

ETHIRAJ COLLEGE FOR WOMEN
(AUTONOMOUS)
DEPARTMENT OF MICROBIOLOGY
M.Sc. APPLIED MICROBIOLOGY
SYLLABUS TO BE EFFECTIVE FROM 2018-2019

ETHIRAJ COLLEGE FOR WOMEN,
(AUTONOMOUS)
CHENNAI-600 008

DEPARTMENT OF MICROBIOLOGY

SYLLABUS



CHOICE BASED CREDIT SYSTEM
OUTCOME BASED EDUCATION

(OFFERED FROM THE ACADEMIC YEAR 2018-2019)

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ETHIRAJ COLLEGE FOR WOMEN
PG DEPARTMENT OF APPLIED MICROBIOLOGY
Revised Syllabus of June 2018

The Post Graduate Department of Microbiology is revising syllabus with effect from the academic year 2018-2019. PG Degree has two academic years. Every academic year is divided into two semester sessions. Each semester will have a minimum of 90 working days and each day will have 5 working hours. Teaching is organized into a modular pattern of credit courses. Credit is normally related to the number of hours a teacher teaches a particular subject. It is also related to the number of hours a student spends learning a subject or carrying out an activity.

PREAMBLE

PG Department of Microbiology submits changes and additions suggested in the curricula that are given in the ensuing pages.

- Modification of Course content in all the Core and Elective courses in accordance with emerging trends in the field of Microbiology.
- Addition of new Course and merging of courses as per the need.
- Shifting of courses between semesters to accommodate syllabus coverage

REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of M.Sc., Applied Microbiology course shall be required to have passed the B.Sc., Degree examinations in Microbiology /Zoology /Botany/Biotechnology under the University of Madras or as equivalent thereto by the Syndicate of the University of Madras.

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study for a period of not less than two academic years, passed the examination of all Four Semesters prescribed.

3. COURSE OF STUDY:

The Main subjects of study for Post graduate Degree shall consist of the following:

PART-I	: Core Theory and Core Practical
PART-II	: Major and Non Major Electives
PART- III	: Soft Skill
PART- IV	: Internship

4. PASSING MINIMUM:

A candidate shall be declared to have passed in each paper / practical of the main subject of study wherever prescribed, if she secured NOT LESS THAN 50% of the marks prescribed for the end semester examination.

5. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Successful candidates passing the examination and securing the marks (i) 60 percent and above and (ii) 50 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND class respectively. Candidates who pass all the examinations prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for ranking.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

On obtaining a postgraduate degree the students will be able to:

PEO1-Display higher order thinking in the knowledge domain and demonstrate professional skills

PEO2- Contribute to the advancement and application of relevant knowledge by self-directed learning

PEO3-Extend and integrate knowledge and skills to design and develop novel products and explore innovative solutions to national and international goals of development.

PEO4-Exercise management skills and develop social interactions in a responsive, ethical and constructive way to meet global standards of excellence in all spheres of activity.

PEO5-Strive for social and economic equity based on the need for gender parity and ecological sustainability.

PROGRAMME OUTCOMES (PO)

- PO1**– To acquire advanced conceptual knowledge and comprehensive understanding of the fundamental principles in respective discipline
- PO2**– To apply knowledge and critically evaluate the concepts and scientific developments to take up any challenge
- PO3**- To visualize and work on laboratory multidisciplinary tasks related to current research in the fields of Mathematical, Physical and Life sciences
- PO4**– To acquire research based knowledge and design methods to conduct investigations of complex problems in research/ Industrial field and achieve employability / self employment.
- PO5**- To communicate effectively ideas verbally in English, leading to Entrepreneurship ventures such as consultancy and training
- PO6**- Employ innovative and environment friendly methods, novel ideas to solve complex and challenging societal and environmental issues.

PROGRAMME SPECIFIC OUTCOME (PSO)

- PSO1-** Analyse the fundamental concepts and biodiversity of microorganisms, enabling critical thinking in different fields of Microbiology.
- PSO2-** Demonstrate the importance of immunity, pathogenesis, cultivation, diagnosis and control of pathogens through therapeutics and prophylaxis in various Health and Pharmaceutical domains.
- PSO3-** Evaluate and Identify the needs, potentials and impact of microorganisms relevant to food, soil and agriculture, ensuring environmental conservation and food safety.
- PSO4-** Design appropriate strategies in bio-processing and fermentation technology, with emphasis on industrial production of biomass and their products.
- PSO5-** Apply the concepts of Genomics and Proteomics through analytical, molecular and *in silico* techniques for the betterment of society.
- PSO6-** Examine the significance of research using statistical tools and communicate the findings in research forums.
- PSO7-** Ensure bio-safety and bioethics for social responsibility, environmental sensitization and obtain Intellectual Property Rights for various research findings.
- PSO8-** Apply computing, communicative and entrepreneurial skills for employability and life long learning.

PROGRAMME PROFILE-M.SC., APPLIED MICROBIOLOGY

SEM	PART	COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/WK	TOTAL HOURS	CA	SE	TOTAL
I	CORE I	16SP18/1C/GMY	General Microbiology	4	4	60	40	60	100
	CORE II	16SP18/1C/MPY	Microbial Physiology	4	5	75	40	60	100
	CORE III	16SP18/1C/BLY	Bacteriology	4	5	75	40	60	100
	CORE ELECTIVE I	16SP18/1E1/MYP	Mycology and Parasitology	3	4	60	40	60	100
	SOFT SKILL	PG18/1S/PEW	Personality Enrichment for Women	2	2	30	-	50	50
	CORE PRACTICAL I	16SP18/2C/PR1	General Microbiology and Microbial Physiology	-	5	60	-	-	-
	CORE PRACTICAL II	16SP18/2C/PR2	Medical Microbiology	-	5	75	-	-	-
II	CORE IV	16SP18/2C/FDY	Food and Dairy Microbiology	4	4	60	40	60	100
	CORE V	16SP18/2C/VLY	Virology	4	4	60	40	60	100
	CORE VI	16SP18/2C/ARM	Analytical Tools and Research Methodology	4	4	60	40	60	100
	CORE ELECTIVE II	16SP18/2E2/BST	Biostatistics	3	3	45	40	60	100
	NON MAJOR ELECTIVE I	16SP18/2E/VMC	Vermicomposting and Mushroom Cultivation	3	4	60	40	60	100
	SOFT SKILL	PG18/2S/LCE PG18/2S/FRE	*Languages-English or French	2	2	30	-	50	50
	CORE PRACTICAL I	16SP18/2C/PR1	General Microbiology and Microbial Physiology	4	4	-	40	60	100
	CORE PRACTICAL II	16SP18/2C/PR2	Medical Microbiology	4	5	-	40	60	100
Total Credits of I and II Semester = 45 *Communication Skills in English/French for Beginners									
III	CORE VII	16SP18/3C/ILY	Immunology	4	4	60	40	60	100
	CORE VIII	16SP18/3C/EMY	Environmental Microbiology	4	4	60	40	60	100
	CORE ELECTIVE III	16SP18/3E3/INP	Industrial and Pharmaceutical Microbiology	3	4	60	40	60	100
	NON MAJOR ELECTIVE II	16SP18/3E/GLP	Gardening and Landscaping	3	4	60	40	60	100

	SOFT SKILL	16SP18/3S/CSC	Computing Skills for competitive examinations	2	2	30	-	50	50
	CORE PRACTICAL III	16SP18/4C/PR3	Immunology and Molecular Biology	-	4	-	-	-	-
	CORE PRACTICAL IV	16SP18/4C/PR4	Environmental Microbiology	-	4	-	-	-	-
	CORE PRACTICAL V	16SP18/4C/PR5	Food and Industrial Microbiology	-	4	-	-	-	-
	INTERNSHIP		**	2					
IV	CORE IX	16SP18/4C/MBY	Molecular Biology and Recombinant DNA Technology	4	4	60	40	60	100
	CORE X	16SP18/4C/PRO	Project	4	5	60	40	60	100
	CORE ELECTIVE IV	16SP18/4E4/MIG	Microbial Genetics	3	4	60	40	60	100
	CORE ELECTIVE V	16SP18/4E5/BIF	Bioinformatics	3	3	45	40	60	100
	SOFT SKILL	16SP18/4S/EEP	Essentials of Entrepreneurship	2	2	30	40	60	100
	CORE PRACTICAL III	16SP18/4C/PR3	Immunology and Molecular Biology	4	4	60	40	60	100
	CORE PRACTICAL IV	16SP18/4C/PR4	Environmental Microbiology	4	4	60	40	60	100
	CORE PRACTICAL V	16SP18/4C/PR5	Food and Industrial Microbiology	4	4	60	40	60	100
<p align="center">**Internship will be carried out during summer vacation of the II semester Total credits of III and IV semester=46 Total credits=91</p>									

STRUCTURE OF SOFT SKILL PAPERS

SEMESTER	CODE	COURSE TITLE
I	PG18/1S/PEW	Personality Enrichment For Women
II	PG18/2S/LCE PG18/2S/FRE	Languages- English /French/German
III	16SP18/3S/CSC	Computing Skills for Competitive Examinations
IV	16SP18/4S/EEP	Essentials of Entrepreneurship

EVALUATION PATTERN FOR CONTINUOUS ASSESSMENT

INTERNAL VALUATION BY COURSE TEACHER/S

CORE/ELECTIVE/PROJECT-THEORY PAPERS

S.NO	COMPONENT	TIME	MAX.MARKS	CAMARK
1	Test I	2 Hrs	50 Marks (To Be Converted to 10)	10
2	Test II	2 Hrs	50 Marks (To Be Converted to 10)	10
3	Assignment/Seminar/Field Visit			10
4	Participatory Learning			10
	Total			40

CORE/ELECTIVE-PRACTICAL PAPERS

S.NO	COMPONENT	TIME	MAX.MARKS	CAMARK
1	Test I	2 Hrs	50 Marks (To Be Converted to 10)	10
2	Test II	2 Hrs	50 Marks (To Be Converted to 10)	10
3	Maintenance Of Observation/Record			10
4	Participatory Learning			10
	Total			40

PROJECT

S.NO	COMPONENT	TIME	MAX.MARKS	CAMARK
1	Presentation I	2 Hrs	50 Marks (To Be Converted to 10)	10
2	Presentation II	2 Hrs	50 Marks (To Be Converted to 10)	10
3	Table Work			10
4	Participatory Learning			10
	Total			40

CA QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2,K3, K4	C – 2 x 20 Marks	1500	40	

RUBRICS FOR CONTINUOUS ASSESSMENT

Assignment	Content/originality/Presentation/Schematic Representation and Diagram/Bibliography
Seminar	Organisation/Subject Knowledge/Visual Aids/Confidence level/presentation-Communication and Language
Field Visit	Participation/Preparation/Attitude/Leadership
Participation	Answering Questions/Clearing Doubts/Participating in Group Discussions/Regular Attendance
Case Study	Finding the Problem/Analysis/Solution/Justification
Problem Solving	Understanding Concepts/Formula and Variable Identification/Logical Sequence/Answer
Group Discussion	Preparation/Situation Analysis/Relationship Management/Information Exchange/Delivery Skills
Flipped/Blended Learning	Preparation/Information Exchange/ Group interaction/Clearing doubts

END SEMESTER EVALUATION PATTERN

THEORY PAPERS

SEMESTER I/II/III/IV

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNAL EXAMINER

MAXIMUM MARKS: 100 TO BE CONVERTED TO 60

PASSING MARKS: 50

PRACTICAL PAPERS

SEMESTER II/IV

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNAL EXAMINER

MAXIMUM MARKS: 100 TO BE CONVERTED TO 60

PASSING MARK: 50

SOFT SKILLS PAPERS

SEMESTER I/II/III/IV

SINGLE VALUATION BY COURSE TEACHER

MAXIMUM MARKS: 50

PASSING MARKS: 25

PROJECT PAPER

SEMESTER IV

DOUBLE VALUATION BY RESEARCH SUPERVISOR AND EXTERNAL EXAMINER

DISSERTATION: 40

VIVA: 20

MAXIMUM MARKS: 100

PASSING MARKS: 50

INTERNSHIP

21 day Internship after I year during summer vacation- mandatory

SEMESTER I COURSE PROFILE-PROGRAMME OF STUDY

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS /WK	TOTAL HOURS	L-T-P	CA	SA	TOTAL
16SP18/1C/GMY	General Microbiology	4	4	60	4-1-0	40	60	100
16SP18/1C/MPY	Microbial Physiology	4	5	75	4-1-0	40	60	100
16SP18/1C/BLY	Bacteriology	4	5	75	3-1-0	40	60	100
16SP18/1E1/MYP	Mycology and Parasitology	3	4	60	3-1-0	40	60	100
PG18/1S/PEW	Personality Enrichment for Women	2	2	30				
16SP18/2C/PR1	General Microbiology and Microbial Physiology	-	5	60	0-0-4	40	60	100
16SP18/2C/PR2	Medical Microbiology	-	5	75	0-0-5	40	60	100
	TOTAL CREDITS	17						

**SEMESTER I
GENERAL MICROBIOLOGY**

**TOTAL HOURS: 60
CREDITS: 4**

**COURSE CODE: 16SP18/1C/GMY
LT P: 4- 1- 0**

COURSE OBJECTIVES:

1. Impart basic knowledge about the History and classification of Microbiology.
2. Throw light on principles and working of different microscopes.
3. Explain Eukaryotic and Prokaryotic cell structure and staining techniques.
4. Provide insights on cultivation techniques and antibiotics.
5. Demonstrate the importance of various sterilization methods.

COURSE OUTLINE:

UNIT I

10 Hours

History of Microbiology – Evolution of Microbiology with its recent developments. Outline Classification of Microorganisms-Bacteria, Fungi, Protozoa and Algae. Haeckel's Three Kingdom concept, Whittaker's Five Kingdom concept, Eight Kingdom concept and Three domain Concept. Principles of Classification – Phenetic and Phylogenetic Classification. Numerical Taxonomy-Similarity Matrix, Dendrograms.

UNIT II

10 Hours

Microscopy – Principle, Working and Application – Simple, Compound, Bright field, Dark field, Phase contrast, Fluorescence Microscopy and Confocal Microscopy, Transmission and Scanning Electron microscopy and Specimen preparation.

UNIT III

12 Hours

Prokaryotic cell structure – Cell Wall, Membrane, Capsule, Flagella, Inclusion Bodies and Spores. Outlines of Eukaryotic cell structure, function and differences between prokaryotic and eukaryotic cell. Staining –Classification of stains with examples. Simple staining, Gram staining, Acid-fast staining, Metachromatic granule staining, Nuclear staining, Capsule staining, Flagella staining and Spore staining.

UNIT IV

14 Hours

Cultivation of Bacteria- Aerobic and Anaerobic methods. Types of culture media and its applications. Decimal dilution. Pure Culture Techniques – Pour plate, Spread plate, Streaking and Stabbing. Preservation of microbial cultures. Antibiotics–Classification and mechanism of action. Antibacterial sensitivity testing methods and quality control. Mechanisms of Drug resistance and antibiotic policy, CLSI guidelines, EUCAST.

UNIT V

14 Hours

Sterilization - Physical and Chemical Methods- High temperature – Moist heat and dry heat, Radiation and Filtration. Disinfection methods - Phenol and Phenolic compounds, Alcohols, Halogens, Heavy metals, Dyes, Detergents, Quaternary Ammonium compounds, Aldehydes and Gaseous agents. Quality control of Sterilization methods.

RECOMMENDED TEXT BOOKS:

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007) Microbiology. 7th edn. Mc Graw – Hill, New York.
2. Prescott. L.M., Harley. J.P., Klein. D.A. (2013). Microbiology 9th edn. Wm. C. Brown publishers, Dubugue.
3. Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11th edn. A La Carte Pearson.

REFERENCE BOOKS:

1. Davis. B.D., Delbecco. R., Eisen. H.N and Ginsburg. H.S. (1990). Microbiology. 5th edn. Harper and Row, New York.
2. Stanier R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R.. (1987) General Microbiology. 5th edn. Englewood cliffs, New Jersey, U.S.A.
3. Madigan, M.T., Martinko, J.M. and Parker, J. (1999). Brock's Biology of Micro organisms. 9th Edn. Prentice Hall, New Jersey.
4. Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th edn. McGraw Hill Inc. New York.
5. Boyd, R.F. (1998). General Microbiology. Times Mirror, Mosby College Publishing, St Louis.

JOURNALS:

1. Journal of Applied Microbiology
2. Journal of Pure and Applied Microbiology

E-LEARNING RESOURCES:

1. <https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>
2. <https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp>
3. <https://courses.lumenlearning.com/boundless-biology/chapter/structure-of-prokaryotes/>
4. <https://www.slideshare.net/AshfaqAhmad52/cultivation-of-bacteria-and-culture-methods>
5. <https://bitesizebio.com/853/5-laboratory-sterilisation-methods/>.

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Analyse the basics concepts of microorganisms, its developments and its classification for microbial diversity and its applications.
CO 2	Apply the knowledge acquired on different microscopes, working principles for visualization and study of structural features of microorganisms.
CO 3	Compare eukaryotic and prokaryotic cell structures, observe and interpret them through staining procedures
CO 4	Apply cultivation procedures to identify and differentiate morphological, biochemical and antibacterial properties.
CO 5	Employ sterilization techniques in health, food, environmental, industrial, domestic and pharmaceutical domains.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	2	2	3	1	1	2	1	2
CO 2	3	2	2	1	1	3	1	2
CO 3	3	2	1	1	1	2	2	2
CO 4	1	2	2	2	1	2	2	2
CO 5	1	2	2	2	1	2	2	2
Average	2	2	2	1.4	1	2.2	1.6	2

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and board, OHP, e-content, Practical learning, Group Discussion, Assignment, Quiz and Seminars.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2,K3, K4	C – 2 x 20 Marks	1500	40	

**SEMESTER I
MICROBIAL PHYSIOLOGY**

**TOTAL HOURS: 75
CREDITS: 4**

**COURSE CODE: 16SP18/1C/MPY
L T P: 4- 1- 0**

COURSE OBJECTIVES:

1. Illustrate Bacterial nutrition and their utilization.
2. Discuss cultivation methods and factors related to microbial growth.
3. Demonstrate concepts of microbial metabolism.
4. Impart the fundamentals and importance of biosynthetic pathways.
5. Discuss the methods involved in Photosynthesis

COURSE OUTLINE:

UNIT I

15 Hours

Nutrition – Nutritional requirements and types in bacteria – Phototrophs, Chemotrophs, Autotrophs and Heterotrophs. Nutrient transport mechanisms- Passive diffusion, Facilitated diffusion, Active transport, Group translocation and Specific transport system.

UNIT II

10 Hours

Microbial growth – Growth curve and Measurement of Growth – Cell Number and Cell Mass and metabolic activity. Batch, Continuous, Synchronous and Asynchronous cultures, Factors affecting growth.

UNIT III

20 Hours

Enzymes – properties, functions and regulation. Basic concepts of metabolism, Oxidation – reduction reactions, Energy generation by anaerobic metabolism – Glycolysis, Pentose Phosphate pathway, ED pathway, Fermentation. Energy generation by Aerobic metabolism - TCA cycle, Glycoxylate pathway and Electron Transport chain, Mechanism of ATP synthesis – Chemiosmosis, Pasteur effect. Metabolism of lipids- β oxidation.

UNIT IV

15 Hours

Anaerobic Respiration. Nitrogen, Sulphur, Iron and Hydrogen Oxidation. Methanogenesis. Biosynthesis – Gluconeogenesis, Peptidoglycan synthesis, Amino acids, Purines, Pyrimidines Fattyacids, Triglycerides, Phospholipids and Sterols.

UNIT V

15 Hours

Photosynthesis – process, antenna of light-harvesting pigments, Photochemical reaction centers, Photosynthetic Electron Transport Chain-Cyclic and Non-cyclic. Oxygenic and Anoxygenic Photosynthesis. Calvin-Benson cycle. Bioluminescence - Process and application.

RECOMMENDED TEXT BOOKS:

1. Stanier R.Y., Ingraham, J.L., Wheelis, M.L and Painter, P.R. (2010). General Microbiology. 5th edn. Macmillan education Ltd. London.
2. Prescott. L.M., Harley. J.P., Klein. D.A. (1993). Microbiology. 2nd edn. Wm. C. Brown publishers, Dubugue.
3. Moat, A.G. and Foster, J.W. (2003). Microbial Physiology.4th Edn. John Wiley and Sons, New York.

REFERENCE BOOKS:

1. Salle. A.J. (1992). Fundamental Principles of Bacteriology. 7th edn. McGraw Hill Inc. New York.
2. Madigan, M.T., Martinko, J.M., & ParkerJ. (2000). Brock Biology of Microorganisms. 9th edn. Prentice Hall International, Inc, London.
3. Ingraham, J.L., & Ingraham, C.A. (2000). Introduction to Microbiology. 2nd edn. Brook / Cole. Singapore.
4. Gottschalk, G. (1986). Bacterial Metabolism.2nd edn. Springer-Verlag, New York.
5. Rose, A.H. (1976). An Introduction to Microbial Physiology. 3rd edn. Plenum, New York.

JOURNALS:

1. Journal of Applied Microbiology
2. Journal of General Microbiology

E-LEARNING RESOURCES:

1. <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/>
2. <https://www.lamission.edu/lifesciences/lecturenote/mic20/Chap06Growth.pdf>
3. <https://www.tandfonline.com/doi/abs/10.3109/07388558409082583?journalCode=ibty20>
4. <https://www.sciencedirect.com/topics/neuroscience/microbial-respiration>
5. <https://www.britannica.com/science/photosynthesis>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Apply knowledge about nutritional requirement, modes of nutrient transport in microorganisms to various disciplines of Microbiology
CO 2	Analyse microbial growth, factors influencing growth and its measurement techniques for applications in various industries.
CO 3	Compare various metabolic pathways and discuss the properties and functions of enzymes
CO 4	Apply anaerobic respiration and biosynthetic pathways to enhance/control microbial growth
CO 5	Assimilate methods involved in microbial photosynthesis and bioluminescence

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	3	3	1	2	3	3
CO 2	3	3	3	3	1	2	3	1
CO 3	3	3	3	3	2	2	2	1
CO 4	3	3	3	3	2	2	2	1
CO 5	3	3	3	3	2	2	2	1
Average	3	3	3	2	1.6	2	2.4	1.4

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER I BACTERIOLOGY

TOTAL HOURS: 75
CREDITS: 4

COURSE CODE: 16SP18/1C/BLY
LT P: 3- 1- 0

COURSE OBJECTIVES:

1. Impart in-depth understanding of normal flora and its importance, Learn bacterial classification and virulence factors contributing to pathogenicity.
2. Teach various cultivation methods, pathogenesis and clinical features of bacteria affecting humans.
3. Illustrate methods involved in collection and transport of samples and its biosafety guidelines for bacterial identification.
4. Provide insights into processing of samples and laboratory diagnosis of pathogenic bacteria.
5. Equip the students with knowledge on the various zoonotic and hospital acquired infections and learn biomedical waste management.

COURSE OUTLINE:

UNIT I

10 Hours

General Bacteriology - Normal Microbial Flora of Human Body and its importance, Host parasite interactions, Gnotobiosis. Classification of bacteria (Bergey's) and virulence factors in pathogenesis. Principles of epidemiology. Collection, transport and processing of specimens in bacteriology.

UNIT II

18 Hours

Gram Positive Bacteria - *Staphylococcus aureus* and Coagulase Negative *Staphylococci* implicated in Hospital acquired infections, *Streptococcus pyogenes*, *Streptococcus viridans*, *Streptococcus agalactiae*, *Streptococcus fecalis*, *Streptococcus pneumoniae*, *Corynebacterium diphtheriae*, *Mycobacterium tuberculosis*, *Mycobacterium leprae*, MAIS complex and *Clostridium tetani*, *Clostridium botulinum*, *Clostridium perfringens* and *Clostridium difficile*.

UNIT III

16 Hours

Gram Negative Bacteria - *Escherichia coli*, *Klebsiella*, *Proteus*, *Salmonella*, *Shigella*, *Vibrio cholerae*, *Pseudomonas*, *Haemophilus influenzae*, *Bordetella*, *Neisseria*.

UNIT IV

16 Hours

Spiral Forms and Non-cultivable Bacteria - *Helicobacter pylori*, *Spirochaetes* – *Treponema pallidum*, *Leptospira*, *Borrelia*. *Mycoplasma*. *Rickettsiae* and *Chlamydia*. Anaerobic bacterial infections.

UNIT V

15 Hours

Zoonotic Bacterial Infections its prevention and control. Nosocomial infections- source, etiology, diagnosis and infection control committee. Biomedical Waste management. Antimicrobial agents in bacterial infections and Specific natural resistance

RECOMMENDED TEXTBOOKS:

1. Greenwood D., Slack R.C.B and Peutherer J.F. (1992). Medical Microbiology. 14thedn, ELBS, Churchill Livingston.
2. Jawetz, E., Melnick, J.L. and Adelberg, E.A.(1997). Review of Medical Microbiology 9th edn. Lange Medical Publications, U.S.A.
3. Ananthanarayanan, R, & Panicker, C.K.J. (2013). Textbook of Microbiology. 9thedn. Orient Longman.

REFERENCE BOOKS:

1. Collee J.C. Duguid J.P. Foraser, A.C, Marimon B.P, (1996). Mackie & McCartney Practical Medical Microbiology. 14thedn, Churchill Livingston.
2. Cheesbrough M. (2006). District Laboratory Practice in Tropical countries.- Part 22ndedn. Cambridge University Press.
3. Ryan K. J. and Ray C. G. (2004). Sherris Medical Microbiology. 4th edition.
4. Topley and Wilson's. (1998). Principles of Bacteriology. 9th edn. Edward Arnold, London.
5. Salle. A.J. (1992). Fundamental Principles of Bacteriology. 7th edn. McGraw Hill Inc. New York.
6. Murray P.R., Rosenthal K.S. and Michael A. (2013). Medical Microbiology. Pfaller. 7th edn. Elsevier, Mosby Saunders.

JOURNALS:

1. Indian Journal of Medical Microbiology
2. Diagnostic Microbiology and Infectious disease

E-LEARNING RESOURCES:

1. https://www.icmr.nic.in/sites/default/files/guidelines/Standard_Operating_Procedures.pdf
2. http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S0256-95742015000500034
3. https://journals.lww.com/revmedmicrobiol/Fulltext/2001/01000/Infections_due_to_anaerobic_bacteria_and_the_role.1.aspx
4. <http://www.textbookofbacteriology.net/>
5. <https://academic.oup.com/cid/article/33/6/834/329873>
6. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3470069/>
7. <https://www.dovepress.com/antibiotic-resistance-a-rundown-of-a-global-crisis-peer-reviewed-fulltext-article-IDR#>
8. <https://www.sciencedirect.com/topics/immunology-and-microbiology/virulence-factors>
9. https://www.healthcare.uiowa.edu/path_handbook/Appendix/Micro/micro_spec_collection.html

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Differentiate normal flora from pathogens, principles of Gnotobiosis, analyse the structure and factors contributing to pathogenicity and acquire the skill of sample collection, transport and processing for bacterial identification
CO 2	Effectively use the knowledge acquired on bacterial diseases and classification for diagnosing Gram positive bacteria and spore formers. Analyse the implications of and Mycobacterial diseases and drug resistance in the society.
CO 3	Detect the etiology and virulence factors of Gram negative bacterial diseases, interpreting the laboratory results after following standard operating procedures
CO 4	Use anaerobic cultivation methods for diagnosis of anaerobic infections and molecular, immunological methods for non-cultivable bacteria.
CO 5	Devise appropriate control measures in tackling hospital and zoonotic infections, following bio safety protocols for effective hospital waste disposal and antibiotic control policy in management of drug resistance.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	1	1	2	2	2	2
CO 2	3	3	2	1	2	2	2	2
CO 3	3	3	2	2	2	2	2	2
CO 4	3	3	2	2	2	2	2	2
CO 5	2	3	3	2	2	3	3	2
Average	2.8	3	2	1.6	2	2	2.2	2

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Case Studies, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2,K3, K4	C – 2 x 20 Marks	1500	40	

**SEMESTER I
ELECTIVE
MYCOLOGY AND PARASITOLOGY
(For Our Department Students)**

**TOTAL HOURS: 60
CREDITS: 3**

**COURSE CODE: 16SP18/1E1/MYP
L T P: 3-1-0**

COURSE OBJECTIVES:

1. Illustrate the basics of medically important fungi and parasites.
2. Provide in-depth knowledge on superficial and systemic fungi.
3. Demonstrate the importance of opportunistic infections caused by fungi.
4. Explain the role of protozoans and helminthes as infectious agents.
5. Impart knowledge on diagnosing the diseases and recovering from it.

COURSE OUTLINE:

UNIT I

10Hours

Introduction to Mycology and Parasitology – Classification of Medically important Fungi. (Chander J, 2009) and Parasites (Chatterjee, 2009). Morphology, and Reproduction, Culture media and Preservation of fungal Cultures. Types of parasites and hosts, Cultivation of parasites.

UNIT II

10 Hours

Clinical features, Pathogenesis, lab diagnosis, treatment of Superficial fungi- *Malassezia furfur*, *Piedraria hortae* and *Trichosporon beigeli*. Clinical types of dermatophytoses and pathogenesis. Fungi causing Mycetoma. Systemic fungi- *Histoplasma capsulatum*, *Blastomyces dermatitidis*, *Coccidioides immitis*, *Paracoccidioides brasiliensis*.

UNIT III

10 Hours

Clinical features, Pathogenesis, lab diagnosis and treatment of Fungi implicated in Opportunistic infections- *Candida albicans*, *Cryptococcus neoformans*, *Pneumocystis carinii*. *Pencillium*, *Aspergillus*, *Rhizopus* and *Mucor*. Dematiaceous fungi.

UNIT IV

20 Hours

Protozoology – Sarcodines - *Entamoeba histolytica*, *Acanthamoeba*. Intestinal Flagellates- *Giardia*, *Haemoflagellates- Leishmania donovani*, *Trypanosoma cruzi* and *brucei*, Apicomplexa -*Plasmodium*, *Toxoplasma*, *Cryptosporidium*. Helminthology- *Taenia*, *Echinococcus*, *Enterobius*, *Trichuris*. *Schistosoma*, *Ascaris* and *Ancylostoma* Tissue nematodes- *Wuchereria* and *Brugia Malayi*.

UNIT V

10 Hours

Mycotoxins. Laboratory diagnosis of Fungal and Parasitic infections. Clinical specimens, Collection and Transport, Recovery by Cultural, Immunological and Molecular methods. Antifungal and antiparasitic agents and testing methods .

RECOMMENDED TEXT BOOKS:

1. Fisher, F. and Cook, N.B. (1998). Fundamentals of Diagnostic Mycology. W.B. Saunders Company, Pennsylvania.
2. Chander, J. (2009). A Text book of Medical Mycology. 3rd edn. Mehta publishers.
3. Chatterjee (2009). Medical Parasitology. 13th edition, CBS Publishers, New Delhi.

REFERENCE BOOKS:

1. Parija S. C. (1996). Text Book of Medical Parasitology. 4th edn, Orient Longman, All India Publishers & Distributors.
2. Levanthal, R. and Cheadle, R.S (2012). Medical Parasitology. 6th edn, S.A.Davies Co., Philadelphia.
3. Walter Beck, J. and Davies, J.E (1976). Medical Parasitology. 2nd edn, C.V.Mosby Company, St. Louis. in Books.
4. Alexopolus, C.J. and Mims, C.W. (1995). Introductory Mycology. 4th edn ,John Wiley and Sons, New York.
5. Choidini P L, Moody A H, Manser WM (2001). Atlas of Medical Helminthology and Parasitology. 4th edn, Churchill living stone.

JOURNALS:

1. Studies in Mycology
2. Journal of Parasitology Research

E-LEARNING RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4001330/>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5620758/>
3. <https://www.ncbi.nlm.nih.gov/pubmed/28774698>
4. https://www.researchgate.net/publication/51301540_Histoplasmosis_in_the_acquired_immunodeficiency_syndrome
5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5508608/><https://www.nature.com/articles/s41598-019-48732-x>
6. <https://www.ncbi.nlm.nih.gov/pubmed/28774700>
7. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3104918/>
8. <https://casesjournal.biomedcentral.com/articles/10.1186/1757-1626-2-58>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Identify, Classify and Cultivate medically important fungi and parasites
CO 2	Evaluate the role of superficial and systemic fungi
CO 3	Predict the importance of fungi causing opportunistic infections in immunocompromised individuals.
CO 4	Assess the role of Protozoans and Helminthes in anthroponotic and zoonotic infections.
CO 5	Apply diagnostic techniques to identify, isolate and interpret fungal and parasitic infections and take appropriate preventive and chemotherapeutic measures.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	1	2	1	1	1	1	1
CO2	2	3	3	1	2	2	2	2
CO3	2	3	3	2	2	2	2	2
CO4	2	3	3	2	2	1	2	1
CO5	1	3	3	2	3	2	3	2
Average	2	2.6	2.8	1.8	2.2	1.6	2	1.6

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Case Studies, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER II COURSE PROFILE-PROGRAMME OF STUDY

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/WK	TOTAL HOURS	L-T-P	CA	SA	TOTAL
16SP18/2C/FDY	Food and Dairy Microbiology	4	4	60	3-1-0	40	60	100
16SP18/2C/VLY	Virology	4	4	60	3-1-0	40	60	100
16SP18/2C/ARM	Analytical Tools and Research Methodology	4	4	60	3-1-0	40	60	100
16SP18/2E2/BST	Biostatistics	3	3	45	2-1-0	40	60	100
16SP18/2E/VMC	Vermicomposting and Mushroom Cultivation	3	4	60	3-1-0	40	60	100
PG18/2S/LCE PG18/2S/FRE	*Languages- English or French	2	2	30		40	60	100
16SP18/2C/PR1	General Microbiology and Microbial Physiology	4	4	-	0-0-4			
16SP18/2C/PR2	Medical Microbiology	4	5	-	0-0-4			
	TOTAL CREDITS	28						

SEMESTER II
FOOD AND DAIRY MICROBIOLOGY

TOTAL HOURS: 60
CREDITS: 4

COURSE CODE: 16SP18/2C/FDY
L-T-P: 3-1-0

COURSE OBJECTIVES:

1. Distinguish the intrinsic and extrinsic factors of growth of microbes in food and illustrate the various food preservation techniques
2. Describe the causes of spoilage of different types of food and plan the methods for detecting the causative microbes of food spoilage
3. Detect and interpret the food borne infections, intoxications and prevent food borne outbreaks
4. Demonstrate the basic tests of food quality and production of fermented milk foods at large scale level
5. Implement quality control and represent the standards in food production

COURSE OUTLINE:

UNIT I

10 Hours

Introduction to Food Microbiology - Factors (Extrinsic and Intrinsic) affecting Microbial Growth in food. Microorganisms in Food - Bacteria and Fungi. Determination of Microorganisms in food. Principles of Preservation - Asepsis, High Temperature, Low Temperature, Drying and Food Additives.

UNIT II

15 Hours

Spoilage of Food: vegetables, Fruits, sugar products, Fish and other sea foods, Meat and meat products. Spoilage of canned food. Microorganisms in Foods and methods for detection: Fresh meat, Processed meat, poultry, Fish and sea foods- Culture, Microscopic, and Sampling Method for detecting microbes. Food packaging materials, properties and benefits. Biosensors in food.

UNIT III

10 Hours

Food Borne Infections and Food Poisoning - *Bacillus*, *Clostridium*, *Escherichia*, *Salmonella*, *Shigella*, *Staphylococcus*, *Vibrio*, Nematodes, Protozoa, Algae, Fungi and Viruses. Food borne outbreaks in India.

UNIT IV

10 Hours

Microbiology of Milk-Microbes in Milk, Milk borne Infections. Fermentation of Milk-Souring, Lactic Acid Fermentation, Colour and flavours, Gassy fermentation and proteolysis. Quality Control Tests – Phosphatase, Resazurin and Reductase Tests. Microbiology of Fermented Milk products - Production of Cheese, Yogurt, Buttermilk, Kumis, Kefir, Acidophilus milk and Probiotics.

UNIT V

15 Hours

Good Hygiene Practices, Sanitation in manufacture and retail trade; Food control agencies and their regulations, Hazard analysis and critical control points (HACCP); GMP, Plant sanitation-employees' health standard, waste treatment, disposal, quality control. Bureau of

Indian standards. Food laws and standards in India (FSS). Recent trends and development in food technologies in India.

RECOMMENDED TEXT BOOKS:

1. Frazier, W.C., & West off, D.C. (1988). Food Microbiology 4thedn. Tata McGraw Hill Publishing Company Ltd. New York
2. Jay J.M. (2005). Modern Food Microbiology 4thedn, CBS Publishers and Distributors., New Delhi
3. Prescott and Dunn, (1982), Industrial Microbiology 4thedn, CBS Publishers and Distributors.

REFERENCES:

1. Robinson R. K. (2000). Dairy Microbiology 3rdedn, Elsevier Applied Science, London.
2. Adams M.R, and Moss M.D, (2005). Food Microbiology 4thedn, New Age International Pvt. Ltd., Publishers. First edition.
3. Banwarst. G.J. (2003). Basic Food Microbiology 2nd edn, CBS Publishers and distributors.
4. Hobbs, B.C. and Roberts, D, (1968), Food Poisoning and Food Hygiene 7thedn. Edward Arnold: London.
5. Vijaya R K, (2004). Food Microbiology 1st edn. MJP Publishers, Chennai.

JOURNALS:

1. International Journal of Food Microbiology.
2. Indian Journal of Microbiology and Research

E-LEARNING RESOURCES:

1. <https://academic.oup.com/bioscience/article/65/8/758/240222>
2. <https://www.fda.gov/food/laboratory-methods-food/bam-food-samplingpreparation-sample-homogenate>
3. <https://www.researchgate.net/publication/243462186> Foodborne diseases in India - A review
4. <https://www.researchgate.net/publication/228662659> Fermented Dairy Products Starter Cultures and Potential Nutritional Benefits/link/000084160cf23f86393d5764/download
5. <https://www.uoguelph.ca/foodscience/book/export/html/2002>
6. <https://www.fda.gov/food>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Apply the role of microorganisms, various preservation techniques, and assess the growth factors of food pathogens in food industry.
CO 2	Evaluate food contamination and spoilage, detect food pathogens based on physical, chemical and immunological methods and choose appropriate preservative techniques for food.
CO 3	Identify and Analyse the role of pathogens in food borne infections and food poisoning and create awareness towards food borne outbreaks in India.
CO 4	Assess the techniques in checking Milk quality, fermentation of milk and to perform production of fermented milk foods at large scale level
CO 5	Plan hygiene and sanitation protocol, apply Hazard analysis, Food laws and standards for good quality in food production

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	3	3	3	2	1	2	2	2
CO 2	2	3	3	2	3	2	2	2
CO 3	3	3	3	1	1	3	2	2
CO 4	2	2	3	3	1	2	2	3
CO 5	1	2	3	3	2	1	3	3
Average	2.2	2.6	3	2.2	1.6	2	2.2	2.4

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Case Studies, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

**SEMESTER II
VIROLOGY**

**TOTAL HOURS: 60
CREDITS: 4**

**COURSE CODE: 16SP18/2C/VLY
L-T-P: 3-1-0**

COURSE OBJECTIVES:

1. Teach the structure, cultivation and various strategies of virus replication.
2. Illustrate the role of viruses in diseases in relation to molecular interactions with the infected cell.
3. Impart knowledge regarding the diagnostics, clinical aspects and related implications of human viral diseases and emerging viral infections
4. Describe oncogenic viral infections, prevention and management.
5. Compare advantages and limitations of techniques used in diagnosis of viral infections.

COURSE OUTLINE:

UNIT I

10 Hours

Brief outline of Virology - General properties of viruses- Morphology and Replication Strategies. Cultivation of Viruses – Inoculation in Animals, Embryonated Eggs, Tissue Culture -Estimation of virus yield-Plaque assay and TCID₅₀, methods for purification of Viruses. Virioids, Prions, Satellite RNAs and virusoids. Classification of Viruses- animal Plant Viruses .

UNIT II

15 Hours

Viral diseases of Humans – Morphology, Classification, Pathogenesis, Diagnosis, Prevention and Treatment of Herpes (Herpes Simplex virus, Varicella – Zoster virus, Cytomegalo virus and Epstein Barr virus) Hepatitis, Pox – (Vaccinia and Variola, Molluscum contagiosum) Rhabdo, Orthomyxo, Paramyxo (Respiratory syncytial virus, Mumps virus, Measles virus) Entero – Cocksackie virus and Polio virus, HIV

UNIT III

15 Hours

Arthropod borne Viral Diseases - Toga and Flavi encephalitis, Mosquito borne encephalitis, Tick borne encephalitis, Venezuelan equine encephalitis, Bunya virus encephalitis, West Nile Yellow fever, Sand fly fever, Dengue, Chikungunya, Hanta, Marburg and Ebola. Study of Plant Virus –Tobacco Mosaic Virus and CMV. Viruses of Algae, Fungi and Cyanobacteria. Viral diseases of Crop plants-Paddy, Cotton, Tomato and Sugarcane.

UNIT IV

10 Hours

Viral Oncogenesis – Oncogenic Viruses, Pathogenesis of Cancers, Diagnosis and Prevention. Emerging viral infections. Bacterial Viruses – Structural Organization, Life Cycle, Transcription, Replication- Lytic and Lysogenic Cycles - ϕ X174, M13, MU, T4, Lambda. Phage Typing and its application in Bacterial Genetics.

UNIT V

10 Hours

Interferons, Viral Vaccines – Conventional Vaccines- Killed and Attenuated, Modern Vaccines-recombinant, subunit, DNA, Peptide Vaccines Other Vaccines and Anti-viral Drugs. Diagnosis of viral infections. Modern approaches of virus control-Antisense RNA, siRNA and miRNA.

RECOMMENDED TEXT BOOKS:

1. Jawetz, E., Melnick, J.L. and Adelberg, E.A. (2000). Review of Medical Microbiology. 19th edn. Lange Medical Publications, U.S.A.
2. Timbury, M.C. (1986). Medical Virology. 9th edn. Churchill Livingstone, London.
3. Topley and Wilson. (1995). Principles of Bacteriology, Virology and Immunity. 9th edn. Edward Arnold, London.

REFERENCE BOOKS:

1. Dimmock N. J. and Primrose S. B. (1994). Introduction to Modern Virology. 5th edn. Blackwell Scientific Publishers.
2. Enquist., Krug., Recaniello and Skalka. (2000). Principles of Virology, Molecular Biology, Pathogenesis and control. 3rd edn. ASM Press
3. Morag C. and Timbury M.C. (1994). Medical Virology. 4th edn. Blackwell Scientific Publishers.
4. Conrat H.F., Kimball P.C. and Levy J.A. (1994). Virology. 3rd edn. Prentice Hall, Englewood Cliff, New Jersey.
5. Luria, S.E., Darnel, J.E., Jr., Baltimore, D. and Campbell, A. (1978). General Virology. 3rd Edn. John Wiley & Sons, New York, 1978

JOURNALS:

1. Indian Journal Of Virology
2. Journal Of Virology

E-LEARNING RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/books/NBK8174/>
2. <http://www.ebi.ac.uk/interpro/entry/IPR011222>
3. <https://accessmedicine.mhmedical.com/content.aspx?bookid=1130§ionid=79739575>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4731227/>
5. <https://www.intechopen.com/books/current-issues-in-molecular-virology-viral-genetics-and-biotechnological-applications/vaccines-and-antiviral-agents>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Outline basics and essential concepts of virology which include the structure, classification, pathogenesis, replication, purification and disease control.
CO 2	Compare the lifecycles of major groups of viruses and analyse their role in exploiting the host.
CO 3	Apply contextual knowledge to assess arthropod borne viruses and viral plant diseases and acquire skills about various diagnostics and therapeutic measures for the viral diseases.
CO 4	Analyse and identify oncogenic viral infections and apply the concepts in viral infectious disease control, prevention and Treatment.
CO 5	Discuss viral vaccines and create awareness about the new emerging threats of viral diseases and modern approaches of virus control.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8
CO 1	3	3	1	1	2	2	2	1
CO 2	2	3	2	1	3	1	2	1
CO 3	1	3	2	1	3	1	1	1
CO 4	2	3	2	1	2	2	2	1
CO 5	2	2	2	1	2	2	2	1
Average	2	2.8	1.9	1	2.4	1.4	1.8	1

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Case Studies, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER II
ANALYTICAL TOOLS AND RESEARCH METHODOLOGY

TOTAL HOURS: 60
CREDITS: 4

COURSE CODE: 16SP18/2C/ARM
LTP: 3-1-0

COURSE OBJECTIVES:

1. Learn principles and applications of types of spectrometry
2. Explain principles and applications of types of centrifuge and chromatography techniques
3. Discuss principles of Electrophoresis, PCR, Scintillation counter, biosensors and microbial identification systems.
4. Learn the Art of report and thesis writing
5. Provide insights on importance of scientific communication, ethical issues in research, plagiarism and IPR.

COURSE OUTLINE:

UNIT I

12 Hours

Principles of analytical instrumentation –Techniques and applications of Colorimetry and Spectrophotometry- Beer lamberts Law, Turbidimetry, UV-Vis Spectroscopy, Fourier Transform Infrared Spectroscopy, Fluorescence spectroscopy, NMR spectroscopy, Mass Spectroscopy, Circular Dichroism and Optical Rotatory Dispersion (ORD).

UNIT II

12 Hours

Centrifugation- Basic Principles, Instrumentation, types of Centrifuges and Methods of Centrifugation. Chromatography- Principles and types- Column, Thin layer, Paper, Adsorption, Gas liquid, Ion Exchange, Affinity, HPLC working and applications

UNIT III

12 Hours

Electrophoretic techniques- Native, SDS and 2D. Gel documentation system. PCR principle and applications. Detection and measurement of radioactivity –liquid and solid scintillation counters, Biosensors - Definition, Components of Biosensors, Types –Electrochemical, Enzyme, Environmental Biosensors and Application of Biosensors. Microbial identification systems (API).

UNIT IV

12 Hours

Objectives of Research- Problem identification and formulation, Approaches, design-exploratory descriptive and experimental, steps and Criteria of good research. Writing the research Report-Title, Authors, Address, Abstract, Keywords, Introduction, Review of literature, Materials and Methods, Results, Discussions, Summary, Acknowledgement and Bibliography, Research report- Tables, Figures and Formatting.

UNIT V

12 Hours

Importance of Scientific communication- Types and modes of scientific communications. Journals in Microbiology, Impact factor of Journals, When and Where to publish . Ethical issues related to publishing, Data fudging, Plagiarism and self plagiarism, software to detect plagiarism. Intellectual property rights-Types, patents, copy rights, trade marks, design rights, geographical indications – importance of IPR – patentable and non patentables – patenting life – legal protection of inventions – world intellectual property rights organization (WIPO). Comparison of IPR in India and foreign countries.

RECOMMENDED TEXT BOOKS:

1. Wilson K., Walker J., Clokie S and Hofmann A. (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th edn. Cambridge University Press.
2. N. Gurumani. (2006). Research Methodology for Biological Sciences. MJP Publisher.
3. Boyer R.F. (2002) Modern Experimental Biochemistry 3rd edn. Pearson Education.

REFERENCE BOOKS:

1. Anderson J.B. and Poole M. (2011). Assignment and Thesis Writing. 4th edn. Wiley India Private Limited.
2. Kothari C.R. and Garg G (2004) Research Methodology: Methods and Techniques. 2nd edn. New Age International Publishers
3. Veerakumari L. (2015) Bioinstrumentation 1st edn. MJP Publishers.
4. Ahuja V.K. (2017) Laws Relating to Intellectual Property Rights. Lexis Nexis.
5. Goel D. and Parashar S. (2013) IPR, Biosafety and Bioethics. Pearson Education in South Asia.

JOURNALS:

1. Journal of Biomedical Instrumentation and Applications
2. Indian Journal of Applied Research

E-LEARNING RESOURCES:

1. https://www.researchgate.net/publication/285688809_Spectrophotometry_Biochemical_Applications
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5206469/>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2757927/>
4. <https://www.aresearchguide.com/write-a-report.html>
5. <https://www.wipo.int/about-ip/en/>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Apply the principles and applications of types of spectrometry to various fields of research
CO 2	Demonstrate the applications of types of centrifuge and chromatography techniques for purification of biological substances
CO 3	Design strategies for use of advanced techniques of Electrophoresis, PCR, Scintillation counter, biosensors and microbial identification systems in research
CO 4	Utilize the Art of report and thesis writing for scientific communication
CO 5	Demonstrate the importance of scientific communication, ethical issues in research, plagiarism and IPR.

MAPPING OF COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	2	3	3	3	2	2	2	1
CO 2	2	3	3	3	2	2	2	1
CO 3	3	3	3	3	2	2	2	1
CO 4	2	1	2	2	2	2	2	3
CO 5	3	2	2	2	2	2	2	3
Average	2.4	2.4	2.6	2.6	2	2	2	1.8

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Case Studies, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

**SEMESTER II
ELECTIVE
BIostatISTICS
(For Our department students)**

**TEACHING HOURS: 45
CREDITS: 3**

**COURSE CODE: 16SP18/2E2/BST
L-T-P: 2-1-0**

COURSE OBJECTIVES:

1. Demonstrate the importance of data collection and presentation of data
2. Perform methods used for measuring central tendency, deviation and error
3. Discuss Probability theory and applications
4. Explain Correlation, regression and hypothesis testing methods
5. Identify appropriate method for analysis of variance and learn few statistical packages

COURSE OUTLINE:

UNIT I

10 Hours

Introduction to Bio-statistics, basic concepts, Biostatistics in Research. Data Collection and Analysis Types of data. Sampling – Designs and Types. Representation of data- Tabulation, Frequency distribution, Diagrams and Graphs.

UNIT II

10 Hours

Measures of Central tendency – Mean – Geometric and Harmonic, Median and Mode and percentiles, Measures of dispersion: Range, Quartile deviation, Mean deviation, Standard deviation, Coefficient of variation. Standard error, skewness and kurtosis.

UNIT III

8 Hours

Probability: Random experiment, Events, Sample space, Mutually exclusive events, Independent and dependent events, Statement of addition and multiplication theorems of probability, Random variables (Discrete and continuous), Probability Distributions-Binomial, Poisson and Normal distributions and a few simple problems

UNIT IV

7 Hours

Correlation - Types, Methods, Coefficient of correlation. Regression - Equations, Regression lines. Testing of hypothesis -Null Hypothesis, Alternate hypothesis, Type I and Type II errors. Tests of Significance- Chi-square test, student t test, Z score.

UNIT V

10 Hours

Analysis of variance- ANOVA-one-way classification, Two-way classification, CRD, RBD, LSD, Duncan's multiple range test (DMR). Statistical package- Features of statistical software, SPSS for various applications in Biostatistical programme.

RECOMMENDED TEXT BOOKS:

1. Rastogi V.B. (2011). Fundamental of Biostatistics. 2nd edn, Ane books Pvt.Ltd.
2. Gupta S.P.(2017). Statistical methods. 45th edn, Sultan Chand & Sons Publisher, New Delhi.
3. Snedecar G.W. and Cochran W.G. (1967). Statistical Methods. Oxford Press.

REFERENCE BOOKS:

1. Rosner B. (2016) Fundamentals of Biostatistics, 8th edn. Cengage Learning USA.
2. Pagano M. and Gauvreau K. (2018) Principles of Biostatistics 2nd edn. CRC press.
3. Zar, J.H. (2008). Biostatistical analysis. 4th Edn. Pearson education Inc. New Jersey
4. Daniel, W.W. (1999). Biostatistics: A foundation for analysis in health sciences. 7th edn. John Wiley & Sons, New York.
5. Campbell, R.C.(1969).Statistics for Biologists. Cambridge University Press

JOURNALS:

1. Nature Microbiology
2. Journal of Pure and Applied Microbiology

E LEARNING RESOURCES:

1. <https://www.hopkinsmedicine.org/gim/research/method/biostat.html>
2. <https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php>
3. https://www.researchgate.net/publication/282576221_Proofs_in_Biostatistics_and_Probability
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC374386/>
5. http://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/BS704_HypothesisTesting-ANOVA/BS704_HypothesisTesting-Anova_print.html

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Apply knowledge of data collection and presentation of data in various fields of Microbiology
CO 2	Assess and implement central tendency, deviation and error in the data collected during research
CO 3	Apply the knowledge of probability theory and its applications in research data analysis
CO 4	Use the methods of calculating correlation, regression in research data analysis and test the hypothesis
CO 5	Demonstrate the methods of analysis of variance in research and use statistical packages

MAPPING OF COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	2	3	3	2	2	3	2	1
CO 2	2	3	3	3	2	3	2	1
CO 3	2	3	3	3	2	3	2	1
CO 4	2	3	3	3	2	3	2	1
CO 5	2	3	3	3	2	3	2	1
Average	2	3	3	2	2	3	2	1

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Case Studies, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2,K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER II
NON-MAJOR ELECTIVE
VERMICOMPOSTING AND MUSHROOM CULTIVATION
(For other department students)

TOTAL HOURS: 60
CREDITS: 3

COURSE CODE: 16SP18/2E/VMC
L T P: 3-1-0

COURSE OBJECTIVES:

1. Classify and compare the characteristics of earthworm species and waste materials needed for vermicomposting
2. Describe the process and benefits of vermicomposting.
3. Differentiate edible and poisonous mushrooms and their effects.
4. Outline the process of mushroom cultivation
5. Analyze the pathological damage on mushrooms and outline the post-harvest practices.

COURSE OUTLINE:

UNIT I

10 Hours

Vermicomposting-Definition and scope of vermicomposting. Classification and characters of Earthworm species, requirements for vermicomposting- bedding materials, organic wastes and their sources.

UNIT II

10 Hours

Methods of vermicomposting- small scale (pit method) and large scale (windrow method)-methods of harvesting of earthworms. Application of Vermicompost in agriculture- Benefits to soil and plants.

UNIT III

10 Hours

Definition and General Characteristics – edible and poisonous mushrooms, Symptoms of mushroom poisoning, Nutritional aspects of edible mushrooms – fats, carbohydrates, proteins, vitamins and minerals – Medicinal value of Mushrooms.

UNIT IV

20 Hours

Mushroom cultivation- Culturing of mushrooms – Single spore method and Tissue culture method . Spawn preparation – Mother spawn and Planting spawn. Design of a mushroom farm (Composting yard and bulk pasteurization chamber).Steps in cultivation of button mushroom (*Agaricus bisporus*) - Composting methods (Long and Short) – Formulations of compost- Spawning – Definition and types. Production of crop – Shelf, Tray and Bag system. Casing operation. Harvesting of Mushrooms.

UNIT V

10 Hours

Management of mushroom pests (insects and nematodes). Diseases of mushroom – Bacterial (Bacterial blotch), Fungal (dry bubble and wet bubble) and Viral. Postharvest techniques (Long term and short term).

RECOMMENDED TEXT BOOKS

1. Kumaresan V (2018) Mushroom cultivation 1st edn. Saras Publication.
2. Singh and Singh. (2005). Modern Mushroom cultivation. 1st edn. Agrobiose publishers.India.
3. Dubey and Maheshwari. (2007), A textbook of biotechnology, S.Chand and company

REFERENCE BOOKS

1. Kannaiyan. (1999). Cultivation of Edible Mushrooms. 1st edn. TNAU Publication.
2. Ismail, S.A. (1997). Vermicology-The Biology of Earthworm.1st edn. Orient longman.
3. Russell S (2003) Essential Guide to Cultivating Mushrooms. 1st edn. Storey Publishing LLC
4. Tiwari SC and Kapoor P (2018). Mushroom-The art of Cultivation. 1st edn Mittal Publications.
5. Edwards CA, Arancon NQ ShermanRL. (2011) Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management 1st edn.CRC Press.

JOURNALS:

1. Research & Reviews: Journal of Agriculture and Allied Sciences
2. Annals of Biology

E-LEARNING RESOURCES:

1. http://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
2. <https://www.researchgate.net/publication/313043953>
3. <https://www.researchgate.net/publication/319117708> Insect Mite and Nematode Pests of Commercial Mushroom Production Technology and Applications
4. http://agridaksh.iasri.res.in/html_file/mushroom/white_button_mush.htmwww.fungi.fun.org/mushword/oyster.m/
5. www.mushroom-directory.com/

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Distinguish the types of earthworms and feed needed for vermicomposting.
CO 2	Differentiate various methods of vermicomposting and its benefits to soil and plants.
CO 3	Assess the nutrient and medicinal value of edible mushrooms and analyse effects of mushroom poisoning
CO 4	Apply the various methods of cultivation of button and oyster mushrooms for small-scale industries.
CO 5	Assess the loss of productivity in mushroom yield due to pests and diseases and analyse the post-harvest practices.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	1	0	2	2	0	1	1	3
CO 2	1	0	2	2	0	1	1	3
CO 3	1	2	2	1	1	1	1	3
CO 4	1	0	2	1	1	1	1	3
CO 5	1	0	2	1	0	1	1	3
Average	1	0.4	2	1.4	0.4	1	1	3

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture (Chalk and Talk, LCD), e-Content, Videos, Group discussion, Quiz/ Seminar/ Assignment

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K3	C – 2 x 20 Marks	1500	40	

SEMESTER II PRACTICALS

GENERAL MICROBIOLOGY AND MICROBIAL PHYSIOLOGY

**TOTAL HOURS: 60
CREDITS 4**

**COURSE CODE: 16SP18/2C/PR1
L T P: 0-0-4**

COURSE OBJECTIVES:

1. Demonstrate the general sterilization techniques followed in a Microbiological Laboratory and its quality control with emphasis on biosafety measures.
2. Illustrate the use of microscopes in identifying microbes, determining their size by micrometry and demonstrate the morphology by various staining techniques.
3. Measure bacterial growth, identify optimal growth parameters, cultivate bacteria, and perform antibiotic sensitivity.

COURSE OUTLINE:

1. Cleaning of glassware.
2. Sterilization – Physical agents- Moist heat, Dry heat, Filtration.
3. Sterilization- Chemical agents–
 - a) Phenol Coefficient method
 - b) Agar Plate Sensitivity method
4. Quality Control of Sterilization – Physical, Chemical – Indicator strips. Biological – spore strips.
5. Calibration of Micrometer and measurement of Microbial size.
6. Observation of Algae by Wet Mount.
7. Demonstration of motility of bacteria by Hanging Drop Method.
8. Staining methods – Gram staining, Acid fast staining, Negative staining, Metachromatic granule staining and Spore staining.
9. Preparation of Solid, Liquid and Semi-solid media.
10. Pure culture technique- Streak Plate, Pour Plate and Spread Plate techniques.
11. Demonstrations of Fungi by LPCB mount and Slide culture technique.
12. Anaerobic Culture of bacteria.
13. Measurement of bacterial growth- by direct count and turbidity method.
14. Effect of temperature on Microbial growth and determination of thermal death point.
15. Effect of heavy metals on bacteria- Oligodynamic action.
16. Effect of pH on microorganisms.
17. Effect of UV radiation on microorganisms.
18. Chemotherapeutic agents- Kirby-Bauer method and Synergistic effect of drug combination.

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Apply sterilization, sanitation and disinfection methods with proper quality control in microbiology laboratories for effective use and disposal of microbes
CO 2	Employ microscopes and staining techniques appropriately in determining the shape, size and other attributes of microbes
CO 3	Formulate the parameters for optimal growth of bacteria and ways to combat them using proper antibiotic control techniques

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	2	2	2	1	1	1	3	2
CO 2	2	2	2	2	1	1	2	2
CO 3	2	3	2	2	2	2	2	2
Average	2	2.3	2	1.7	1.3	1.3	2.3	2

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Demonstration and experimentation.

QUESTION PAPER PATTERN:

Time : 9 Hours (3 hours, 3 days)

Max. Marks: 60

Major- 25 marks

Minor-15 marks

Spotters- 5 x 2 =10 marks

Record – 5 marks

Viva- voce- 5 marks

**SEMESTER II
PRACTICALS
MEDICAL MICROBIOLOGY**

**TOTAL HOURS: 75
CREDITS: 4**

**COURSE CODE: 16SP18/2C/PR2
L-T-P : 0-0-5**

COURSE OBJECTIVES:

1. Discuss the importance and role of normal flora and pathogenic microbes.
2. Provide hands on exposure to processing of clinical specimens and laboratory diagnosis of microorganisms using different techniques.
3. Develop diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases

COURSE OUTLINE:

BACTERIOLOGY

1. Collection and transport of clinical specimens.
2. Direct examinations – wet films for faeces, staining for Pus, Sputum, Throat / Ear/Nasal /Wound swabs.
3. Differential and Special Staining methods- AFB, Metachromatic, Capsular-positive, Flagella.
4. Cultivation and Isolation methods – Basal, Differential, Enriched, Selective and Special media for the Pathogenic Bacteria.
5. Isolation and identification biochemical identification test for the respective Bacteria- *Staphylococcus*, *Streptococci*, *E.coli*, *Klebsiella*, *Pseudomonas*, *Proteus*, *Salmonella*, *Shigella*.
6. Antibiotic Sensitivity Tests — Disc Diffusion - Stokes and Kirby Bauer methods.
7. MBC and MIC techniques – Agar and broth dilution methods.
8. Beta-Lactamase activity- Acidometric method, Iodometric method.

VIROLOGY

9. Isolation and characterization of Bacteriophage from natural resources.
10. Phage titration.
11. Inoculation of Virus into Chick Embryo – CAM and yolk Sac.
12. Observation of Viral inclusions and CPE stained smears.
13. Detection of viral infections by ELISA.

MYCOLOGY

14. KOH observation of Skin, Hair and Nail scrapings for fungi, Woods Lamp Examination.
15. Preparation of fungal media- SDA/ Corn Meal Agar- Cultural and Microscopic characteristics of *Mucor*, *Rhizopus*, *Aspergillus*, *Penicillium*, *Candida*, Dermatophytes, *Fusarium*, *Curvularia*.
16. Slide Culture and LPCB mount, Chlamydospore formation on CMA.
17. Detection of *Candida albicans*- Germ tube test. Sugar Assimilation and Fermentation.

PARASITOLOGY

18. Examination of Parasites in Clinical specimens – ova / cysts in faeces - Direct and Concentration methods –Formal Ether and Zinc sulphate methods, Saturated Salt Solution Method.
19. Blood smear examination of Malarial Parasites –Leishman's stain.

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Isolate and identify bacterial pathogens from clinical specimens through biochemical and antimicrobial sensitivity testing procedures.
CO 2	Utilize practical skills for virus cultivation procedures using embryonated eggs and apply the scientific methods in identifying viruses from clinical samples.
CO 3	Evaluate the role of microorganisms in a range of diseases and apply cultivation and identification methods for fungi and parasites.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO NUMBER	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	3	3	3	3	2	2	2	1
CO 2	3	3	2	3	2	2	2	1
CO 3	3	3	3	3	2	3	2	1
Average	3	3	2.6	3	2	2.3	2	1

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Demonstration and experimentation.

QUESTION PAPER PATTERN:

Time : 9 Hours (3 hours, 3 days)

Max. Marks: 60

Major- 25 marks

Minor-15 marks

Spotters- 5 x 2 =10 marks

Record – 5 marks

Viva- voce- 5 marks

SEMESTER III COURSE PROFILE-PROGRAMME OF STUDY

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/WK	TOTAL HOURS	L-T-P	CA	SA	TOTAL
16SP18/3C/ILY	Immunology	4	4	60	3-1-0	40	60	100
16SP18/3C/EMY	Environmental Microbiology	4	4	60	3-1-0	40	60	100
16SP18/3E3/INP	Industrial and Pharmaceutical Microbiology	3	4	60	3-1-0	40	60	100
16SP18/3E/GLP	Gardening and Landscaping	3	4	60	3-1-0	40	60	100
16SP18/3S/CSC	Computing Skills for competitive examinations	2	2	30	1-1-0			
16SP18/4C/PR3	Immunology and Molecular Biology	-	4	-	0-0-4	40	60	100
16SP18/4C/PR4	Environmental Microbiology	-	4	-	0-0-4	40	60	100
16SP18/4C/PR5	Food and Industrial Microbiology	-	4	-	0-0-4	40	60	100
	TOTAL CREDITS	18						

**SEMESTER III
IMMUNOLOGY**

TOTAL HOURS: 60

COURSE CODE: 16SP18/3C/ILY

CREDITS: 4

L-T-P: 3-1-0

COURSE OBJECTIVES:

1. Introduce basic concepts in Immunology.
2. Provide insights to the Human Defense Mechanisms against Infections.
3. Study various applications of Immunological Techniques.
4. Discuss the importance of Immunity, Immune Response and Vaccines.
5. Illustrate the mechanisms of Autoimmune, Immunodeficiency Disorders.

COURSE CONTENT:

UNIT I

10 Hours

Introduction - History, Scope OF Immunology and Recent development. Cells of Immune system. Hematopoiesis. Lymphoid Organs. T cell receptors, B cell receptors and other specific receptors. Inflammation. Lymphocyte trafficking.

UNIT II

15 Hours

Antigens and Antibodies – Antigens - Factors Influencing Antigenicity, Epitopes, Haptens, Superantigen, Mitogen, Adjuvants. Sequestered antigens. Antibodies - Structure, Types and Functions. Theories of antibody production and class switching. Production of monoclonal and polyclonal antibodies. Antigen Antibody Interactions - Agglutination and Precipitation reactions. Principles and Applications of RIA, ELISA, ELISPOT, Immunofluorescence, Nephelometry, FACS analysis.

UNIT III

15 Hours

Infection and Immunity. Introduction and Classification of immunity - Innate and Acquired. Factors involved in Immunity. Complement. Host Parasite Relationship. – Immune response against bacterial, viral, fungal and helminthic infections. Evasion of immune defense. MHC - Definition, Structure, Types, Function and MHC restriction. HLA typing and its application in organ transplantation.

UNIT IV

10 Hours

Immunoprophylaxis. Active and Passive Immunization. Latest Immunization schedule. Vaccines – Introduction and types. Recent vaccines. Hypersensitivity– Introduction, types and treatment. Skin test. Immunosuppressive drugs.

UNIT V

10Hours

Autoimmune Diseases. Types - cell Mediated, organ specific immune inflammatory, Humoral Mediated. Treatment of Autoimmune diseases. Immunodeficiency disorders. Immunotolerance and anergy. Oncoimmunology - An overview. Immunotherapy

RECOMMENDED TEXT BOOKS:

1. Kuby, J.(2006). Immunology 2nd edn. H.W.Freeman and company. New York.
2. Janeway C, Travers P, Walport M, Sholmchik M.(2004). Immunobiology 6th edn Gerald Science
3. Roitt R.I.M(2001). Essential Immunology.10th edn. Blackwell Scientific Publishers.

REFERENCEBOOKS:

- 1.Stites D.P.,Abba I.Terr, Parslow T.G.(1997). Medical Immunology. 9thedn, Prentice-Hall Inc.
- 2.Tizard, R.I.(2000) Immunology- An Introduction. 4thedn. Saunders College Publishing, Philadelphia.
3. Nairn, R., & Helbert, M.(2006). Immunology for Medical Students. 2nd edn. Mosby International limited.
- 4.Humphrey, J.H. and White, R.G. (1995). Immunology for Students of Medicine, 5th edn. ELBS, London
- 5.Ananthanarayanan, R, & Panicker,C.K.J. (2013). Textbook of Microbiology. Orient Longman.

JOURNALS:

1. Indian Journal of Experimental Biology.
2. Journal of Clinical Immunology.

E-LEARNING RESOURCES:

1. <https://www.mechanobio.info> › Development
- 2.<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2581910>
- 3.<https://microbiologybook.org/mayer/ab-ag-rx.htm>
- 4.https://www.ebi.ac.uk/interpro/potm/2005_2/Page2.htm
- 5.<https://www.nejm.org/medical-research/autoimmune-disease>

COURSE OUTCOME:

	CO STATEMENT
CO 1	Discuss cells and organs of immune system and its role in types of immunity
CO 2	Evaluate the reactions between various antigens and antibodies and apply the knowledge in diagnosing diseases and disorders
CO 3	Analyse the concepts and factors influencing immunity, HLA typing and its applications and compare the role of MHC in graft rejection in transplantation and plan appropriate strategies
CO 4	Employ the principles of immunity for vaccine development and analyse types of hypersensitivity reactions
CO 5	Evaluate autoimmune and immune deficiency disorders and apply immunotherapy in modulating oncogenesis.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	2	3	1	-	-	1	1	1
CO 2	1	3	3	2	2	1	1	2
CO 3	1	3	1	2	2	1	1	1
CO 4	1	3	2	2	2	1	1	1
CO 5	2	1	1	1	2	1	1	1
Average	1.4	2.6	1.6	1.4	1.6	1	1	1.2

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Case Studies, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER- III
ENVIRONMENTAL MICROBIOLOGY

TOTAL HOURS: 60
CREDITS: 4

COURSE CODE: 16SP18/3C/EMY
LTP: 3-1-0

COURSE OBJECTIVES:

1. Describe the distribution and enumeration of air microflora and categorize the air borne diseases.
2. Illustrate the process of sewage water treatment and determine the role of microorganisms in water pollution and water quality
3. Discuss the ability of microorganisms to produce food, fuel and mitigate environmental pollution.
4. Outline the beneficial activities of soil microbes in mobilization of major nutrients
5. Explain the role of microbes in plant pathogenesis

COURSE OUTLINE:

UNIT I

10 Hours

Microbiology of Air- Droplet Nuclei, Aerosols, Air borne transmission of Microbes. Assessment of air quality settlement under gravity, filtration technique, centrifugation, Impingement in solid and liquid, air Sanitation and air borne diseases – Bacterial, fungal, viral and protozoan.

UNIT II

15 Hours

Microbiology of potable water – Municipal water treatment. Sewage treatment process – Primary treatment process-screening and straining, grit removal, sedimentation, flotation, Coagulation and Flocculation, Secondary treatment process – Aerobic and Anaerobic, and tertiary treatment- Disinfection. Disposal of sewage sludge. Water borne Diseases. Microbiological examination of water quality – Multiple tube test, Membrane filtration technique and BOD. Water Pollution.

UNIT III

10 Hours

Utilization of Solid Waste as Food, Feed and Fuel- Composting, Vermicomposting, Biogas production, Single Cell Proteins, Biodegradation of Xenobiotics - Recalcitrant Halocarbons, Recalcitrant, TNTs, PCBs, Synthetic polymers, Leather and Paper, Saccharification and pyrolysis. Pollution control bodies and Environmental laws in India.

UNIT IV

10 Hours

Distribution of Microorganisms in Soil, Rhizosphere effect, Rhizosphere ratio, Rhizosphere, Spherosphere, Phyllosphere. Biofertilizer – Uses and Production of *Rhizobium sp.*, *Azotobacter sp.*, *Azospirillum sp.* *Cyanobacteria* and Phosphate solubilisers. Distribution and significance of Extremophiles.

UNIT V

15 Hours

Plant microbial disease-Causative agents, disease cycle and control of Rust, Red-rot in sugarcane, Citrus Canker, Soft rot in carrot, Crown gall disease. Bunchy top, angular leaf spot of cotton and Damping off of tobacco. Biopesticides – Fungal – Bacterial, and Viral.

RECOMMENDED TEXT BOOKS:

1. Atlas R. M and Bartha R. (1992). Microbial Ecology Fundamentals and Applications. 3rd edn Benjamin & Cummings Redwood City .CA
2. Agrios,G N (1978). Plant pathology 2nd edn Academic press, NewYork.
3. Subbarao.N.S. Biofertilizers in Agriculture and Forestry, 3rd edn. Oxford and IBH Publishing co. Pvt Ltd.

REFERENCE BOOKS:

1. Rheinheimer .G (1980). Aquatic Microbiology 2nd edn. John Wiley And Son, London.
2. Subba Rao.N.S. (2005) Soil microorganisms and Plant Growth. 4th edn. Oxford and IBH Publishing Pvt Ltd
3. Daniel, C.J. (1996). Environmental Aspects of Microbiology, 1st edn. Bright Sun Publications.
4. Maier RM, Pepper IL, Gerba CP (2008). Environmental Microbiology, 2nd edn. Academic Press
5. Buckley RG. (2016) Environmental Microbiology 1st edn. CBS Publishing.

JOURNALS:

1. Nature Environment and Pollution Technology
2. Journal of Environmental Sciences.

E -LEARNING RESOURCES:

1. <https://www.academia.edu/37403579>
2. http://agritech.tnau.ac.in/crop_protection/sugarcane_diseases/sugarcane_d4.html
3. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5231>
4. <http://www.fao.org/3/t0551e/t0551e05.htm>
5. www.environmentshumail.blogspot.in/
6. <https://serc.carleton.edu/microbelife/index.html>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Infer the activities and functions of air microflora and their impact on air quality.
CO 2	Analyse and categorize the crucial role of microbes in sewage water treatment, water pollution and water quality.
CO 3	Appraise the microbial processes involved in the treatment of solid wastes and determine its ability in production of food fuel and biodegradants.
CO 4	Compare and contrast the role and benefits of soil microbes in nutrient cycling and plant growth.
CO 5	Assess the survival and spread of microbes through plant pathogenesis and apply microbes as biopesticides.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	2	2	0	1	1	1	0
CO 2	3	2	2	0	2	1	1	0
CO 3	2	0	3	3	1	1	3	3
CO 4	3	0	3	3	1	1	1	2
CO 5	3	3	3	2	0	1	3	1
Average	2.8	1.4	2.6	1.6	1	1	1.8	1.2

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk, LCD)
2. Flipped Learning, e-Content, Videos
3. Group discussion
4. Quiz/ Seminar/ Assignment

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER- III
ELECTIVE (for Our Department Students)
INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

TEACHING HOURS: 60
CREDITS: 3

COURSE CODE: 16SP18/3E3/INP
LTP 3-1-0

COURSE OBJECTIVES:

1. Describe industrial fermentation processes.
2. Explain the Construction, Design and Operation of Fermentor.
3. Provide insights on Downstream process.
4. Introduce the concepts of Industrial production of Microbial products.
5. Illustrate the Principles of Pharmaceutical Microbiology.

COURSE CONTENT:

UNIT I

10 hours

Introduction- Scope of Industrial Microbiology and Fermentation technology. Study of Industrially important Microorganisms (GRAS) and their preservation. Criteria for selection and strategies for Strain Improvement, maintenance and containment of recombinant organisms.

UNIT II

10 hours

Fermentation process- batch and continuous culture kinetics; effect of environment, temperature, pH, nutrient concentration, monitoring microbial growth in culture; cell number, direct and indirect methods. Continuous culture, Aeration and agitation- concepts of Newtonian and Non-Newtonian fluids, plastic fluids, apparent viscosities; antifoam agents. Inoculum development – Yeast, Bacteria and Mycelium. Scale up process.

UNIT III

10 hours

Basic features, design, components of a typical fermentor, different types of fermentor. Instrumentation and control of fermentation. Fermentation media – formulation strategies- sources of carbon and nitrogen, vitamins and minerals; role of buffers, precursors, inducer and inhibitors. Industrial sterilization – sterilization of media, air and equipment - Batch and continuous sterilization.

UNIT IV

15 hours

Down-Stream Processing- Choice of recovery process, biomass separation from fermentation media- Precipitation, filtration, centrifugation, Cell disruption for intracellular products, solvent extraction and recovery, chromatography, membrane processes, drying, crystallization and whole broth processing. Industrial production of aminoacids, enzymes- amylase, Protease and pectinase, alcoholic beverages – Wine and Beer. Industrial effluent treatment.

UNIT V

15 hours

Pharmaceutical Microbiology- Production of vitamins, antibiotics, steroids and Vaccines, interferons and interleukins and therapeutic enzymes. Sterility testing of pharmaceutical products and quality assurance- GMP, QC of raw materials and Microbiological assays.

Recent trends of biotechnological and microbiological patents. Government regulations for microbial products.

RECOMMENDED TEXT BOOKS:

1. Stanbury, P. F., Whitaker, A., and Hall, S.T. (2017). Principles of Fermentation Technology 3rd edn. Pergamon press.
2. Reed,G. (2004). Prescott and Dunn’s Industrial Microbiology, 4th edn, CBS publication and distributors.
3. Patel A.H (2012). Industrial Microbiology. 2ndednMac Millan India Pvt Ltd.

REFERENCE BOOKS:

1. Cruger, W., Anneliese, C and Aneja, K.R (2017). Biotechnology-A textbook of Industrial Microbiology, 3rd edition, Medtech publisher.
2. Casida, J. E. (1968) Industrial Microbiology.John &Wily Eastern.
3. Sivakumar, P.K., Joe, M.M and Sukesh, K (2010). An introduction to Industrial Microbiology. 1stedn, S.Chand and Company Ltd, New Delhi.
4. Pepler, H.J. and Pearl Man, D. (1979). Fermentation Technology, Vol 1 & 2, 2nd edn Academic Press, London.
5. E1-Mansi, E.M.T., Bryce, C.F.A., Demain, A.L. and Allman,A.R. (2007). Fermentation Microbiology and Biotechnology. 2nd edition, CRC press, Taylor and Francis Group.

JOURNALS:

1. Journal of Industrial Microbiology and Biotechnology.
2. Journal of International pharmaceutical research.

E -LEARNING RESOURCES:

1. <http://www.biologydiscussion.com/microbiology-2/microorganisms-microbiology-2/role-of-microorganisms-in-industrial-processes-microbiology/84754>
2. <https://www.rheosense.com/applications/viscosity/newtonian-non-newtonian>.
3. <http://technologyinscience.blogspot.com/2012/08/different-types-of-fermentors.html#.XWj58y4zbIU>
4. <http://www.biologydiscussion.com/biotechnology/downstream-processing/stages-in-downstream-processing-5-stages/10160>
5. <https://www.upcounsel.com/intellectual-property-examples>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Assimilate knowledge on basics and different stages in Industrial fermentation process.
CO 2	Analyse the principles of growth kinetics, methods of measure microbial growth measurement and inoculum development process in industries
CO 3	Apply theoretical knowledge on design, construction and working of different types of fermenters and medium formulation on an industrial scale.
CO 4	Plan industrial production of microbial products and stages in downstream process.
CO 5	Analyse production of pharmaceutical products in detail and apply information on recent trends in biotechnological and microbiological patents in industries

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO7	PSO8
CO 1	2	1	2	2	1	1	1	1
CO 2	2	1	1	2	1	1	1	1
CO 3	2	1	2	3	1	2	1	2
CO 4	2	1	2	3	2	2	1	2
CO 5	2	2	3	3	2	2	2	2
Average	2	1.2	2	2.6	1.4	1.6	1.2	1.6

KEY: STRONGLY CORELATED-3 MODERATELY CORELATED-2 WEAKLY CORELATED-1 NO CORELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Assignment, Quiz, Peer Learning and Seminar.

QUESTION PAPER PATTERN-

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER III
NON MAJOR ELECTIVE
GARDENING AND LANDSCAPING
(For other Department Students)

TOTAL HOURS: 60
CREDITS: 3

COURSE CODE: 16SP18/3E/GLP
LTP: 3-1-0

COURSE OBJECTIVES:

1. Illustrate the different principles of gardening
2. Introduce basic concepts on history and style of gardening
3. Study about Lawn making and Nursery management
4. Provide insights on plant species used in gardening.
5. Demonstrate the nuances of Landscaping.

COURSE CONTENT:

UNIT I

10 Hours

Fundamentals of ornamental horticulture – principles of gardening. Methods of plant propagation- seed, cutting, grafting and layering -advantages and disadvantages.

UNIT II

15 Hours

History of gardening in India-Styles of garden- components of garden Methods of planting of flowerbed, hedges, topiary, water garden, paved garden - maintenance.

UNIT III

15 Hours

Lawn making- types of grasses- methods of planting–maintenance. Nursery management. Operations and maintenance of a nursery, media and containers, Nursery practices for roses.

UNIT IV

10 Hours

Important plant species in gardening. Definition, Classification, Planting and maintenance of annuals- trees, shrubs, climbers and creepers.

UNIT V

10 Hours

Basic concepts and art principles of landscaping- Indoor Landscaping –Requirements for Indoor gardening, Gardening in tubs and hanging baskets- Residential landscape design.

RECOMMENDED TEXT BOOKS:

1. Sheela, V.L. (2011). Horticulture. 1st Edition. MJP Publishers.
2. Randhawa and Amitabha (1998). Floriculture in India. 1st Edition. Allied Publishers.
3. Alan. T (1985). Green house gardener. 1st Edition. Marshall Cavendish Books.

REFERENCE BOOKS:

1. Flemer William. (1972). Nature’s guide to successful gardening and landscaping. 1st Edition. Crowell publications.
2. Ann Reilly. (1990) Home Landscaper. 1st Edition. Home Planners.
3. Black and Decker. (1993). Landscape design and construction. 1st Edition. Random House, Canada.
4. Patrick Taylor. (1998). The Oxford Companion to the Garden. 2nd Edition. Oxford University Press.
5. Kumar, N. (2010). Introduction to Horticulture. 1st Edition. Oxford and ibh Publishers.

JOURNALS:

1. Journal of Horticulture
2. Horticultural Plant Journal

E-LEARNING RESOURCES:

1. https://www.academia.edu/30203259/fundamentals_of_horticulture_and_production_technology_of_fruit_crops
2. <http://eagri.org/eagri50/HORT281/pdf/lec34.pdf>
3. http://agritech.tnau.ac.in/horticulture/horti_Landscaping_lawn%20making.html
4. <https://www.housebeautiful.com/uk/garden/a585/top-tips-garden-maintenance/>
5. <https://www.gardendesign.com/landscape-design/>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Outline fundamentals of gardening and seed propagation
CO 2	Discuss the history of gardening and various styles of gardening
CO 3	Create ideas on Lawn making and plantsmaintenance in Nurseries
CO 4	Cultivate different plant species in gardens
CO 5	Identify various types of Landscaping.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	1	1	1	1	1	1	1	1
CO 2	1	1	1	1	1	1	1	1
CO 3	1	1	1	1	1	1	1	1
CO 4	1	1	1	1	1	1	1	1
CO 5	1	1	1	1	1	1	1	1
Average	1	1	1	1	1	1	1	1

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Teaching by showing plant specimen, OHP, Assignment, Quiz, Seminar and Garden diagrammatical representations.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3	C – 2 x 20 Marks	1500	40	

SEMESTER III
SOFT SKILL
COMPUTING SKILLS FOR COMPETITIVE EXAMINATIONS

TOTAL HOURS: 30
CREDITS: 2

COURSE CODE: 16SP18/3S/CSC
L-T-P: 1-1-0

COURSE OBJECTIVES

1. Learn basic mathematics required for competitive exams.
2. Impart logical reasoning and quantitative aptitude.
3. Provide knowledge to challenge the competitive examinations

COURSE CONTENT:

UNIT I

10 Hours

Basic Mathematics – BODMAS. Arithmetic rules – Commutativity of addition and multiplication, Arithmetic and Geometric Progression. Factorization - HCF. LCM. Fractions – Proper, Improper, Mixed and Equivalent fractions. Area and perimeter. Basic Algebra.

UNIT II

10 Hours

Calculation of Mean and Average. Ratio and proportion. Direct and inverse proportions. Exponents and power. Square roots and cube roots. Linear equations. Weights and Measures. Metric conversions. Percentage. Profit and Loss.

UNIT III

10 Hours

Problem solving in relation with logical reasoning, day and date, hour and seconds, time and direction, velocity and direction of Train. Missing numbers. Series of Alphabets. Alphabet and Number codes. Interpretation from Union and Intersect. Data handling - Pie charts and graphs.

RECOMMENDED TEXT BOOKS:

1. Dr. Surender Singh. UGC NET Paper I. Tata McGraw Hill Education.
2. S. Chand .Quantitative aptitude for competitive examinations. S. Chand publications 7th edition.

REFERENCE BOOKS:

1. Timothy Gowers .The Princeton companion to Mathematics. First edition. Princeton University Press.
2. Dr. R. S Agarwal. A Modern Approach to verbal and Nonverbal Reasoning. S. Chand publications.

JOURNALS:

1. The Journal of Indian Mathematical Society.
2. Kragujevac Journal of Mathematics

E- LEARNING RESOURCES

1. <http://www.csirhrdg.res.in/>.
2. <http://www.math.com/>.
3. <https://www.test-preparation.ca/metric-conversion-practice-questions/>
4. <https://www.javatpoint.com/reasoning>
5. <https://www.indiabix.com/aptitude/questions-and-answers/>

COURSE OUTCOME

CO NUMBER	CO STATEMENT
CO 1	Outline the basic concepts and formulae in Mathematics
CO 2	Compute metric conversions and apply them in various practical circumstances.
CO 3	Appraise various patterns of logical reasoning and aptitude based questions which forms the important criteria in competitive examinations.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	1	2	3	2	1	3	2	3
CO 2	1	2	3	2	1	3	2	3
CO 3	3	3	3	2	2	3	2	3
Average	1.6	2.3	3	2	1.3	3	2	3

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY

Lecture by chalk and talk, Computing problems, LCD Classes, OHP, Group Discussion, Quiz, Peer Learning.

QUESTION PAPER PATTERN:

Time: 3 Hours

50 Objective type questions

Max. Marks: 50

50x 1= 50 marks

SEMESTER IV COURSE PROFILE-PROGRAMME OF STUDY

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOUR S/WK	TOTAL HOURS	L-T-P	CA	SA	TOTAL
16SP18/4C/MBY	Molecular Biology and Recombinant DNA Technology	4	4	60	3-1-0	40	60	100
16SP18/4C/PRO	Project	4	5	60		40	60	100
16SP18/4E4/MIG	Microbial Genetics	3	4	60	3-1-0	40	60	100
16SP18/4E5/BIF	Bioinformatics	3	3	45	2-1-0	40	60	100
16SP18/4S/EEP	Essentials of Entrepreneurship	2	2	30	1-1-0	40	60	100
16SP18/4C/PR3	Immunology and Molecular Biology	4	4	60	0-0-4	40	60	100
16SP18/4C/PR4	Environmental Microbiology	4	4	60	0-0-4	40	60	100
16SP18/4C/PR5	Food and Industrial Microbiology	4	4	60	0-0-4	40	60	100
	TOTAL CREDITS	28						

SEMESTER- IV
MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY

TOTAL HOURS: 60
CREDITS: 4

COURSE CODE: 16SP18/4C/MBY
LTP: 3-1-0

COURSE OBJECTIVES:

1. Provide basic concepts in classification and structure of proteins, lipids, plasmids
2. Explain the application of various gene cloning vectors
3. Provide in depth knowledge in artificial gene transfer mechanisms and selection of recombinants
4. Discuss the importance of various molecular techniques
5. Learn the application of genetic engineering in various fields.

COURSE OUTLINE

UNIT I

10 Hours

Proteins: structural classification of proteins, primary, secondary, tertiary, quaternary structures of proteins. Ramachandran plot. Lipid Composition of Microorganisms - common types of membrane lipids: Phospholipids, Cholesterol, Glycolipids, Archaeal Lipids, ganglioside, cerebroside, sphingomyelin, triacylglycerols, arachidonic acid, properties. Plasmids - Nomenclature, General properties of plasmids- replication, copy number, host range and Incompatibility. Structure and uses of natural plasmids. Plasmids encoding metal resistance and plasmids for degradation of recalcitrant compounds (PAH, PCB).

UNIT II

10 Hours

Gene cloning. Isolation of DNA - Bacteria, Phage, Plasmid, Plant and animal DNA. DNA modifying enzymes and their applications: DNA polymerases, Terminal deoxynucleotidyl transferase, kinases and phosphatases, topoisomerases methylases, reverse transcriptase and DNA ligases. Restriction endonucleases, Use of linkers and adaptors. Cloning vectors – Plasmids pBR322, pUC vectors. Shuttle vectors. λ Phages, M13 phage. Cosmids, Phagemids. Artificial chromosomes -YAC and BAC, Baculovirus based vectors.

UNIT III

10 Hours

Transformation. Artificial techniques - Calcium chloride induction, electroporation, microinjection, biolistic method liposome and viral-mediated delivery, *Agrobacterium* - mediated delivery. Methods of selection of recombinants- *E. coli* and yeast genomic and cDNA libraries - construction and screening.

UNIT V

15 Hours

An overview of applications of Genetic Engineering – Production of recombinant protein in prokaryotes and eukaryotic cells. Agriculture- transgenic plants, Antisense technology, Medicine- gene therapy for inherited diseases, recombinant pharmaceuticals- Vaccines, growth hormones, Insulin, Blood products. DNA analysis in forensic science.

UNIT IV

15 Hours

Molecular techniques - colony and plaque hybridization probes. Gene probes - Reporter Genes. Southern, Northern and Western blot, Dot and Slot blotting. PCR- Hot start, nested, RT- PCR, Real time, Multiplex PCR. DNA finger printing, RFLP and RAPD

RECOMMENDED TEXT BOOKS:

1. Brown T. A. (1995). Gene Cloning. 4th edn Chapman and Hall.
2. Russell P.J, (2010). Genetics-a molecular approach 3rd edn, Benjamin Cummings.
3. Bernard R. Glick and Jack J. Pasternak (1998). Molecular Biotechnology.3rd edn ASM Press, Washington, D.C.

REFERENCE BOOKS

1. Nelson, D.L and Cox, M.M. (2008). Leininger Principles of Biochemistry, 5th edn. W.H. Freeman and Company.
2. Watson, J. D., Gilman, M., Witkowseski, J., (1992). Recombinant DNA, 2nd edn, Scientific Books.
3. Old R. W. and Primrose S. B. (1989). Principles of Gene Manipulation. 4th edn. Black well Scientific Publications, London.
4. Frifelder D. (1995) Molecular Biology. 4th edn Narosa Publishing House, New Delhi.
5. Glover, D.M. (1984) Gene Cloning: The Mechanism of DNA Manipulation.2nd edn Chapman and Hall, London.

JOURNALS:

1. Journal of Molecular Biology
2. Indian Journal of Biotechnology

E-LEARNING RESOURCES:

1. <https://www.molbiotools.com/usefullinks.html>
2. <https://geneticgenie.org>
3. <https://www.nestgrp.com/molbiol.shtml4>
4. <https://www2.mrc-lmb.cam.ac.uk/>
5. www.restrictionmapper.org/links.htm

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Identify the importance of proteins, lipids and properties of plasmids in rDNA technology
CO 2	Evaluate the role of Vectors in Gene Cloning
CO 3	Apply the principles of selection, construction, screening of recombinants and application of artificial transformation techniques.
CO 4	Utilize the Molecular Techniques for DNA and Protein analysis
CO 5	Discuss the application of Genetic Engineering in the field of Agriculture and medicine towards scientific research

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	1	1	0	0	1	0	0	1
CO 2	0	1	0	1	3	1	0	1
CO 3	0	1	0	1	1	1	0	1
CO 4	0	1	0	0	3	2	1	2
CO 5	2	1	2	2	3	3	3	3
Average	0.6	1	0.4	0.8	2.2	1.4	0.8	1.6

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Computing problems, LCD Classes, OHP, Group Discussion, Quiz, Peer Learning

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER 1V
ELECTIVE
MICROBIAL GENETICS
(For our department students)

TOTAL HOURS: 60
CREDITS: 3

COURSE CODE: 16SP18/4E4/MIG
L T P: 3-1-0

COURSE OBJECTIVES:

1. Provide a deeper knowledge in structure, replication and repairing mechanisms of DNA
2. Illustrate the significance and functions of RNA.
3. Distinguish the types and importance of Mutations.
4. Discuss the gene regulation mechanisms in prokaryotes and eukaryotes.
5. Explain different types of gene transfer mechanisms.

COURSE OUTLINE:

UNIT I

15 Hours

Organization of genetic material in prokaryotes and eukaryotes, Concept of gene, genome, genome size, C-value, and C-value paradox. Composition and Structure of DNA - super helicity of DNA, linking number, topological properties and role of topoisomerase. Structure of A-DNA, B-DNA and Z-DNA. Replication in Prokaryotes – Models of DNA replication – Replisome, unidirectional and bidirectional replication, Rolling circle replication. Enzymes involved in replication. Replication in Eukaryotes. Repair of DNA damage- mismatch repair, photo reactivation, excision repair, SOS, recombination repair.

UNIT II

10 Hours

Structural features of RNA (rRNA, tRNA, mRNA) and polycistronic and monocistronic RNA. Transcription, Post transcriptional modification, maturation and splicing of RNA transcripts and catalytic RNA. Genetic code and wobble hypothesis. Protein synthesis and Inhibitors of protein synthesis. Post translational modification. An overview of protein sorting and transport.

UNIT III

10 Hours

Mutation, mutants and mutagenesis -Spontaneous and induced mutation, different types of mutants, molecular basis of mutagenesis, site specific, random and Tn mutagenesis. Transition, transversion and tautomeric shifts. Point mutations and consequences-silent mutation, missense mutation, nonsense mutation. Mutagenic chemicals and radiations and their mechanisms of actions – EMS, MMS, acridines, NTG, Hydroxylamine -Mutagenic radiations -UV and gamma rays, Importance of mutation. Mutation toxicity testing

UNIT IV

10 Hours

Transcriptional regulation in prokaryotes (inducible and repressor system, positive and negative regulation) Operon concept-lac and trp operons. Viral and phage genetics-Genomic organization and genetic significance of M13, SV 40, Hep B, H1-N1, Retroviruses. Lytic and lysogenic cycles of lambda phage. Fungal genetics-Yeast (*Saccharomyces cerevisiae*), Neurospora genomes as genetic model systems. Britton and Davidson's model of eukaryotic gene regulation.

UNIT V**15 Hours**

Gene Transfer Mechanisms – Conjugation-Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping. Transduction-Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers, Transformation-Discovery, mechanism of natural competence. and Transposition-Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition and Mu transposon.

RECOMMENDED TEXT BOOKS:

1. Friedfelder D. (1990). Microbial Genetics, 2nd edn, Navosa publishing house, India
2. Gardner E.J and Snusted D.P (1991). Principles of Genetics, 8th edition, John Wiley and sons Inc.
3. Peter Paoella, Introduction to Molecular biology, 4th edn International edition, McGraw-Hill.

REFERENCE BOOKS:

1. Hays W. (1985). The Genetics of Bacteria and Viruses, 2nd edn. Blackwell Scientific Publishers, Oxford.
2. Synder L and Chapness W. (1997). 3rd edn Molecular genetics of bacteria. ASM Press Washington-D.C.
3. Russell P.J. (2010). Genetics in Molecular approach, 3rd edn Pearson New International edn.
4. Strachan, T. and Read, A. P. (1996). 1st edn Human Molecular Genetics, Bios Scientific Publishers, U.K.
5. Benjamin Lewin. (1997). Genes VII. 7th edn Oxford University Press, London, UK.

JOURNALS:

1. Journal of Microbiology and Biotechnology
2. Research Journal of Biotechnology

E-LEARNING RESOURCES:

1. <https://mmg.natsci.msu.edu/>
2. <https://geneticgenie.org>
3. <https://www.nestgrp.com/molbiol.shtml4>
4. <https://www2.le.ac.uk>
5. <https://openstax.org/details/books/microbiology>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Discuss the significance of genetic material.
CO 2	Explain the types of RNA and protein synthesis machinery
CO 3	Analyse the impact of mutation and its repair mechanism.
CO 4	Identifying and distinguishing genetic regulatory mechanisms
CO 5	Summarise gene transfer mechanisms for experimental study.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	1	1	0	1	2	1	0	1
CO 2	1	1	0	1	2	0	1	2
CO 3	1	1	1	1	3	1	3	2
CO 4	1	1	1	1	3	2	3	2
CO 5	0	1	2	2	3	3	3	3
Average	0.8	1	0.8	1.2	2.6	1.4	2	2

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Computing problems, LCD Classes, OHP, Group Discussion, Quiz, Peer Learning

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2, K3, K4	C – 2 x 20 Marks	1500	40	

SEMESTER- IV
ELECTIVE
BIOINFORMATICS
(For Our Department students)

TOTAL HOURS: 45
CREDITS: 3

COURSE CODE: 16SP18/4E5/BIF
L T P: 2-1-0

COURSE OBJECTIVES:

1. Explain basics and uses of internet and biological databases
2. Demonstrate the use of tools for parsing and retrieving sequences and structures from appropriate databases and predicting genes.
3. Equip with the necessary inputs for alignment of sequences for homology studies, evolutionary significance and their scoring functions with special emphasis on drug designing.
4. Analyse prokaryotic and eukaryotic genome using cloning, sequencing strategies and preparation of ordered gene libraries
5. Impart in-depth knowledge on deducing protein structures, analyse the expression of proteins, genes and to study variations.

COURSE OUTLINE

UNIT I

9 Hours

Basics of Internet- Internet Protocol (TCP/IP), Worldwide web (WWW), File transfer protocol (FTP), HTML, HTTP, Telnet and URL. Biological Data Base- Nucleic acid sequence databases- GenBank, EMBL, DDBJ, Protein sequence databases- SWISS-PROT, TrEMBL, PIR and Uniprot. Structure database- PDB, Genome Databases at NCBI, EBI, TIGR, SANGER.

UNIT II

9 Hours

Computer tools for Sequence Analysis. Similarity vs homology. Similarity searching- Dot plot, Dynamic programming. Scoring matrices- PAM and BLOSUM. Pair wise alignments- BLAST and FASTA. Multiple alignment- CLUSTAL and T-coffee. Gene prediction methods and tools.

UNIT III

9 Hours

Detection of Conserved Protein Motifs. Protein structure prediction. Phylogenetic analysis- rooted vs unrooted tree. NJ and Maximum Parsimony, bootstrapping. Basics of drug designing- Lipinski's rule of five, ligand and target selection, drug designing tools.

UNIT IV

9 Hours

Whole genome analysis – Preparation of ordered Cosmid Libraries, Bacterial Artificial Chromosome Libraries, and Shot Gun Libraries. Conventional (Sanger's and Gilbert) automated sequencing and Modern DNA Sequencing Methods.

UNIT V

9 Hours

DNA and Protein micro array – Principles and applications. Analysis of single nucleotide polymorphism using DNA chips. Proteome analysis- two dimensional separation of total cellular proteins by mass spectroscopy. Applications of Bioinformatics- pharmaceutical industry, immunology, agriculture, forestry, cheminformatics in biology, geoinformatics.

RECOMMENDED TEXT BOOKS:

1. Attwood, T.K. and Parry-Smith, D.J. (1999). Introduction to Bioinformatics. Addison Wesley Longman Limited, England.
2. Mount D.W., (2013). Bioinformatics sequence and genome analysis, 2ndedn. CBS Publishers, New Delhi.
3. Xiong J, (2011). Essential bioinformatics, First south Indian Edition, Cambridge University Press.

REFERENCE BOOKS:

1. Paul G. Higgs and Teresa K. Attwood. (2005). Bioinformatics and Molecular Evolution. Blackwell publishing, First Indian Reprint.
2. A.M. Lesk.(2017). Introduction to Bioinformatics. Oxford University Press India.
3. S.C. Rastogi, N.Mendiratla and P.Rastogi.(2013)Bioinformatics methods and applications- Genomics, Proteomics and Drug Discovery. Prentice Hall India
4. Andreas D. Baxevanis, B. F. Francis Ouellette.(2012) Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd edn, Wiley and Sons.
5. Harshawardhan P.Bal, (2006). Bioinformatics Principles and Applications, Tata McGraw-Hill Publishing Company Limited.

JOURNALS:

1. In Silico Biology
2. BMC bioinformatics

E-LEARNING RESOURCES

1. <https://www.ncbi.nlm.nih.gov/home/tutorials/>
2. <http://cef-cfr.ca/uploads/Membres/Yangetal.pdf>
3. <https://www.ebi.ac.uk/Tools/msa/clustalo/>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1978274/>
5. <http://dn3g20un7godm.cloudfront.net/2011/AM11SA/93.pdf>
6. http://www.premierbiosoft.com/tech_notes/microarray.html
7. <https://academic.oup.com/chromsci/article/55/2/182/2333796>
8. <http://ab.inf.uni-tuebingen.de/teaching/ws09/bioinformatics-i/10-sequencing.pdf>

COURSE OUTCOME

CO NUMBER	CO STATEMENT
CO 1	Effectively use internet in biological database searching, communicating biological data by depositing, storing and retrieving sequences and structures.
CO 2	Analyse and identify genes and proteins from a set of sequences using appropriate bioinformatic tools
CO 3	Apply the evolutionary relatedness in predicting structure, function of biomolecules, metabolism and to Perform insilico drug designing,
CO 4	Able to prepare, store and analyse gene libraries for whole genome analysis and sequencing
CO 5	Deduce the structure of proteins, gene expressions, analyse the variations thus applying Bioinformatics in several fields for benefit of the society.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	1	-	1	1	2	2	2	3
CO 2	2	2	2	1	3	2	1	3
CO 3	3	3	3	2	3	2	3	2
CO 4	2	2	2	2	3	2	2	2
CO 5	2	3	2	2	3	2	3	2
Average	2	2	2	1.6	2.8	2	2.2	2

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY

Lecture by chalk and talk, Flipped Learning, OHP, e-content, Problem Solving, Group Discussion, Learning with tools or bioinformatic software, Assignment, Quiz, Peer Learning, Seminar.

QUESTION PAPER PATTERN:

Knowledge Level	Section	Word Limit	Marks	Total
K2	A – 10 x 2 Marks	50	20	100
K2, K3	B – 5 x 8 Marks	500	40	
K2,K3, K4	C – 2 x 20 Marks	1500	40	

**SEMESTER- IV
PRACTICALS
IMMUNOLOGY AND MOLECULAR BIOLOGY**

**TOTAL HOURS: 60
CREDITS: 4**

**COURSE CODE: 16SP18/4C/PR3
LTP: 0-0-4**

COURSE OBJECTIVES:

1. Learn various immunological techniques and tests
2. Provide foundation in experimental microbial genetics
3. Apply the knowledge of molecular and immunological testing in clinical laboratories for pathogen identification

COURSE OUTLINE:

1. Blood collection, Serum and Plasma separation.
2. RBC, WBC and Differential Cell Counts.
3. Separation of Lymphocytes from Peripheral Blood by Density Gradient Centrifugation.
4. Purification of Antibodies by Ammonium Sulfate Precipitation.
5. Bacterial agglutination.
6. Latex agglutination – RF, ASO, CRP.
7. WIDAL.
8. RPR.
9. Haemagglutination – TPHA, ABO blood grouping.
10. Precipitation – estimation of antigen concentration by SRID, Double Immunodiffusion-pattern and specificity and Immunoelectrophoresis. Staining of Precipitation lines.
11. Serum Electrophoresis.
12. Coomb's testing.
13. Estimation of DNA by diphenylamine method.
14. Determination of T_m value of DNA.
15. Isolation of Plasmid DNA.
16. Isolation of Chromosomal DNA.
17. Estimation of RNA
18. Restriction Digestion of DNA & Ligation of Digested DNA fragments.
19. Transformation.
20. Replica Plate Technique.
21. Separation of Proteins by Column Chromatography.
22. Separation of Proteins by SDS PAGE.
23. Western blot.
24. PCR.

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Interpret Immunological tests for diagnostic purposes
CO 2	Undertake novel research with techniques like DNA extraction, sequencing, gel electrophoresis and gene transfer mechanisms
CO 3	Apply the techniques of various molecular and immunological procedures to enhance job skills

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	1	3	0	1	1	2	1	1
CO 2	1	3	0	1	1	2	1	2
CO 3	2	1	0	1	3	3	1	3
CO 4	2	2	1	1	3	3	2	3
CO 5	0	2	2	2	3	3	3	3
Average	1.2	2.2	0.6	1.2	2.2	2.6	1.6	2.4

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Demonstration and experimentation.

QUESTION PAPER PATTERN:

Time : 9 Hours (3 hours, 3 days)

Max. Marks: 60

Major- 25 marks

Minor-15 marks

Spotters- 5 x 2 =10 marks

Record – 5 marks

Viva- voce- 5 marks

**SEMESTER- IV
PRACTICALS
ENVIRONMENTAL MICROBIOLOGY**

**TOTAL HOURS: 60
CREDITS: 4**

**COURSE CODE: 16SP18/4C/PR4
LTP: 0-0-4**

COURSE OBJECTIVES:

1. Enumeration and analysis of Pathogenic Microorganisms in Air and Soil
2. Testing the quality of soil for the presence of Nitrogen fixing organisms, Phosphate solubilizers and other bio fertilizers
3. Determination of soil enzymes, phyllosphere microorganisms and study manure

COURSE OUTLINE:

1. Water analysis-Multiple Tube Test:
 - a. Presumptive test.
 - b. Confirmed test.
 - c. Completed test
2. Membrane filtration technique.
3. Estimation of BOD of the sewage sample.
4. Enumeration of bacteria and fungi from air – Settle plate technique.
5. Enumeration of bacteria and fungi from air – Air sampler.
6. Isolation of *Rhizobium Sp.* from nodules.
7. Isolation of *Azotobacter Sp.* from soil.
8. Isolation of *Azospirillum Sp* from soil
9. Isolation of *Frankia Sp* from soil.
10. Isolation of Phosphate solubilisers from soil.
11. Preparation of Biofertilizer and testing the efficiency of prepared biofertilizer
12. R:S ratio of soil.
13. Estimation of soil enzymes- urease and phosphatase.
14. Study of phylloplane microflora by leaf impression method.
15. Isolation of cellulose degrading bacteria.
16. Isolation of phenol degrading organisms from soil.
17. Isolation of pesticide degrading bacteria from soil.
18. Preparation of a vermicompost.

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Analyse nutritive value of soil and associate them with the microbes in the soil
CO 2	Examination and identification of Pathogenic Microorganisms in water and apply their implications to the society.
CO 3	Assess the role of Microorganisms and their enzymes in the preparation of manure

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	2	2	2	2
CO 2	2	2	2	2	2	2
CO 3	1	2	2	2	2	2
Average	2	2.3	2	2	2	2

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Demonstration and experimentation.

QUESTION PAPER PATTERN:

Time : 9 Hours (3 hours, 3 days)

Max. Marks: 60

Major- 25 marks

Minor-15 marks

Spotters- 5 x 2 =10 marks

Record – 5 marks

Viva- voce- 5 marks

**SEMESTER- IV
PRACTICALS
FOOD AND INDUSTRIAL MICROBIOLOGY**

**TOTAL HOURS: 60
CREDITS: 4**

**COURSE CODE: 16SP18/4C/PR5
LTP: 0-0-4**

COURSE OBJECTIVES:

1. Perform sterility check for industrially important products.
2. Detect, interpret and discuss about the food borne infections and intoxications
3. Analyse and demonstrate the basic tests of food quality and production of fermented dairy foods
4. Develop related products to Food, Beverage and Pharmaceutical industries

COURSE OUTLINE:

1. Isolation of Bacterial and fungal pathogens from spoiled food.
2. Direct microscopic examination and standard plate count of milk.
3. Isolation of lactic acid bacteria from probiotic foods.
4. Methylene blue reductase test.
5. Phosphatase test
6. Resazurin test.
7. Sterility testing of injectables.
8. Isolation of antibiotic producer by crowded plate technique and bioassay of penicillin.
9. Wine production.
10. Production of Beer from cereals.
11. Preparation of Sauerkraut.
12. Cheese production.
13. Separation of amino acids by ion exchange chromatography.
14. Comparison of amylase activity of *Aspergillus* culture grown in liquid medium and on solid substrate.
15. Immobilization of enzyme in calcium alginate beads and qualitative and quantitative estimation of activity.
16. Visit to Food / Beverage Industry.

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO1	Employ quality control methods on milk and dairy products
CO2	Check Food samples and assess the quality of food
CO3	Gain entrepreneurial skill in production of products related to Food,Beverage and Pharmaceutical Industry.

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	2	3	3	3	2	2	3	2
CO 2	3	3	3	3	2	2	3	2
CO 3	2	2	3	3	2	2	2	3
Average	2.3	2.6	3	3	2	2	2.6	2.3

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Demonstration and experimentation.

QUESTION PAPER PATTERN:

Time : 9 Hours (3 hours, 3 days)

Max. Marks: 60

Major- 25 marks

Minor-15 marks

Spotters- 5 x 2 =10 marks

Record – 5 marks

Viva- voce- 5 marks

**SEMESTER IV
SOFT SKILL
ESSENTIALS OF ENTREPRENEURSHIP**

**TOTAL HOURS: 30
CREDITS: 2**

**COURSE CODE: 16SP18/4S/EEP
L-T-P: 1-1-0**

COURSE OBJECTIVES

1. Analyse self and improve the personality
2. Gain knowledge about Entrepreneurship.
3. Analyse the opportunities and get equipped in setting up small scale units.

COURSE OUTLINE:

UNIT I

10 Hours

Resume writing- Tips for making good impression-Interview dress, hair style, shoes and posture. Writing e-mail, Telephone interview.

UNIT II

10 Hours

Women Entrepreneurship-need and problems faced by women entrepreneurs- styles and types. Development programs- Financial assistance for Small scale units-Role of SSI sector.

UNIT III

10 Hours

Identification of Business opportunity. Ownership structures-Proprietorship, Partnership, company, Co-operative, Franchise.

RECOMMENDED TEXT BOOKS:

1. Hisrich, Robert D., Michael Peters and Dean Shepherded. Entrepreneurship, TataMc Graw Hill, ND
2. Barringer, Brace R., and R., Duane Ireland. Entrepreneurship, Pearson Prentice Hall, New Jersey (USA).

REFERENCES BOOKS:

1. Lall, Madhurima, and Shikha Sahai. Entrepreneurship. Excel Book, New Delhi.
2. Charantimath and Poornima. Entrepreneurship Development and Small Business Enterprises. Pearson Education, New Delhi.

JOURNAL:

1. International Journal of Entrepreneurship and small Business
2. Prabandhan-Indian Journal of Management.

E- LEARNING RESOURCES:

1. <https://www.jobscan.co/blog/resume-summary/>
2. <https://work.chron.com/tips-conducting-job-interview-16512.html>
3. <https://www.ukessays.com/essays/business/problems-and-challenges-faced-by-small-enterprises-business-essay.php>
4. <https://www.dcmsme.gov.in/ssiindia/census/highlights.htm>
5. <https://smallbusiness.chron.com/similarities-sole-proprietorship-franchise-22821.html>

COURSE OUTCOME:

CO NUMBER	CO STATEMENT
CO 1	Practise presentation skills, for attending interviews with confidence.
CO 2	Outline the needs and critically assess the Pros and Cons of Women Entrepreneurship.
CO 3	Employ necessary inputs to start a small scale business

MAPPING - COURSE OUTCOME WITH PROGRAM SPECIFIC OUTCOME:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO7	PSO8
CO 1	1	1	3	3	3	3	2	3
CO 2	2	2	3	3	3	3	3	3
CO 3	1	2	3	3	3	3	3	3
Average	1.3	1.6	3	3	3	3	2.6	3

KEY: STRONGLY CORRELATED-3, MODERATELY CORRELATED-2, WEAKLY CORRELATED-1, NO CORRELATION-0

TEACHING METHODOLOGY:

Lecture by chalk and talk, Computing problems, LCD Classes, OHP, Group Discussion, Quiz, Peer Learning.

QUESTION PAPER PATTERN:

Time: 3 Hours

Max. Marks:50

Section A- Answer any 10 questions(out of 12 questions) 10 x 5 = 50 marks