

Course Code: U5R2MBDSE1:1	**Credit:** 4
Category: Discipline Specific Elective	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Objectives

- To be aware of the history and scope of biotechnology
- To familiarize with the enzyme technology
- To know the recombinant DNA technology
- To get knowledge about the nanotechnology
- To understand the importance of patents in research

Unit I: History and scope **12 hrs**

Biotechnology - Definition – concepts - history, scope and importance, emergence of modern biotechnology - global impact and current excitement of biotechnology (Health care, agriculture, Human Genome Project, Genomics and Proteomics), Biotechnology in India and development.

Unit II: Enzyme technology **12 hrs**

Enzyme production technology through microbes, problems and applications. Enzyme immobilization - definition, advantages of using immobilized enzymes, various methods of immobilization: adsorption, entrapment, ionic bonding, cross linking and encapsulation.

Unit III: r-DNA technology **12 hrs**

Principles and application of recombinant DNA technology, production of recombinant vaccine, Insulin, interferon, hormones. Production of Monoclonal antibodies and its applications,Gene therapy – types (somatic cell gene therapy, germ line gene therapy, enhancement and eugenic genetic engineering).

Unit IV: Nanotechnology **12 hrs**

History and development of nanotechnology, introduction, definitions of nanoparticles, nanotubes, nanowires, microbial production of nanoparticles and its applications.Characterization of nanoparticles using UV-Vis, FTIR spectroscopy, electron microscopy – HRTEM, SEM, AFM, EDS and XRD.

Unit V: Intellectual property rights **12 hrs**

IPR-Tools of IPR (copy rights, patenting, trade mark & trade secret), patenting of biological materials, GATT, WTO, WIPO. Biosafety and Bio ethics – Definitions, principles, Bio safety guide lines for Microbiology Laboratory.

Text Books:

1. Text book of Biotechnology. R.C.Dubey (2017).Chand and company (P) Ltd.

2. Glick. B, R and Pasternak J. J (2001) Molecular biotechnology. ASM press,Washington.

3. Kumaresan .V (2009) Biotechnology. Saras Publication.

4. Singh B. D (2006).Biotechnology.KalyaniPublication.

Reference Books:

5. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5th edition).McGraw-Hill company, New York.

6. Helen Kreuzerand Massey (1996).Recombinant DNA and Biotechnology, American society for Microbiology, Washington

7. Trevan,M,D, Boffey,S.CouldingK.HandStanburry.p.(1990)Biotechnology the basic principles-Tata McGraw Hill edition.

8. Nanotechnology Fundamentals and applications I.K.International Publishing House Pvt.Ltd,Neu Delhi.

9. Sathyanarayana, U (2008).Biotechnology.Books and allied (P) Ltd.

Course Outcomes:
After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Describe History and scope of Biotechnology	K2
CO2	Classify various methods of enzyme immobilization.	K2
CO3	Develop expertise on r-DNA techniques	K3
CO4	Interpret the application of Nanotechnology	K2
CO5	Explain Intellectual property rights	K3

Title of the Course: Microbial Biotechnology						**Course Code:** U5R2MBDSE1:1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2	2	2	2	3	2	3	2	2	2.4
CO2	3	2	2	3	3	3	3	3	2	3	2.6
CO3	3	3	2	3	3	3	3	3	2	3	2.8
CO4	3	3	2	3	3	3	3	3	2	3	2.8
CO5	3	3	2	3	3	3	3	3	2	3	2.8
	Mean Overall Score										**2.68**
	Result										**High**

MICROBIAL ECOLOGY

Course Code: U5R2MBCC11	**Credit:** 4
Category: Core Course	**Hrs/Week:** 06, **Total Inst.Hrs:** 72
Nature of the Course: Skill Development	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To study the function and diversity of microbes present in natural environments.
- To be familiarized with the various types of microbial interactions.
- To know the methods of waste water treatment and waste management.
- To understand the biodegradation of dyes and pesticides, solid waste disposal, bioleaching, bioremediation of heavy metals etc.
- To Characterize and explore the key bacterial habitats such as the Rhizosphere, Spermosphere and phyllosphere, soil and groundwater ecosystems and open oceans.

Unit I: Historical Development and Diversity **14 Hrs**

The scope of Microbial Ecology; Historical overview-Beginings of Microbiology, Pure Culture Period, Microbial Ecology in the 20th Century. Microbial Biodiversity-Bacterial, Archaeal and Eucaryal.

Unit II: Microbial Interactions among Microbes **14 Hrs**

Interaction between diverse microbial populations: Neutralism-Commensalism-Synergism-Mutualism-Competition-Ammensalism-Parasitism and Predation.

Unit III: Microbial Interactions with Plants and Animals **15 Hrs**

Interactions with plant roots-The Rhizosphere, Mycorrhizae. Nitrogen fixation in nodules. Interaction with animals: Predation on microorganisms by animals. Fungal predation on animals.

Unit IV: Microbial Adaptations **15 Hrs**

Microbes in extreme environments: Temperature – Radiation – Pressure – Salinity - water activity – Movement - Hydrogen Ion Concentration - Redox Potential - Magnetic force - Organic Compounds – Inorganic Compounds.

Unit V: Biotechnological aspects of Microbial Ecology **14 Hrs**

Biodeterioration, Treatment of Solid waste – Landfills, Composting; Treatment of Liquid waste – Primary, Secondary and Tertiary. Bioleaching, Bioremediation.

Text Books

1. Ronald M Atlas, Richard Bartha (2009). Microbial Ecology: Fundamentals and applications. 4th Edition, Benjamin Cummings Publication.
2. Campbell R. (1983). Microbial Ecology. 2nd edition, Blackwell Scientific Publications, London.
3. Martin Alexander (1997). Introduction to Soil Microbiology. 2nd edition, John Wiley & Sons.
4. Vijaya Ramesh K (2004). Environmental Microbiology. 1st edition, MJP Publishers.

Reference Books:

5. Joseph C Daniel (1999). Environment aspects of Microbiology. 1st edition, Bright sun Publications.
6. InduShekhar Thakur (2006). Industrial Biotechnology Problems and Remedies. IK International Pvt. Ltd.
7. Mehrotra, R.S. and Ashok Aggarwal (2003). Plant Pathology. 2nd edition, Tata McGraw Hill Publishing Company Limited.
8. Ian L Pepper, Charles P Gerba, Terry J Gentry (2015). Environmental Microbiology. 3rd edition, Academic Press.

Course Outcomes:

On completion of the course, students should be able to do

S.No.	Course Outcomes	Knowledge Level
CO1	Predict the functions and diversity of microbes in natural environments	K2
CO2	Observe the various Microbial interactions and the effect of microbial infections on plant physiology	K1
CO3	Develop a keen knowledge on the Biodegradation of dyes and pesticides, waste water treatment, solid waste disposal, bioleaching, bioremediation of heavy metals.	K6
CO4	Explain microbial interactions with plants and animals	K5
CO5	Determine the microbial adaptations	K5

Title of the Course: Microbial Ecology						**Course Code:** U5R2MBCC11					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	2	3	2.8
CO2	3	3	3	3	3	3	3	3	2	3	2.8
CO3	3	3	3	3	3	3	3	3	2	3	2.8
CO4	3	3	3	3	3	3	3	3	2	3	2.8
CO5	3	3	3	3	3	3	3	3	2	3	2.8
	Mean Overall Score										**2.8**
	Result										**High**

PHARMACEUTICAL MICROBIOLOGY

Course Code: U6R2MBDSE2:1	**Credit:** 4
Category: Discipline Specific Elective	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To gain knowledge on Chemotherapeutic agents
- To learn the antibiotic resistance
- To understand the microbial spoilage
- To familiarize with the Preservation of Pharma products
- To know the drug discovery

Unit I: Introduction to chemotherapeutic agents 12 hrs

History and development of chemotherapeutic agent, Properties of antimicrobial agents, Types of chemotherapeutic agents – Synthetic, Semisynthetic, Natural. Antibiotics: Types of antibiotics with their mode of action; antibacterial, antifungal, antiviral, antiprotozoal

Unit II: Antibiotic resistance and development of new therapeutics 12 hrs

Development of antibiotic resistance, Mechanism of antibiotic resistance, Antimicrobial Peptides: History, properties, sources, mode of action, application. Phage therapy: introduction to phages, lytic cycle, types of phages involved in phage therapy Plant based therapeutic agents.

Unit III: Sterilization and Microbial spoilage of pharma products 12 hrs

Microbial contamination spoilage and hazard: Sources of contamination, factors affecting survival and growth, breakdown of active ingredient and general formulations. Principles of sterilizations with respect to pharmaceutical industries. Methods of sterilizations: Steam, dry heat, Radiation, Gaseous and Filtration.

Unit IV: Preservation of Pharma Products: Principles of preservation 12 hrs

Objectives of preservation, the ideal preservative, rational development of a product preservative system etc. Antimicrobial preservatives and their properties: antimicrobial activity, factors affecting antimicrobial activity, preservative monographs. Preservative stability and efficacy. methods of Preservative evaluation and testing.

Unit V: Drug Discovery and Development 12 hrs

Microbial, Recombinant, Biochemical and Molecular level screening systems and their construction/ design strategies. Conventional Process; Bio-prospecting. Search of database/data mining for Drug designing; Preclinical and Clinical trials; Estimation of toxicity: LD50 and ED50; Rational Drug Design – Principle (Structure activity relationship

-SAR) and Tools (applications of High through Put Screening, Combinatorial synthesis, Pharmaco-genomics).

References:

1. Pharmaceutical Microbiology – Edt. byW.B.Hugo & A.D.Russell Sixth edition. Blackwell scientific Publications
2. Prescott's Microbiology 8th Edition by Willey, Joanne, Sherwood, Linda, Woolverton, Chris
3. Pharmaceutical Microbiology by Ashutosh Ka
4. Hugo, WB and Russell, AD. Pharmaceutical Microbiology, (2003). Blackwell Science, Oxford, UK.
5. Krogsgaard L, Lilijefors T. and Madsen, U. Textbook of Drug Design and Discovery, (2004). Taylor and Francis, London.
6. Geoffrey Hanlon and Norman Hodges. Essential Microbiology for pharmacy and pharmaceutical science. (2013).Wiley Blackwell.
7. S. P. Vyas & V. K. Dixit. Pharmaceutical Biotechnology. (2003) CBS Publishers & Distributors, New Delhi.
8. Bhatia R and Ichhpujani RL. Quality Assurance in Microbiology. (1995). CBS Publishers, New Delhi. 9. Gregory Gregoriadis. Drug Carriers in biology & Medicine. (2001). Academic Press New York.
10. Davis, B. D., Dulbecco, R, Eisen, H. N., Ginsberg, R. S. Microbiology. (1990). Harper and Row Publishers, Singapore.

Course Outcomes:

After completion of this course, students would be able to

S.No	Course outcome	Knowledge level
CO1	Explain the chemotherapeutic agents	K2
CO2	Identify different antimicrobial agents and its mode of action.	K3
CO3	Summarize the microbial spoilage of pharma products	K3
CO4	Apply the regulatory guidelines in pharmaceuticals product.	K3
CO5	Determine the process involved in Drug discovery and development	K5

Title of the Course: Pharmaceutical Microbiology						**Course Code:** U6R2MBDSE2:1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	2	2	2.8
CO2	3	3	3	3	3	3	3	3	2	2	2.8
CO3	3	3	3	3	3	3	3	3	2	2	2.8
CO4	3	3	3	3	3	3	3	3	2	2	2.8

CO5	3	3	3	3	3	3	3	3	3	2	2.9
										Mean Overall Score	**2.82**
										Result	**High**

FOOD MICROBIOLOGY

Course Code: U6R2MBDSE2:2	**Credit:** 4
Category: Discipline Specific Elective	**Hrs/Week:** 05, **Total Inst.Hrs:** 60
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Objectives:

- To provide knowledge about microbes in food and food spoilage factors
- To learn about the microbial foods and fermentation.
- To study the food quality, safety and preservation methods.
- To make aware of food borne pathogens
- To learn about food product development.

Unit I: Importance of Food Microbiology **12 hrs**

Food as a substrate for microorganisms-important microorganisms in food (molds, bacteria, Yeast)-factors affecting the growth of microorganisms in food-intrinsic & extrinsic factors.

Unit II: Principles of Food Preservation **12 hrs**

Applications of food preservation, asepsis, use of temperature-low, high-pasteurization & canning, drying, natural and chemical preservatives.

Unit III: Fermented microbial foods **12 hrs**

Microbial activity in foods-fermented vegetable-Sauer Kraut-fermented dairy product-cheese. Oriental fermented foods. Basic concept of probiotics-characteristics and applications.

Unit IV: Food Borne Infections and Intoxications **12 hrs**

Food poisoning and food borne infection-bacterial infections-salmonellosis, bacterial intoxication-botulism, fungal mycotoxicosis and mycotoxins, investigation of food poisoning out breaks-food standards.

Unit V: Food Control and Sanitation **12 hrs**

Food control agencies and their regulations, hazard analysis and critical points (HACCP), Microbiology in Food sanitation.

Text Books:

1. Frazier and Westhoff, DC. (2014). Food Microbiology. 5th Edition, TATA McGraw Hill Publishing, Company LTD., New Delhi.
2. Adams, M.R and Moss, MO. (1995). Food Microbiology. The Royal Society of chemistry, Cambridge.
3. Banwart GJ. (2004). Basic food microbiology, 2nd Edition, Chapman & Hall, New York.
4. Sivasankar B. (2005). Food Processing and preservation, Prentice-Hall of India Pvt.Ltd.

Reference Books:

5. James M. Jay. (2003). Modern Food Microbiology, 4th edition, CBS Publishers and Distributers.
6. Ramanathan N. (2009). A Textbook of Food Microbiology, OM Sakthipathipagam
7. Vijaya Ramesh K. (2007). Food Microbiology. MJP Publishers

Course Outcomes:

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Examine the importance of Food associated microbes	K1
CO2	Assess the values of food preservation	K5
CO3	Analysis of microbial activity in foods.	K4
CO4	Find the Food borne pathogens and its impacts	K5
CO5	Describe the food safety methods	K2

Title of the Course: Food Microbiology						**Course Code:** U6R2MBDSE2:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	2	3	2.9
CO2	3	3	3	3	3	3	3	3	2	3	2.9
CO3	3	3	3	3	3	3	3	3	2	3	2.9
CO4	3	3	3	3	3	3	3	3	2	3	2.9
CO5	3	3	3	3	3	3	3	3	2	3	2.9
	Mean Overall Score										**2.9**
	Result										**High**

BIOINSTRUMENTATION

Course Code: U6R2MBDSE3:1	**Credit:** 4
Category: Discipline Specific Elective	**Hrs/Week:** 04, **Total Inst.Hrs: 48**
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives

- To acquire knowledge in Basic Chemistry
- To understand the basics of centrifugation and colorimeter
- To inculcate the spectroscopy and electrophoretic techniques
- To teach the chromatographic techniques
- To know the basics of Radio-isotopic techniques

Unit I: Basic chemistry **10hrs**

Acids, bases, buffers; measurements- units of weights and volume; Preparation of solutions; calculation of concentration and methods of expressing concentration of solutions- normality and molarity solutions. Basic instruments- balances, pH meter, Laminar air flow chamber.

Unit II: Centrifugation **10hrs**

Preparative and Analytical Centrifuges, Sedimentation analysis RCF, Density Gradient Centrifugation. Colorimetry – principle, Beer – Lambert's law – Applications.

Unit III: Spectroscopic Techniques **10hrs**

Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, MS, NMR, ESR, Atomic Absorption Spectroscopy, Electrophoretic Techniques: Theory and Application of PAGE, Agarose Gel Electrophoresis 2DE, Iso-electric Focusing,.

Unit IV: Chromatography Techniques **10hrs**

Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC, HPLC.

Unit V: Radio-isotopic Techniques **8hrs**

Introduction to Radioisotopes and their Biological Applications, Radioactive Decay. Types and Measurement, Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, Autoradiography, Radiation Dosimetry.

Text Books:

1. Veerakumari (2005). MJP Publishers.
2. Palaivelu.P(2002) Analytical Biochemistry, MKU University.
3. B.Sivakumar (2005). Bioseperations - Principles and Techniques.Prentice-Hall of India Pvt.ltd.
4. P.Asokan (2002). Analytical Biochemistry. Chinna Publications.
5. Dubey, R.C. (2006). Text book of Biotechnology. Chand and company (P)Ltd.

Reference Books:

6. UpadhayayNath, 2001.Biophysical chemistry.
7. P Sambrrok, J. and Ruseell, D.W. (2001) Molecular Cloning – A Laboratory Manual (3rd eidition, Vol. 1, 2, 3) Cold Spring Laboratory Press, New York. Ress
8. Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
9. John G. Webster. (2004). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
10. Wilson, K. and Walker.J (2005). Practical Biochemistry Principles and Techniques,6th edition, CambridgeUniversity/
11. Holme.J and Peck.H (1993). Analytical Biochemistry 2nd edition. Longman Scientific and Technical.
12. ChatwalAnand, 2003. Instrumental methods of chemical analysis

Outcome

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Describe the basic chemistry in preparation of solution imparted	K1
CO2	Express their proficiency in doing analytical techniques	K5
CO3	Analyze the samples using various instruments	K4
CO4	Take part in handling all instruments	K4
CO5	Conclude for Research and Development	K5

Title of the Course: Bioinstrumentation						**Course Code:** U6R2MBDSE3:1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	2	3	3	3	3	3	2	3	2.8
CO2	3	3	2	3	3	3	3	3	2	3	2.8
CO3	3	3	2	3	3	3	3	3	2	3	2.8

CO4	3	3	2	3	3	3	3	3	2	3	2.8
CO5	3	3	2	3	3	3	3	3	2	3	2.8
									Mean Overall Score		**2.8**
									Result		**High**

VETERINARY MICROBIOLOGY

Course Code: U6R2MBDSE3:2	**Credit:** 4
Category: Discipline Specific Elective	**Hrs/Week:** 04, **Total Inst.Hrs:** 48
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To learn about spore forming bacteria and some important aerobes and anaerobes.
- To learn general and pathogenic mycology.
- To study viral properties, epidemiology, pathogenesis
- To understand science and practice of vaccines
- To provide training in essential diagnostic techniques.

Unit I – Bacteriology **9 hrs**

Systematic study of following pathogenic bacteria: Gram positive cocci, family Micrococaceae, endospore forming Gram positive rods and cocci, family Bacillaceae genus Bacillus, Sporolactobacillus and Clostridium. Spirochetes. Family Spirochetaceae and other families like Spirillaceae, coryneform bacteria, Dermatophillaceae, Streptomycetaceae.

Unit II – Veterinary Mycology **10 hrs**

Systematic study of animal mycoses such as aspergillosis, candidiasis, cryptococcosis, epizootic lymphangitis, mycetomas, sporotrichosis, histoplasmosis, blastomycosis, coccidioidomycosis, haplomycosis, rhinosporidiosis, zygomycosis, mycotic abortion, mycotic mastitis, mycotic dermatitis, dermatophytoses, mycotoxicosis etc.

Unit III – Systemic Animal virology **9 hrs**

New castle disease virus, canine distemper virus, rinderpest virus, PPR virus; infectious bursal disease virus; rotavirus, blue tongue virus, African horse sickness virus; rabies virus, ephemeral fever virus, borna virus.

Unit IV– Vaccinology **10 hrs**

History of veterinary vaccinology. Vaccines: classification, comparison of major types. Components of various types of vaccines: immunogens, adjuvants, stabilizers, preservatives, vehicles. Vaccine qualities: definitions and methods of testing. Vaccine development: cost-effectiveness of preventive immunization programmes.

Unit V – Diagnostics of Infectious Diseases **10 hrs**

Diagnosis of infectious diseases: an overview. Principles of serodiagnostic: agglutination-reaction based tests, precipitation-reaction based tests, complement fixation test and enzyme immunoassays.

References:

Text Books:

1. Glen Sonder J & Karen W Post 2005. Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases. Cold Spring Harbor Lab. Press.
2. Prescot LM, Harley JP &Klen DA. 2005. Microbiology. Wm. C. Brown Publ.
3. Tortora GJ, Funke BR & Case CL. 2004. Microbiology: An Introduction. Benjamin/Cummins Publ.
4. Carter J & Saunders V. 2007. Virology: Principles and Applications. 1st Ed. Wiley.
5. Knipe DM, Howley PM, Griffin DE. 2006. Fields Virology. 5th Ed. Vols. I, II. Lippincott, Williams & Wilkins.

Reference Books:

6. Dodds WJ & Schulz R. (Eds). 1999. Veterinary Vaccines and Diagnostics. Vol. 41 (Advances in Veterinary Medicine) 1st Ed. Academic Press.
7. Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. New Generation Vaccines. 3rd Ed. Marcel-Dekker.
8. Pastoret PP, Blancou J, Vannier C &Verschueren C. 1997. Veterinary Vaccinology. Elsevier.
9. Detrick B & Hamilton RG. (Eds). 2006. Manual of Molecular and Clinical Laboratory Immunology. 7th Ed. American Society for Microbiology.
10. Rose NR, Friedman H & Fahey JL. (Eds). 1986. Manual of Clinical Laboratory Immunology. American Society for Microbiology.
11. Weir DM. 1986. Handbook of Experimental Immunology. Vol. IV. Blackwell.

Course Outcomes:
After completion of this course, students would be able to

S.No	Course Outcomes	Knowledge Level
CO1	Explain bacterial pathogenic microorganisms of veterinary significance	K2
CO2	Identify the zoonotic aspects of microbial pathogens	K3
CO3	Examine the viral diseases associated with animals	K4
CO4	Justify the clinical specimens of infectious diseases	K5
CO5	Elaborate the veterinary vaccines.	K6

Title of the Course: Veterinary Microbiology						**Course Code:** U6R2MBDSE3:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	2	3	3	3	3	3	2	3	2.8
CO2	3	3	2	3	3	3	3	3	2	3	2.8
CO3	3	3	2	3	3	3	3	3	2	3	2.8
CO4	3	3	2	3	3	3	3	3	2	3	2.8
CO5	3	3	2	3	3	3	3	3	2	3	2.8

	Mean Overall Score	**2.8**
	Result	**High**

MICROBIAL INOCULANTS

Course Code: U4R2MBSEC1:1	**Credit:** 2
Category: Skill Enhancement Course	**Hrs/Week:** 02, **Total Inst.Hrs:** 24
Nature of the Course: Employability	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To gain information on microbes used as biofertilizers
- To get acquire knowledge of Symbiotic nitrogen fixers
- To enable knowledge about non-symbiotic nitrogen fixers
- To know the Phosphate solubilizers
- To familiarize with the knowledge of mycorrhizae.

Unit I: Introduction **5 hrs**

General account of the microbes used as biofertilizers for crop plants and their advantages. Introduction – definition – advantages.Biocontrol agent – *Pseudomonas.*Green Manure – *Azolla.*

Unit II: Symbiotic N2 fixers **5 hrs**

Rhizobium - Cyanobacteria – Frankia – Isolation, identification, characterization, mass inoculum production and applications.

Unit III: Non - symbiotic N2 fixers **4 hrs**

Azospirillum- Free living – *Azotobacter*- isolation, characterization, massinoculumproduction and field application.

Unit IV: Phosphate solubilizers **5 hrs**

Phosphate solubilizing microbes – Isolation, characterization, mass inoculum production, field application – Phosphate solubilization mechanism.

Unit V: Mycorrhizae **5 hrs**

Mycorrhizae - classification - Taxonomy of mycorrhizae - Isolation of VA mycorrhiza - Mass inoculums production of VAM – field application of Ectomycorrhizae and VAM.

Text Books:

1. Kannaiyan,S (2003). Biotechnology of Biofertilizers,CHIPS, Texas.

2. Kumaresan.V (2009). Biotechnology.Saras Publications.

3. SubbaRao N .S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. pvt.Ltd. New Delhi.

Reference Books:

4. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5th edition).McGraw-Hill company, New York

5. Text book of Microbiology. R.C.DubeyMaheshwari (2006).Chand and company (P) LTD.

6. MahendreK.Rai (2005). Hand book of microbial biofertilizers. The Howorth Press, Inc.New York.

7. Reddy, S.M. *et al* (2002) Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.

8. SubbaRao N.S (1988) Biofertilizers in Agriculture and forestry Oxford and IBH publishing Co...Ltd...New Delhi.

Course Outcomes

After completion of this course work students would be able to

S.No	Course outcome	Knowledge level
CO1	Describe microbes used as Biofertilizer	K2
CO2	Explain symbiotic nitrogen fixers	K3
CO3	Find non- symbiotic nitrogen fixers	K5
CO4	Interpret phosphate solubilizing microbes	K2
CO5	Classify mycorrhizae	K2

Title of the Course: Microbial Inoculants						**Course Code:** U4R2MBSEC1:1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2	2	2	3	3	3	3	2	3	2.6
CO2	3	1	1	2	3	3	3	3	2	3	2.4
CO3	3	1	1	2	3	3	3	3	2	3	2.4
CO4	3	2	2	2	3	3	3	3	2	3	2.7
CO5	3	2	2	2	3	3	3	3	2	3	2.6
	Mean Overall Score										**2.54**
	Result										**High**

VERMITECHNOLOGY

Course Code: U4R2MBSEC1:2	**Credit:** 2
Category: Skill Enhancement Course	**Hrs/Week:** 02, **Total Inst.Hrs:** 24
Nature of the Course: Entrepreneurship	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- Tolearnthebasicprinciplesofbiological,chemicalandenvironmentalconceptsofpertainingtoVermitechnology
- To know the morphological characteristics of earthworms
- To understand the different applications of vermiculture
- To development skill in marketing and research fields
- To create knowledge on Self-Employment Opportunity

Unit –I Scope and Importance of Vermiculture **5hrs**

Definition, History, Scope and importance – common species for Vermiculture, Environmental requirements–culture methods–Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage, Vermiwash-Preparation and its application.

Unit-II Morphology of earthworm **5hrs**

Taxonomic position and diversity of earthworms - Types – morphology and physiology of earthworm – Ecological roles and needs for earthworm culture / wormery breeding techniques–indoor and outdoor cultures –monoculture and polyculture – relative merits and demerits.

Unit-III Application of Vermiculture **5hrs**

Applications of vermiculture – vermin – composting, use of Verm castings inorganic farming / horticulture – earthworms for management of biomedical solid waste – feed/bait for capture /culture fisheries–forest regeneration. Nutrient Composition of the Vermicompost.

Unit-IV Marketing of Vermiculture **5hrs**

Marketing the products of vermiculture - Cost – benefit analysis- qualitycontrol, marketresearch,marketing techniques – creating the demand by awareness, demonstration and advertisement – packing and transport – direct marketing,

Unit-V Future Perspective of Vermiculture **4hrs**

Future perspectives – Predators/ pathogen control in wormeries – potential and constraints for vermiculture in India other countries. Visit to relevant Labs/Field Visit.

Text Books:

1. SultanAhmed Ismail, 2005, the Earthworm Book,Second Revised Edition. Mother India Press, Goa.
2. Edward,C.A and Bohlen, P.J1996,Ecologyof Earthworms–3rd Edition,Chapman andHall.

Reference Books:

3. Jsmail,S.A.,1970, Vermicology,Thebiologyof earthworms,OrientLongman, London.
4. Lee,K.E.,1985.Earthworms heirecologyandrelationshipwithsoilandLanduse,Academic Press,Sydney(Unit-II,III).
5. Shukla,G.S1994.EconomicZoology.MeerutRastogiPublication.
6. Seethalekshmy.MAnd Santhi.R,2014, Vermitechnology, 2nd edition.SarasPublication,
7. Jordan & Verma,2009. Invertebrate Zoology, Chand & Company Ltd.
8. Mary Violet Christy,2008. Vermitechnology,MJP Publishers, Chennai.

Course Outcomes:

Aftercompletion of thiscourseworkstudentswouldbeableto

S.No	Course Outcomes	Knowledge Level
CO1	Select better vermicompost bedpreparation	K1
CO2	Identify Morphological characters of earthworms	K2
CO3	Explain the applications of earthworms	K3
CO4	Develop skill in marketing and research field	K6
CO5	Find the Self-Employment Opportunity	K5

Title of the Course: Vermitechnology						**Course Code:** U4R2MBSEC1:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	2	3	2.9
CO2	3	3	3	3	3	3	3	3	2	3	2.9
CO3	3	3	3	3	3	3	3	3	2	3	2.9
CO4	3	3	3	3	3	3	3	3	2	3	2.9
CO5	3	3	3	3	3	3	3	3	3	1	2.8
	Mean Overall Score										**2.88**

		Result	**High**

MUSHROOM TECHNOLOGY

Course Code: U5R2MBSEC2:1	**Credit:** 2
Category: Skill Enhancement Course	**Hrs/Week:** 04, **Total Inst.Hrs:** 48
Nature of the Course: Entrepreneurship	**Marks:** CIA: 25+ Ext: 75 = 100

Objectives:

- To learn the basics of mushrooms in human food
- To know mushroom propagation for food industries
- To give an opportunity for future entrepreneurship
- To get knowledge on mushroom cultivation
- To get idea on nutrition availability in mushroom

Unit I: Introduction **10 hrs**

Introduction - History - Classification and distribution of mushrooms- Life cycle- Common edible mushroom in India (*Calacybeindica*, *Volvariellavolvacea*, *Pleurotussajor-caju* and *Agaricus bisporus*), Research centers: International level, National level and Regional level..

Unit II: Pure Culture and Spawn Preparation **10 hrs**

Collection- Isolation of pure culture - preparation of nutrient media (PDA and Oatmeal agar media) - sterilization - Preparation of test tube slants to store mother culture - culturing of *Pleurotus* mycelium on petriplates - Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication.

Unit III: Cultivation Technology **10 hrs**

Layout of mushroom shed- small scale and large scale, Types of raw materials (substrates) - preparation and sterilization, Mushroom bed preparation - Paddy straw, sugarcane trash, maize straw, banana leaves - maintenance of mushroom shed - harvesting method - storage and preservation of mushrooms.

Unit IV: Storage and Nutrition **9 hrs**

Storage and nutrition: Short term storage - long term storage (scanning, pickles, papads, drying, and storage in salt solutions) - Nutrition: Proteins, amino acids, mineral elements. Nutrition: Carbohydrates - Crude fiber content, vitamins.

Unit V: Food Preparation and Economic Importance **9 hrs**

Types of foods prepared from mushroom - soup, cutlet, omlette, samosa, pickles and curry. Economics of mushroom cultivation:Fixed assets, recurring expenditure, labour, economics

of cultivation throughout the year, Cost benefit ratio: Marketing in India and abroad – Export value.

References:

1. Nita Bahl (1988). Hand book of Mushrooms, 2nd edition, CRC press.
2. Shu Ting Chang, Philip G. Miles, Chang. S.T. (2004). Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact. 2nd edition, CRC press.
3. Paul Stamets, J.S. and Chilton, J.S. (2004). Mushroom cultivation: A practical guide to growing mushrooms at home, Agarikon Press

Reference Books:

4. Marimuthuet al., (1991) Oyster Mushrooms, Dept. of Plant Pathology, TNAU, Coimbathore.
5. Tewan and Pankaj Kapoor S.C. 1993. Mushroom cultivation. Mittal Publication. Delhi.
6. Swaminathan M. (1990) Food and Nutrition. Bappco. The Bangalore Pritning and Publishing Company Ltd., Bangalore.
7. Singh, Reeti and Singh, V.C. (2005). Modern Mushroom Cultivation. Agrobios, India.

Course Outcomes

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Discuss the characteristics of mushroom and scope of Mushroom technology	K2
CO2	Find the pure culture and spawn production of Mushroom	K5
CO3	Determine the different Cultivation methods	K3
CO4	Describe the storage and maintain the nutritional value	K2
CO5	Manipulate the food Products from mushrooms	K5

Title of the Course: Mushroom Technology						**Course Code:** U5R2MBSEC2:1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	2	3	2.9
CO2	3	3	3	3	3	3	3	3	2	3	2.9
CO3	3	3	3	3	3	3	3	3	2	3	2.9
CO4	3	3	3	3	3	3	3	3	2	3	2.9
CO5	3	3	3	3	3	3	3	3	2	3	2.9
										Mean Overall Score	**2.9**
										Result	**High**

MEDICAL LAB TECHNOLOGY

Course Code: U5R2MBSEC2:2	**Credit:** 2
Category: Skill Enhancement Course	**Hrs/Week:** 04, **Total Inst.Hrs:** 48
Nature of the Course: Entrepreneurship	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To learn about the Blood system and their functions.
- To get Knowledge on Cardiovascular system.
- To clear ideas about diagnostic pathology and laboratory safety.
- To become aware of laboratory safety measures
- To create knowledge on Clinical Biochemistry

Unit-I Hematology **10hrs**

Composition of Blood and their functions-Collections of blood-types of Anemia-Mechanism of blood coagulation-Bleeding time, Clotting time, Determination of Hemoglobin, Erythrocyte Sedimentation Rate(ESR),Packed Cell Volume(PCV)-Total count of RBC and WBC-Differential Count of WBC, Platelet count, Reticulate Count-Absolute Eosinophil count. Estimation of Blood Cholesterol.

Unit-II Physiology **10hrs**

Cardiovascular system- Cardiac cycle - Blood Pressure and Pulse - Regulation of heart rate, Cardiac Shock. Heart sounds, Electro Cardiogram-Significance, Ultra Sonography-Ultrasonic Diagnostic methods-Computer Tomography.

Unit-III Diagnostic Pathology **10hrs**

Handling and labeling of histology specimens, tissue processing of histological tissues for paraffin embedding, block preparation. Microtome-type of microtome, sectioning-Staining-staining methods-Mounting – problems encountered during section cutting and remedies-Frozen section technique-freezing microtome.

Unit-IV Laboratory Safety **9 hrs**

Role of Medical Lab Technologist, ethics, responsibility, safety measure and hazards in clinical biochemistry lab and first aid in laboratory accidents. Glassware's& plastic ware's used in lab, calibration of volumetric apparatus, cleaning & care maintenance.

Unit-V Clinical Biochemistry **9 hrs**

Liver function test-Serum bilirubin -SGPT-SGOT- Alkaline phosphatase and Urine analysis- Bile salts- Bile pigments and Urobilinogen. Kidney Function Test- Urea, uric acid and Creatinine.

Text Books:

Mukkerjee K.L. (1999).Medical laboratory Technology. Vol I, II, III.TataMcGrawHill Publications.

Course Outcomes

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Discuss the Blood system and their functions	K6
CO2	Illustrate the Cardiovascular System	K2
CO3	Determine the diagnostic Pathology	K5
CO4	Apply the Laboratory safety methods	K3
CO5	Formulate the techniques of Biochemistry	K6

Title of the Course: Medical Lab Technology						**Course Code:** U5R2MBSEC2:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	3	3	3	3	3.0
CO2	3	3	3	3	3	3	3	3	3	3	3.0
CO3	3	3	3	3	3	3	3	3	3	3	3.0
CO4	3	3	3	3	3	3	3	3	3	3	3.0
CO5	3	3	3	3	3	3	3	3	3	3	3.0
	Mean Overall Score										**3.0**
	Result										**High**

CLINICAL BIOCHEMISTRY

Course Code: U6R2MBSEC3:1	**Credit:** 2
Category: Skill Enhancement Course	**Hrs/Week:** 02, **Total Inst.Hrs: 24**
Nature of the Course: Entrepreneurship	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To know the basic concepts of Clinical Biochemistry
- To understand the basic Biochemistry tests
- To get knowledge on disorders of carbohydrate metabolism
- To become familiar with the disorders of biomolecules.
- To learn the disorders of lipid metabolism

Unit I: Basic concepts of Clinical Biochemistry: 5 hrs

A brief review of units and abbreviations used in expressing concentrations and standard solutions. Specimen collection and processing (Blood, urine, faeces). Anticoagulant preservatives for blood and urine. Transport of specimens. Blood coagulation – disturbances in blood clotting – haemophilia A and haemophilia B. Blood groups, haemoglobin in anaemias, sickle cell anemia, thallasemia, Porphyrias and porphyrinurias. Blood banking.

Unit II: Biochemical tests 5 hrs

Homeostasis, Disorders of fluids, electrolyte balance and gastrointestinal system, disorder involving change in hydrogen ion concentration. Liver function tests, jaundice, haemolytic, hepatic and obstructive jaundice. Renal function tests, normal and abnormal constituents of urine.

Unit III Disorders of carbohydrate metabolism: 4 hrs

Sugar level in normal blood, maintenance of blood sugar concentration – endocrine influence on carbohydrate metabolism, hypoglycemia, glycosuria, renal threshold value, diabetes mellitus – classification, complications, glucose tolerance test (GTT), diabetic coma, diabetic ketoacidosis, glycogen storage diseases, fructosuria, galactosemia, and hypoglycemic agents.

Unit IV Disorders of protein, amino acid and nucleicacid metabolism: 5 hrs

plasma proteins, their origin, significance and variation in diseases. Nitrogen balance, proteinuria, multiple myeloma, Wilsons disease. Phenylketonuria, alkaptonuria, tyrosinosis, albinism, Hartnupsdisease.Fanconic syndrome, cystinuria, Gout.

Unit V Disorders of lipid metabolism: **5 hrs**

lipid metabolism in liver and adipose tissue, plasma lipoproteins, cholesterol triglycerides and phospholipids in health and diseases, fatty liver, atherosclerosis, lipid storage diseases, hypolipoproteinemia and hyperlipoproteinemia.

Text Books:

1. Clinical Chemistry in diagnosis and treatment, Philip, 6th ed ELBS. D. Mayne & Edward Arnold, 1994.
2. Textbook of Clinical Chemistry, 3rd ed, Burtis&Ashwood, TietZ WB Saunders, 1999.
3. Text book of Medical Biochemistry 2nd Ebasics of biochemistrydition, M.N. Chatterjee and Rana Shinde, Jaypee Brothers Medical publishers Private limited, New Delhi 1995.

Reference Books:

4. Clinical Biochemistry – Metabolic & Clinical Aspects, William J.Marshall, Stephen K. Bansert, Churchill Livingstone, 1995.
5. Clinical Chemistry – Principles, procedures, correlations – Bishop, Lippincott.2000.
6. Fundamentals of Biochemistry - Ambikashanmugam, S.Chand, by Publishers 1986.

Course Outcomes

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Define the basic concepts of Clinical Biochemistry	K1
CO2	Apply the basic Biochemistry tests	K3
CO3	Interpret the disorders of carbohydrate metabolism	K4
CO4	Examine the disorders of biomolecules	K5
CO5	Describe disorders of lipid metabolism	K2

Title of the Course: Clinical Biochemistry						**Course Code:** U6R2MBSEC3:1					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2	2	3	3	3	3	3	3	3	2.8
CO2	3	3	2	3	3	3	3	3	3	3	2.9
CO3	3	3	2	3	3	3	3	3	3	3	2.9
CO4	3	3	2	3	3	3	3	3	3	3	2.9
CO5	3	3	2	3	3	3	3	3	3	3	2.9
	Mean Overall Score										**2.88**
	Result										**High**

GOOD LABORATORY PRACTICES

Course Code: U6R2MBSEC3:2	**Credit:** 2
Category: Skill Enhancement Course	**Hrs/Week:** 02, **Total Inst.Hrs: 24**
Nature of the Course: Entrepreneurship	**Marks:** CIA: 25+ Ext: 75 = 100

Course Objectives:

- To Prepare students for practical study in life science laboratories.
- To handle safely every laboratory facility and know troubleshoot measures during laboratory processes.
- To maintain the laboratory
- To keep, analyse laboratory data with accuracy.
- To Errors related with handling of laboratory material and work becomes more accurate and precise.

Unit I: Quality Control **12 hrs**

Internal and external Assessment, Quality improvement, Total Quality Control Programme. Quality Assurance – Attributes, Immunization programme

Unit II: Internal Quality Control **12 hrs**

Clinical Microbiology Laboratories- Standard operating procedure manuals, Specimens- Equiqments – iosafety cabinets, Media, Tests_ Biochemical, Staining, Antimicrobial Susceptiblity, Serological Biological Production units

Unit III: External Quality Assessment **12 hrs**

EQA-Types-Requirement of EQA programme. Organization of EQA, Scoring System in EQA, National External Quality Control assessment.

Unit IV:Good manufacturing practices **12 hrs**

Quality Control Factors influencing GMP- Production and documentation- Principles of production and quality control of biologicals.

Unit V: Quality Control **12 hrs**

Analytical Validation Overview of Quality Assurance- Objectives & Components, Need for Quality Assurance & its benefits. Quality Management-Quality System, Quality plan.

Text books:

1.Handbook Good Laboratory Practices-World health organization(WHO)

2.Life science protocol manual (2018)-DBT star college scheme

3. Guidelines for good laboratory practices-Indian council of medical research, New Delhi (2008)

Course Outcomes

After completion of this course, students would be able to

S.No.	Course Outcomes	Knowledge Level
CO1	Define the fundamentals of GLP	K1
CO2	Illustrate the safely practice in basic laboratory procedures and protocols in future lab situations.	K2
CO3	Apply the procedures in lab maintenance	K3
CO4	Inspect the non-instrumental basic laboratory techniques	K4
CO5	Determine the instrumental basic laboratory techniques	K5

Title of the Course: Good Laboratory Practices						**Course Code:** U6R2MBSEC3:2					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	2	3	3	3	1	1	1	1	2.1
CO2	3	3	3	3	3	3	3	2	3	2	2.8
CO3	3	3	2	3	3	3	3	2	3	2	2.7
CO4	3	3	2	3	3	3	3	2	3	2	2.7
CO5	3	3	2	3	3	3	3	2	3	2	2.7
	Mean Overall Score										**2.6**
	Result										**High**

BIOFERTILIZER

Objectives:

- To give the information of Biofertilizer for better soil management
- To learn importance of and non- symbiotic N2 fixers
- To get knowledge on symbiotic nitrogen fixers
- To acquire information about phosphate solubilizers
- To understand the taxonomy of Mycorrhizae

Unit I: Introduction **5 hrs**

General account of the microbes used as biofertilizers for crop plants and their advantages. Symbiotic N2 fixers*: Rhizobium* – Isolation, characterization, Identification, Classification, inoculum production and applications.

Unit II: Non - symbiotic N2 fixer **5 hrs**

Non - symbiotic N2 fixer - *Azospirillum*- Free living – *Azotobacter, Clostridium, Klebsiella and Anabaena* - free isolation, characterization, mass inoculum production and field application.

Unit III: Symbiotic N2 fixers **5 hrs**

Symbiotic N2 fixers - Cyanobacteria, *Azolla*- Isolation, characterization, mass multiplication – Role in rice cultivation- Crop response - field application. Frankia - Isolation, characterization – actinorrhizal nodules – non leguminous crop symbiosis.

Unit IV: Phosphate solubilizers **5 hrs**

Phosphate solubilizers - Phosphate solubilizing microbes – Isolation, characterization, mass inoculum production, field application – Phosphate solubilization mechanism.

Unit V: Mycorrhizal **5 hrs**

Mycorrhizal - classification - Taxonomy of mycorrhizae - Isolation of VA mycorrhiza - Mass inoculum production of VAM – field application of Ectomycorrhizae and VAM.

References:

1. Kannaiyan,S.(2003). Biotechnology of Biofertilizers,CHIPS, Texas.

2. SubbaRao N .S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. pvt. Ltd. New Delhi.

3. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5thedition).McGraw-Hill company, New York

4. Text book of Microbiology. R.C.DubeyMaheshwari(2006).Chand and company (P)LTD

Reference Books:

5. MahendreK.Rai(2005). Hand book of microbial biofertilizers. The HoworthPress ,Inc.New York.

6. Reddy, S.M. *et al* (2002) Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.

7. SubbaRao N.S (1988) Biofertilizers in Agriculture and forestry Oxford and IBH publishing Co...Ltd...New Delhi.

Course Outcomes:

After completion of this course work students would be able to

Sl.No	Course outcome	Knowledge level
CO1	Explain Biofertilizers	K2
CO2	Describe Non - symbiotic N2 fixer	K2
CO3	Find the symbiotic nitrogen fixers	K5
CO4	Interpret phosphate solubilizing microbes	K2
CO5	Classify different types of Mycorrhizal	K2

Title of the Course: Biofertilizer						**Course Code:**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	2	2	3	3	3	3	1	3	2.6
CO2	3	3	2	2	3	3	3	3	1	3	2.6
CO3	3	3	2	2	3	3	3	3	1	3	2.6
CO4	3	3	2	2	3	3	3	3	1	3	2.6
CO5	3	3	2	2	3	3	3	3	1	3	2.6
	Mean Overall Score										**2.6**
	Result										**High**

APPLIED MICROBIOLOGY

Course Objectives

- To gain knowledge on interactions among soil, air and water microorganisms
- To study about different industrial products production
- To know the cultural characteristics of various microorganisms
- To focus on Contamination and Food spoilage
- To get idea on Marine microorganisms

Unit I: Environmental Microbiology **5 hrs**

Soil as dynamic ecosystem, Microbial flora of soil, Interactions among soil microorganisms (Neutralism, Commensalism, Mutualism, Antagonism, Competitions, Parasitism and Predation). Biological Cycles (Carbon, Nitrogen, Sulphur and Phosphorus cycle). Air Microbiology: Sampling of air microflora, Biodiversity in Air. Water Microbiology: Types of water (atmospheric, surface and stored onstitutions), Biodiversity of aquatic environments.

Unit-II: IndustrialMicrobiology **5 hrs**

Industrial product from microorganisms - Antibiotics production of Penicillin, Streptomycin. Enzyme from microbes: Amylase, Protease, Organic Acids - Citricacids, aceyicacid. Aminoacid – Glutamicacid, Lysine- Production of alcoholic beverages - Beerandwine. Bio-fuels– Ethanol, Methane, Biogas.

Unit-III: Medical Microbiology **5 hrs**

Morphology, Cultural characteristics, Pathogenesis, laboratory diagnosis, prevention, control andtreatment of disease caused by the following organisms: *Mycobacterium tuberculosis*, *Clostridumtetani*, *Salmonelltyphi*, *Vibrio cholera*, Swine flu, Rota, Ebola, HIV, Dengue virus and Chickenguineavirus and Hepatitis viruses.

Unit-IV: Food and Dairy **5 hrs**

Introduction, History, Occurrence of Microorganisms in food, intrinsic and extrinsic factors influencing microbial growth. Contamination, spoilage and preservation of foods. Fruits, Vegetables, Eggs, Meat, Poultry, Fishes, Milk and Milk Products. Fermented foods: Sauerkraut, Pickles, Buttermilk, Yoghurt, Cheese.

Unit-V: Marine Microbiology **4hrs**

Methods of studying microorganisms: Methods of collection, enumeration (total and viable counts), isolation, culture and identification based on morphological, physiological and biochemical characteriistics. Marine microorganisms in food, preservation of marine

microbes.

Text Books:

1. A text book of Microbiology R.C.Dubey, Dr.K.Maheshwari ,M.Chand Publishers. Edition.2012.
2. Food Microbiology – William C. Frazier and Dennis C. Westoff, Tata MCGraw Hill Education (2013).
3. Industrial Microbiology -l.E.Casida, Newage INTERNATIONAL PUBLISHER Ltd., NewDelhi.

Reference Books:

4. Marine Microbiology-A. Mitraand Kakoli Banerjee, Narendra Publishing House (2004).
5. Patel A.H. (2016). Industrial Microbiology, 2nd Edition. Rajiv Berifor Mac Millan India Ltd., New Delhi.
6. Ananthanarayan & Panikar's, Textbook of Microbiology. 9th Edition, 2013.

Course outcomes:

After completion of this course work students would be able to

Sl.No	Course outcome	Knowledge level
CO1	Compare the ecological biodiversity	K4
CO2	Distinguish the Microbial production of industrial products	K2
CO3	Interpret the pathogenicity,control and treatment of various disease	K2
CO4	Develop aware onpreservationofvariousfoods	K3
CO5	Describe the applications of marine microorganisms	K2

Title of the Course: Applied Microbiology						**Course Code:**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3	3	3	3	3	1	3	1	3	2.6
CO2	3	3	3	3	3	3	2	3	1	3	2.7
CO3	3	3	3	3	3	3	3	3	1	3	2.8
CO4	3	3	3	3	3	3	3	3	1	3	2.8
CO5	3	3	3	3	3	3	2	3	1	3	2.7
	Mean Overall Score										**2.72**
	Result										**High**