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1.1.2: The programmes offered by the institution focus on employability / entrepreneurship / skill development and their course syllabi are adequately revised to incorporate contemporary requirements

SYLLABUS OF THE COURSES FOCUSING EMPLOYABILITY / ENTREPRENEURSHIP / SKILL DEVELOPMENT

Colour Coding

EMPLOYABILITY

ENTREPRENEURSHIP

SKILL DEVELOPMENT

B.Sc. MICROBIOLOGY

YEAR – I	FUNDAMENTALS OF MICROBIOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB101
SEMESTER - I		HRS/WK - 3
CORE - 1		CREDITS - 3

Objective: To make the students understand the basic principles in Microbiology

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: will be able to appreciate the discoveries in Microbiology
CO 2: will be able to identify the various structures in bacterial cell
CO 3: will be able to apply the principles of various microscopes
CO 4: will be able to explain different methods of physical sterilization
CO 5: will be able to elaborate chemicals used in sterilization

SEMESTER: I	COURSE CODE: 19MB101					COURSE TITLE: FUNDAMENTALS OF MICROBIOLOGY			HOURS: 3	CREDITS: 3
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OFCOs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3	5	4	2	2	5	3	3	3.2	
CO2	2	5	3	4	3	4	5	4	3.7	
CO3	2	4	4	4	3	4	5	5	3.7	
CO4	3	5	4	4	4	4	5	5	4.2	
CO5	3	5	4	5	5	4	5	5	4.5	
Mean Overall Score									3.8	

Result: The score of this course is 3.8 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme Specific Outcomes.

Unit– 1 **(9 Hrs)**

Introduction - History (Discoveries - Contributions of Women Scientists in Microbiology) - Scope of Microbiology - Employability in Microbiology (Job opportunities and Entrepreneurship)

Unit– 2 **(9 Hrs)**

Morphology - Shape, size, arrangement of Bacteria - Structure of bacterial cell - Structure and functions of cell organelles (Cell wall, structures found outside the cell wall and within the cell wall) - Structure of Endospore

Unit– 3 **(9 Hrs)**

Morphology - Simple, Compound, Dark-field, Phase-contrast, Fluorescent, Electron Microscopes - Stains and dyes – Staining methods

Unit– 4 **(9 Hrs)**

Sterilization - Physical agents - High temperature,Low temperature, Desiccation, Osmotic pressure, Radiation, Filtration

Unit– 5 **(9 Hrs)**

Sterilization - Chemical agents - Phenols and phenolic compounds, Alcohols, Halogens, Heavy metals and their compounds, Dyes, Synthetic detergents, Quaternary ammonium compounds, Aldehydes, Gaseous agents -Antibiotics - Classification, Mode of action – Antifungal and antiviral agents.

Text Book

- Prescott, L. M., J. P. Harely and D. A. Klain, Microbiology, 2003 (5th Edition) McGraw Hill, NewYork.

Reference Books

- Atlas R. A. Principles of Microbiology (2nd Edition), 1997. Wm. C. Brown Publishers, Iowa.
- Salle A. J., Fundamental Principles of Bacteriology, 1974 (TMH Edition), Tata McGraw Hill Publishing Company, NewDelhi.

E-Reference

- http://www.microbeworld.org

YEAR – I	GROWTH AND NUTRITION OF MICROORGANISMS (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB203
SEMESTER - II		HRS/WK - 3
CORE - 3		CREDITS - 3

Objective: To make the students understand the basic principles of microbial growth

Course Outcomes:
Upon successful completion of the course, the student:
CO1: will be able to describe microorganisms based on nutrition
CO2: will be able to identify the factors affecting bacterial growth
CO3: will be able to apply the concept of microbial growth
CO4: will be able to explain the process of bacterial reproduction and motility
CO5: will be able to explain different methods of nutrient uptake in microorganisms

SEMESTER: II	COURSE CODE: 19MB203					COURSE TITLE: GROWTH AND NUTRITION OF MICROORGANISMS			HOURS: 3	CREDITS: 3
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	2	5	4	4	3	3	3	4	3.5	
CO2	2	4	4	4	4	3	3	4	4.3	
CO3	2	3	3	4	3	2	3	3	2.8	
CO4	3	5	4	4	4	3	5	4	4.0	
CO5	3	3	3	5	5	4	4	4	3.8	
Mean Overall Score									3.6	

Result: The score of this course is 3.6 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and ProgrammeSpecificOutcomes.

Unit– 1 **(9 Hrs)**

Nutrient requirements of microorganisms - Growth factors - Nutritional types

Unit– 2 **(9 Hrs)**

Culture media - Pure culture – Maintenance and preservation of cultures - Environmental factors affecting growth

Unit– 3 **(9 Hrs)**

Microbial growth – exponential growth - Growth curve - Measurement of microbial growth – Batch and Continuous culture - Synchronous growth

Unit– 4 **(9 Hrs)**

Sporulation - Bacterial reproduction - Motility of bacteria – Flagellar and gliding – Chemo-, photo-, Aero-, Magneto- taxis

Unit– 5 **(9 Hrs)**

Uptake of nutrients – Simple, Passive, Facilitated diffusion, Active transport, Group translocation

Text Book

- Schlegal, H.G., 1993. General Microbiology, (7th Edition), Press Syndicate of the University ofCambridge.

Reference Books

- Caldwell, D.R., 1995. Microbial Physiology &Metabolism, Wm.C. Brown Communications, Inc.USA.
- Dawes, I. W. and Sutherland L.W. I992. Microbial Physiology, (2ndEdition), Oxford Blackwell ScientificPublications.

I B.Sc. Microbiology	BASIC TECHNIQUES IN MICROBIOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	21MBP201
SEMESTER – I & II		HRS/WK - 4
CORE PRACTICAL - 1		CREDITS – 3

Objective:
To enable the students, learn the basic procedures in microbiology

LIST OF EXPERIMENTS

Microscopy

1. Gram staining – gram positive cocci
2. Gram staining – gram negative bacilli
3. Spore staining
4. Acid – fast staining
5. Motility – hanging drop method

Biochemical tests

4. Catalasetest
5. Oxidasetest
6. Indoletest
7. Methyl redtest
8. Voges – Proskauer test
9. Citrate utilizationtest
10. Triple sugar iron agar test
11. Ureasetest

Pure culture technique

12. Mediapreparation
13. Pour platemethod
14. Spread plate method
15. Quadrantstreaking

LIST OF SPOTTERS

1. Inoculationloop
2. Inoculationneedle
3. L –rod
4. Robertson cooked meatmedium
5. MacConkeyagar
6. EMBagar
7. Na slant with liquidparaffin
8. Na stab with liquidparaffin
9. Dark fieldmicroscopy
10. Stage micrometer
11. Ocular micrometer
12. Chlamydomonas
13. Spirochetes
14. Laminar air flowchamber
15. Incubator
16. Autoclave
17. Hot airoven

18. Inoculationhood
19. Colorimeter
20.pHmeter
21. Anaerobicjar
22. Volvox
23. Gram positivecocci
24. Gram negative bacilli
25. Sporestaining
26. Acid fastbacilli
27. Indoletest
28. Methyl redtest
29. Voges – Proskauer test
30. Citrate utilizationtest
31. Triple sugar iron agar test
32. Ureasetest
33. Na slant withPseudomonas
34. Membrane filter
35. Meta chromaticgranules

YEAR – II	IMMUNOLOGY	19MB305
SEMESTER - III	(For the students who are admitted in the year 2019 – 2020 and onwards)	HRS/WK - 4
CORE – 5		CREDITS - 3

Objective: To make the students understand the basic concepts of Immunology and immune system.

Course Outcomes:
Upon successful completion of the course, the student:
CO1: will be able to differentiate types of immunity
CO2: will be able to describe antigens and antibodies
CO3: will be able to appreciate the concept of Complement
CO4: will be able to explain the structure and functions of immune cells
CO5: will be able to explain the concept of hypersensitivity

SEMESTER: III	COURSE CODE: 19MB305					COURSE TITLE: IMMUNOLOGY			HOURS: 4	CREDITS: 3
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3.5	3	4	5	4	4	4	5	4.6	
CO2	3	3	3.5	3.5	3	3	4	4.5	3.4	
CO3	2	3	3	4	4	3	4.5	5	3.5	
CO4	4	2	3	3.5	4	3.5	3.5	4	3.4	
CO5	3	2.5	3.5	4	4	3.5	4	4.5	3.6	
Mean Overall Score									3.7	

Result: The score of this course is 3.7 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit1: **(12 hrs)**

Infection- Classification of infections, Source of infection, Methods of transmission of infection, Factors predisposing to microbial pathogenicity, Types of infectious diseases – Immunity - Innate or native immunity, Factors affecting innate immunity, Mechanisms of innate immunity, Acquired or adaptive immunity, Active immunity, Passive immunity, Local immunity, Herd immunity

Unit2: **(12 hrs)**

Antigens- Types of antigens, Determinants of antigenicity, Biological classes of antigens, Determinants recognized by the innate immune system. **Antibodies – Immunoglobulins -** Antibody Structure, Enzyme digestion, Immunoglobulin chains, Immunoglobulin domains,

Hyper variable and framework regions, Constant region domains, Hinge region, Immunoglobulin classes, Abnormal Immunoglobulins, Immunoglobulin specificities, Antibody diversity, Class switching

Unit3: **(12 hrs)**

Antigen – Antibody reactions- Serological reactions, Precipitation reaction, Mechanism of precipitation, Agglutination reaction; Complement System **-** General properties, Components, Complement activation, Classical complement pathway, Alternative complement pathway, Lectin complement pathway, Regulation of complement activation, Biological effects of complement, Quantitation of complement and its components, Biosynthesis of complement, Defeciencies of the complement system

Unit4: **(12 hrs)**

Structure and Functions of Immune Cells & Organs- The lymphoid system,Central (primary) lymphoid organs, Thymus, Bone marrow, Peripheral (secondary) lymphoid organs, Lymph nodes, Spleen, Cells of the lympho reticular system, Lymphocytes**,** T – Cell maturation, T cell receptors, Types of T cells, B – Cell maturation, Null cells, Phagocytic cells, Abnormalities of immune cells, Major histocompatibility complex (MHC), Classes of proteins, HLA complex, HLA typing**,** MHC restriction - Immune Response- Humoral Immune Response (Antibody Mediated), Primary and secondary responses, Fate of antigen in tissues, Production of antibodies, Cellular Immune Response, Scope of cell – mediated immunity (CMI), Induction of cell – mediated immunity (CMI), Cytokines, Detection of cell mediated immunity (CMI), Transfer Factor, Immunological Tolerance, Theories of Immune Response

Unit5: **(12 hrs)**

Hypersensitivity - Classification of hypersensitivity reactions, Type I Reactions (IgE dependent), Anaphylaxis, Atopy, Type II reactions: cytolytic and cytotoxic, Type III reactions: immune complex diseases, Arthus reaction, Serum sickness, Type IV reactions: Delayed Hypersensitivity, Tuberculin (Infection) type, Cutaneous basophil hypersensitivity, Contact dermatitis type, Type v reactions (stimulatory hypersensitivity), Shwartzman reaction

Text Book

- Ananthanarayanan, R and Paniker C.K. Text Book of Microbiology, 2009, (8thEdition), Universities Press (India) Private Ltd., Hyderabad – 500029 (A. P.), India.

Reference Books

- Tizard, I. R. Immunology. 1995 (4^{lh} Edition), Saunders CollegePublishing.
- Weir, D.M. and J. Stewart.Immunology.1997 (8th Edition), Churchill Livingstone, New York.
- Mark Peakman and DiegoVergani. 1st magazine, 1997, Basic and Clinical Immunology. Churchill Livingstone, NewYork.

YEAR - II	MOLECULAR BIOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB306
SEMESTER - III		HRS/WK - 3
CORE - 6		CREDITS - 3

Objective: To make the students understand the basic principles in molecular biology.

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: will be able to appreciate the Central dogma of Molecular biology
CO 2: will be able to explain the structure of nucleic acids
CO 3: will be able to describe the organization of prokaryotic genetic material
CO 4: will be able to explain the process of DNA replication
CO 5: will be able to explain the process of gene expression

SEMESTER: III	COURSE CODE: 19MB306					COURSE TITLE: MOLECULAR BIOLOGY			HOURS: 4	CREDITS: 3
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3.5	3	4	4	4	4	4	5	3.9	
CO2	3	3	3.5	3.5	3	3	4	4.5	3.4	
CO3	2	3	3	4	4	3	4.5	5	3.5	
CO4	4	2	3	3.5	4	3.5	3.5	4	3.4	
CO5	3	3	3.5	4	4	3.5	4	4	3.6	
Mean Overall Score									3.6	

Result: The score of this course is 3.6 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit1: **(9 Hrs)**
Basic concepts of Molecular biology**:** Nucleic acid as Genetic material- Griffith experiment, Hershey & Chase experiment; Central dogma of Molecular biology, structure and functions of Nucleic acid: Nucleosides and Nucleotides, purines andpyrimidines.

Unit2: **(9 Hrs)**
Structure of DNA and RNA: Structure of DNA - Forms of DNA (A, B and Z) -Denaturation and renaturation of DNA -Structure of RNA –Types (t-RNA, r-RNA, m-RNA) - RNA as the genetic material.

Unit3: **(9 Hrs)**

Organization of prokaryotic genetic material - Plasmids - Organization of eukaryotic genetic material - Chromosome – Transposons – Concept of gene – genetic code.

Unit4: **(9 Hrs)**

Replication of DNA - Enzymology of replication – Mutation types – Mutagenic agents – Carcinogenicity testing - DNA damage and repair.

Unit5: **(9 Hrs)**

Gene expression – Detailed account of Transcription and Translation – Post-transcriptional modifications in prokaryotes and eukaryotes – Post - translational modifications.

Text Books

- Freifelder's Essentials of Molecular Biology, 2015 4Th/Ed by Malacinski, Jones & Bartlett.
- Principles of Molecular Biology. Veer Bala Rastogi,2016.

Reference Books

- Benjamin Lewin, Gene VIII. 2003 (8^{th} Edition). Oxford University Press.
- Twyman, R M., Advanced Molecular Biology – A concise Reference, 1998. Viva Books Private Ltd., NewDelhi.
- Introduction to Molecular Biology, 2010.Peter Paolella. Tata McGraw-Hill Publishing Company.

YEAR - II	IMMUNOTECHNOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB407
SEMESTER - IV		HRS/WK - 4
CORE - 7		CREDITS - 3

Objective: To make the students understand the applications of immune reactions

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: will be able to describe antigen and antibody reactions
CO 2: will be able to describe immunodeficiency diseases
CO 3: will be able to appreciate the concept of autoimmunity
CO 4: will be able to explain transplantation and malignancy
CO 5: will be able to explain the applications of immunohematology

SEMESTER: IV	COURSE CODE: 19MB407					COURSE TITLE: IMMUNOTECHNOLOGY			HOURS: 4	CREDITS: 3
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	2	5	4	4	3	3	4	4	4.5	
CO2	2	4	4	4	4	3	3	4	4.3	
CO3	2	3	3	4	4	2	3	3	3.8	
CO4	3	5	4	4	4	3	3	4	3.0	
CO5	3	3	3	5	5	4	4	4	3.8	
Mean Overall Score									3.8	

Result: The score of this course is 3.8 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit1:(12 hrs)

Antigen-Antibody reactions- Antigen-Antibody titre- complement fixation test (CFT), Neutralization tests, Opsonization, Radioimmunoassay (RIA), Enzyme immnunoassay (EIA), Enzyme linked Immunosorbant assay (ELISA), Chemiluminescence immunoassay (CLIA), Immunoelectroblot/western blot techniques, immunochrmatographic tests, Immunoellectron microscopic tests, immunofluorescence

Unit2: **(12 hrs)**

Immunodeficiency Diseases - Primary immunodeficiencies, Disorders of specific immunity, Humoral immunodeficiencies, Cellular immunodeficiencies, Combined immunodeficiencies, Disorders of complement, Disorders of phagocytosis, Secondary immunodeficiencies.

Unit3: **(12 hrs)**

Autoimmunity - Mechanisms of autoimmunity, Classification of autoimmune diseases, Hemocytolytic autoimmune diseases, Localised (organ – specific) autoimmune diseases, Systemic (non – organ specific) autoimmune diseases, Pathogenesis of autoimmune disease - Production of antibodies - Monoclonal antibodies, Factor influencing antibody production.

Unit4: **(12 hrs)**

Immunology of transplantation and malignancy **-** Immunology of transplantation, Classification of transplants, Types of grafts, allograft reaction, Histocompatibility antigens, Histocompatibility testing, Immunology of malignancy, Clinical evidence of immune response in malignancy, Tumour antigens, Immune response of malignancy, Immunological surveillance, Immunotherapy of cancer.

Unit5: **(12 hrs)**

Immunohematology - ABO blood group system, Rh blood group system, Other blood group system, Medical applications of blood groups, Blood transfusion, Hemolytic disease of the newborn, Detection of Rh antibodies, Identification of Rh incompatibility, ABO hemolytic disease.

Text Book

- Text Book of Microbiology, 2009, (8lh Edition).Ananthanarayanan,R and Paniker C.K. Universities Press (India) Private Ltd., Hyderabad – 500029 (A. P.), India.

Reference Books

- Immunology. 1995 (4lh Edition).Tizard, I. R. Saunders CollegePublishing.
- Immunologv.1997 (8th Edition). Weir, D.M. and J. Stewart. Churchill Livingstone, New York.
- Basic and Clinical Immunology. 1997. Mark Peakman andDiegoVergani. Churchill Livingstone, New York.

YEAR – II	MICROBIALGENETICS (For the students who are admitted in theyear 2019 – 2020 andonwards)	19MB408
SEMESTER – IV		HRS/WK - 3
CORE – 8		CREDITS - 3

Objective: To make the students understand the basic principles in microbial genetics.

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: will be able to appreciate bacterial transformation
CO 2: will be able to explain Bacterial Conjugation
CO 3: will be able to describe the Regulation of gene expression
CO 4: will be able to explain Phage genetics
CO 5: will be able to explain the process of Transduction

SEMESTER: IV	COURSE CODE: 19MB408					COURSE TITLE: MICROBIAL GENETICS			HOURS: 4	CREDITS: 3
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3	4	3	2	3	4	4	4	3.37	
CO2	3	4	2	3	2	4	4	4	3.25	
CO3	3	3	4	3	3	4	4	4	3.50	
CO4	4	3	4	2	2	4	4	4	3.37	
CO5	3	4	3	3	3	4	4	4	3.50	
Mean Overall Score									3.39	

Result: The score of this course is 3.39 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit-1 **(9 Hrs)**

Introduction; Bacterial plasmids; Gene transfer mechanisms - Bacterial Transformation– the discovery of transformation, detection of transformation – competence – DNA uptake – molecular mechanism of transformation – mapping by transformation.

Unit– 2 **(9 Hrs)**

Bacterial Conjugation– Insertion of F plasmid into the *E. coli* chromosome, Hfr Transfer, Recombination in recipient cells, properties of systems lacking recombination proteins – the RecA, B, C proteins and their function – chromosome transfer in bacteria other than *E. coli*

Unit– 3 **(9 Hrs)**

Regulation of gene expression– common modes of regulation – the *E. coli* Lactose system and the operon model – the tryptophan operon, a biosynthetic system. Autoregulation

Unit– 4 **(9 Hrs)**

Bacteriophages– General properties life cycle– counting phage- Phage genetics I: phage T4, Genetic mapping of phage T4 phage, features of T4 life cycle. Phage genetics II: phage λ, life cycle of λ, recombination of λ DNA.

Unit– 5 **(9 Hrs)**

Transduction – generalized & specialized transduction – co-transduction and linkage – Mapping by cotransduction.

Text Book

- Microbial Genetics. 1987. Freifelder D. Narosa Publishing House, NewDelhi.
- Modern Microbial Genetics. 2002 (2nd Edition). Streips U. N. and R. E. Yasbin. Wiley-Liss, Inc., NewYork.

Reference Books

- Gene VIII. 2003 (8thEdition). Benjamin Lewin. Oxford UniversityPress.
- Advanced Molecular Biology – A concise Reference. 1998. Twyman R M. Viva Books Private Ltd., NewDelhi.
- Freifelder's Essentials of Molecular Biology. 2015 (4thEdition).Malacinski, Jones &Bartlett. Narosa Publishing House, New Delhi.

II B.Sc. Microbiology	BASIC EXPERIMENTS IN IMMUNOLOGY & MICROBIAL GENETICS (For the students who are admitted in the year 2019 – 2020 and onwards)	21MBP402
SEMESTER – III & IV		HRS/WK - 4
CORE PRACTICAL – 2		CREDITS – 3

Objective: To enable the students learn the basic procedures in Immunology

LIST OF EXPERIMENTS

1. Separation of serum
2. Separation of plasma
3. Blood grouping – Forward
4. Widal – Slide test
5. ASO test
6. RPR test
7. RA test
8. VDRL test
9. Study of blood smear for cell morphology
10. Differential Count
11. WBC & RBC Count
12. Bacterial agglutination

LIST OF SPOTTERS

1. Centrifuged blood showing serum & bloodclot
2. Eosinophil
3. Monocyte
4. Lymphocytes
5. Neutrophils
6. Widaltest
7. Single Radial Immunodiffusion
8. Immunoelectrophoresis test
9. Latex agglutinationtest
10. Counter Immunoelectrophoresis
11. ASOantigen
12. RPRantigen
13. Haemocytometer
14. ELISAplate
15. Normalsaline
16. Widal O, Hantigen
17. Anti A, B and Dreagent
18. Electrophoresis Horizontaltank
19. EDTA
20. Leishman stain
21. Pasteurpipette
22. Micropipette
23. Waterbath
24. TrisodiumCitrate
25. Rocket Immuno Electrophoresis
26. Ouchterlony method
27. *Electrophoresis powerpack*
28. Gelpuncture
29. RBCpipette
30. WBCpipette
31. ABO blood grouping

32. Centrifuge
33. VDRLshaker

YEAR – III	FOOD AND DAIRY MICROBIOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB509
SEMESTER - V		HRS/WK - 5
CORE – 9		CREDITS - 4

Objective: To make the students understand the importance of microbes in food and dairy industry.

Course Outcomes: `

Upon successful completion of the course, the student:

CO 1: will be able to describe the importance of microorganisms in food and methods used for food preservation.

CO 2: will be able to identify the source of contamination and spoilage causing microorganisms in different foods

CO 3: will be able to understand the role of microorganisms in food fermentation.

CO 4: will be able to apply the knowledge in dairy product production and develop the skill for testing milk sample.

CO 5: will be able to understand food borne diseases and detect the pathogens in different food samples.

SEMESTER: V	COURSE CODE: 19MB509					COURSE TITLE: FOOD AND DAIRY MICROBIOLOGY			HOURS: 5	CREDITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3.5	3.5	4	4.5	4	4	4	5	4.6	
CO2	3	3	3.5	3.5	3	3	4	4.5	3.4	
CO3	2.5	3	3	4	4	3	4.5	4.5	3.5	
CO4	4	2.5	3	3.5	3.5	3.5	3.5	4	3.4	
CO5	3	2.5	3.5	4	4	3.5	4	4.5	3.6	
Mean Overall Score									3.7	

Result: The score of this course is 3.7 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit– 1 **(15 hrs)**

Food as a substrate for microorganisms - Microorganisms important in food microbiology - Principles of food preservation - asepsis - removal of microorganisms - high temperature - low temperature-drying- food additives -radiation

Unit– 2 **(15 hrs)**

Contamination, spoilage and preservation of - vegetables and fruits, meat and meat products, fish and sea food, poultry products, canned food.

Unit– 3 **(15 hrs)**

Food fermentations – bread, malted beverages, idly, fermented vegetables, pickles, Oriental fermented foods- Probiotics: definition, types of microorganisms and health benefits

Unit– 4 **(15 hrs)**

Milk and milk products - fermented dairy products - butter, cheese, yogurt, acidophilus milk; Spoilage and defects of fermented dairy products; Milk-borne diseases; Microbiological analysis of milk – dye reduction test, total bacterial count; Applications of microbial enzymes in dairy industry (Proteases and Lipases).

Unit– 5 **(15 hrs)**

Food-borne infections and intoxications - bacterial, non-bacterial - laboratory methods for detection of food borne pathogens (cultural and rapid method) - Food plant sanitation - quality control -HACCP.

Text Books

- Food Microbiology. 2013 (5th Edition). William C. Frazier, Dennis C. Westhoff, K. N. Vanitha. McGraw-Hill Education,India.
- Modern Food Microbiology. 2007 (2nd Edition). James, M.J. CBS Publisher, New Delhi

Reference Books

- Food Microbiology. 2016 (1stEdition). Foster, W. M. CBS Publishers and Distributors Pvt. Ltd, NewDelhi.
- Food Microbiology. 2015 (4th Edition). Adams, M.R., Moss, M.O and McClure, P. J. RSC Publication, CPI Group (UK) Ltd, Croydon, UK.
- Modern Food Microbiology. 2005 (7thEdition). James M. Jay, Martin J. Loessner, David A. Golden. Springer Science &Business.
- Food Microbiology -Fundamentals and Frontiers. 2001 (2ndEdition). Doyle, M. P.,L. R. Beuchat and T. J. Montville. ASM Press. Washington, D.C.
- Dairy Microbiology Hand Book. 2002 (3rd Edition). Richard K. Robinson. John Wiley & Sons, New York,US.

YEAR – III	MEDICAL BACTERIOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB510
SEMESTER - V		HRS/WK - 5
CORE- 10		CREDITS - 4

Objective: To make the students understand the medical importance of bacteria.

Course Outcomes:

Upon successful completion of the course, the student:

CO 1: will comprehend the role of virulence factors in bacterial infections
CO 2: will gain knowledge on pathogenic bacteria of Enterobacteriaceae
CO 3: will gain knowledge on Gram positive bacterial pathogens
CO 4: will become familiar with the pathogenic potential of rare bacterial species
CO 5: will be able to recognize intracellular bacterial pathogens

SEMESTER: V	COURSE CODE: 19MB510					COURSE TITLE: MEDICAL BACTERIOLOGY			HOURS: 5	CREDITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	4	4	3	4	4	4	3	4	3.75	
CO2	4	4	3	4	3	3	4	4	3.62	
CO3	4	4	4	3	4	4	4	3	3.75	
CO4	4	3	3	4	4	4	3	4	3.62	
CO5	4	4	3	4	3	4	4	3	3.62	
Mean Overall Score									3.68	

Result: The score of this course is 3.68 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit– 1 **(15Hrs)**

Generalattributes and virulencefactors of bacteriacausinginfections - Morphology, classification, cultural characteristics - pathogenicity, laboratory diagnosis and prevention of infections caused by the following organisms - *Staphylococci, Streptococci, Pneumocooci*, *Neisseria meningitidis* and *N. gonorrhea*, *Corynebacteria.*

Unit– 2 **(15Hrs)**

Escherichia coli, *Klebsiella*, *Salmonella typhi, S. paratyphi A and S. paratyphi B*, *Shigella*, *Proteus*, *Vibrio cholerae*, *Pseudomonas*

Unit-3 **(15Hrs)**

Bacillus anthracis, Clostridium perfringenes, Cl. Tetani, Cl. botulinum, *Mycobacterium tuberculosis, M. leprae*, Atypical Mycobacteria

Unit-4 **(15Hrs)**

Yersinia, *Haemophilus*, *Helicobacter, Francisella*, *Brucella*, *Bordetella, Legionella*, *Listeria*

Unit-5 **(15Hrs)**

Rickettsiae, *Chlamydia*, Spirochaetes, *Mycoplasma*, Actinomycetes

Text Book

- TextBookofMicrobiology.2000(6lhEdition).Ananthanarayanan,R. and C.K.J. Panicker. Orient Longman Private Ltd.,Chennai.

ReferenceBooks

- Jawetz Melnick &Adelberg's Medical Microbiology. 2019 (28thEdition). Stefan Riedel, Stephen A. Morse, Timothy A. Mietzner, Steve Miller. Mc GrawHill.
- Medical Microbiology. 2008 (6thEdition). Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller. Mosby - Elsevier.
- Medical Microbiology. 2012. (18th Edition). David Greenwood, Richard Slack, Michael Barer and W. L. Irving. ChurchillLivingstone.

YEAR – III	MEDICAL PARASITOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB511
SEMESTER - V		HRS/WK - 5
CORE- 11		CREDITS - 4

Objective: To make the students understand the medical importance of parasites.

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: Acquires knowledge about the laboratory diagnosis and treatment of parasitic diseases.
CO 2: Learns about the diseases caused by amoebae and flagellates.
CO 3: Gains knowledge about the diseases caused by sporozoa and ciliate protozoan.
CO 4: Understands the diseases caused by cestode andtrematode.
CO 5: Attains knowledge about the diseases caused bynematode.

SEMESTER: V	COURSE CODE: 19MB511					COURSE TITLE: MEDICAL PARASITOLOGY			HOURS: 5	CREDITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	4	4	3	4	4	4	4	4	3.87	
CO2	4	3	4	4	4	3	4	4	3.75	
CO3	4	4	4	3	3	4	3	4	3.62	
CO4	3.5	4	3	4	4	4	3	3	3.56	
CO5	4	4	3	3.5	4	4	4	4	3.81	
Mean Overall Score									3.72	

Result: The score of this course is 3.72 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit-1 **(15Hrs)**

Introduction – Classes of parasites – Classes of hosts– Host-parasite relationship – Sources of infection – Modes of transmission – Pathogenesis - Laboratory diagnosis of parasitic diseases – Treatment

Unit-2 **(15Hrs)**

Entamoeba histolytica- Naegleria fowleri, Giardia lamblia, Trichomonas vaginalis Leishmania donovani, Trypanosoma brucei complex

Unit-3 **(15Hrs)**

Plasmodium species, *Toxoplasma gondii*, *Cryptosporidium parvum, Isospora belli*, *Balantidium coli*

Unit-4(15Hrs)

Taenia saginata, Taenia solium, Schistosoma haematobium, *Fasciola hepatica*, *Fasciolopsis buski*

Unit-5 **(15Hrs)**

Trichuris trichiura, Ancylostoma duodenale, *Ascaris lumbricoides*, *Enterobius vermicularis*, *Wuchereria bancrofti*,

Text Books

- Text Book of Medical Parasitology. 2013 (4th Edition). Subhash Chandra Parija. All India Publishers and Distributors,Chennai.
- Paniker's Text Book of Medical Parasitology. 2018 (8thEdition). Sougata Ghosh. Jaypee Brothers Medical Publishers (P) Ltd., NewDelhi

Reference Books

- Medical Parasitology. 2018. (5thEdition). D.R.Arora and Brij Bala Arora. CBS Publishers and Distributors Pvt. Ltd., NewDelhi,
- Essentials of Medical Parasitology. 2019 (2nd Edition). Apurba Sankar Sastry and Sandhya Bhat, 2019, Jaypee Brothers Medical Publishers (P) Ltd., NewDelhi
- Medical Parasitology. 2010 (4thEdition). RL Icchpujani and Rajesh Bhatia. Jaypee Brothers Medical Publishers (P) Ltd., NewDelhi
- Medical Parasitology 2019 (4thEdition). CP Baveja and V Baveja. Ariya Publishing Company, NewDelhi
- Medical Parasitology. 2012 (3rd Edition). RP Karyakarte and AS Damle. Books and Allied (P) Ltd., Kolkata

YEAR – III	INDUSTRIAL MICROBIOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB512
SEMESTER – V		HRS/WK - 5
CORE – 12		CREDITS - 4

Objective: To make the students understand the industrial aspects of microbiology.

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: will acquire the knowledge about the study of practical understanding of fermentation.
CO 2: will gain knowledge about product purification by downstream process
CO 3: will get insight knowledge about microbial metabolites
CO 4: will get depth insights about the microbial synthesis of industrially important enzymes.
CO 5: will acquire the knowledge about the industrial production of antibiotics and vitamins

SEMESTER: V	COURSE CODE: 19MB512					COURSE TITLE: INDUSTRIAL MICROBIOLOGY			HOURS: 5	CREDITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3	4	3	3	3	4	4	4	3.50	
CO2	4	3	3	2	3	4	4	4	3.37	
CO3	3	3	3	3	2	4	4	4	3.25	
CO4	3	3	3	2	2	4	4	4	3.12	
CO5	3	4	3	2	3	4	4	4	3.37	
Mean Overall Score									3.29	

Result: The score of this course is 3.29 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit– 1 **(15 Hrs)**

General concepts of industrial microbiology, screening and strain development strategies - raw materials used in media production media optimization – foaming - fermentation equipment and its uses – types of fermenters

Unit– 2 **(15 Hrs)**

Types of fermentation - batch, continuous, dual or multiple, surface, submerged, aerobic, anaerobic - Downstream process – recovery and purification of products – sterilization – development of inocula - scale up processes, Methods of achieving sterility

Unit– 3 **(15 Hrs)**

Primary and Secondary Metabolites- Catabolic- anabolic products, Trophophase - idiophase Relationships in the Production of Secondary products, Production of alcohol and beverages Ethanol, beer and wine, vinegar - Single cell proteins - Organic acids - lactic acid, citric acid, acetic acid - Steroidtransformations

Unit– 4 **(15 Hrs)**

Industrial production of enzymes- amylase, proteinase, cellulase - Amino acid production - glutamic acid and lysine

Unit– 5 **(15 Hrs)**

Production of antibiotics - penicillin, tetracycline, streptomycin – Role of precursors - Production of Vitamins - riboflavin, cyanocobalamin, Production of bacterial insecticide.

Text Book

- Industrial Microbiology. 2016 (2nd Edition). Patel, A.H. Trinity press, Boston,USA.

Reference Books

- Principles of fermentation Technology. 2016 (3rdEdition). Stanbury. P.F., A. Whitaker and S.J. Hall. 2016. Butterworth - Heinemann (Pergamon),Oxford.
- Biotechnology. 2000 (2nd Edition). Crueger W. and A Crueger. Panima Publishing Corporation, New Delhi.
- Prescott & Dunn's Industrial Microbiology. 2004. (4th Edition). Reed, G. CBS Publishers Distributors,Delhi.
- Modern Industrial Microbiology and Biotechnology. 2007. (1stEdition). Nduka Okafor. Science Publishers,USA.
- Biotechnology. 2016 (10thEdition). Satyanarayana, U. 2016. Books and Allied (P) Ltd,Kolkata.

YEAR – III	ENVIRONMENTAL MICROBIOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19EMB51A
SEMESTER – V		HRS/WK - 4
ELECTIVE		CREDITS - 3

Objective: To make the students understand the role of microbes in ecology.

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: understands the different kind of microflora present in air and water environments
CO 2: will be able to know the different process to treat the waste water and drinking water
CO 3: knows about water pollution, and the process of composting and bioremediation
CO 4: knows different kinds of microbes present in extreme environments
CO 5: knows interactions among microorganisms and the study of non-cultivable microbes

SEMESTER: V	COURSE CODE: 19EMB51A					COURSE TITLE: ENVIRONMENTAL MICROBIOLOGY			HOURS: 4	CREDITS: 3
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	2	5	4	4	3	3	3	4	3.5	
CO2	2	4	4	4	4	3	4	3	3.5	
CO3	2	3	3	3	3	2	3	3	2.7	
CO4	3	5	4	4	4	3	5	4	4.0	
CO5	3	5	4	4	5	4	4	4	4.1	
Mean Overall Score									3.5	

Result: The score of this course is 3.5 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit–1 **(12Hrs)**

Microbiology of air –Droplet**,** droplet nuclei, aerosols – air sanitation- airborne diseases- Microflora of water - lakes, ponds, rivers, ocean, estuary, ground water - Waterborne diseases - Eutrophication

Unit-2 **(12Hrs)**

Waste water treatment- primary, secondary (anaerobic and aerobic - trickling, activated sludge, oxidation pond) –Sludge digestion- Disposal - Drinking water treatment - chlorination – Microbiological standards of water.

Unit-3 **(12Hrs)**

Water pollution – indicators of water pollution – BOD, COD; techniques for the study of water pollution; Composting; Bioremediation - types, importance, advantages and applications

Unit-4 **(12Hrs)**

Microorganisms in extreme environment - Applications of extremophiles; bioleaching;Microbial biofilm - Biochemistry of microbial biofilm, beneficial and harmful roles of biofilm.

Unit– 5 **(12Hrs)**

Interaction among microbial populations (Neutralism, commensalisms, parasitism, antagonism); Microbial diversity - recent techniques to study non-cultivable microbes - Applications, advantages and limitations

Text Books

- Microbial Ecology - Fundamental and Applications. 1998. Atlas and Bartha. Benjamin/ Curmmings Publishing Company, Inc., California
- Environmental Aspects of Microbiology. 1996. Joseph C. Daniel. Brightsun Publications,Chennai.

Reference Books

- Environmental Microbiology. 1992. Mitchell, R. John Wiley, NewYork.
- Environmental Microbiology. 1981. Grant W. D. and Long P.E. Blackie and Son Ltd,,Glasgow
- Environmental Microbiology. 2016. Sharma, P.D. Rastogi Publications, Meerut,India.

YEAR – III	SOIL AND AGRICULTURAL MICROBIOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB613
SEMESTER - VI		HRS/WK - 5
CORE - 13		CREDITS - 4

Objective: To make the students understand the importance of microbes in soil fertility and plant diseases.

Course Outcomes:

Upon successful completion of the course, the student:

CO 1: Understands different soil microflora and their roles in improving soil fertility
CO 2: Knows the plant-microbe interactions and their outcomes
CO 3: Studies different cyclical movement nutrients and different kinds of biofertilizers and biopesticides
CO 4: Understands different plant diseases due to bacterial and fungal phytopathogens
CO 5: Studies different plant diseases due to viruses and nematodes

SEMESTER: VI	COURSE CODE: 19MB613					COURSE TITLE: SOIL AND AGRICULTURAL MICROBIOLOGY			HOURS: 5	CREDITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	2	5	4	4	3	3	3	4	3.5	
CO2	2	4	4	4	4	3	3	4	4.3	
CO3	2	3	3	4	3	2	3	3	2.8	
CO4	3	5	4	4	4	3	5	4	4.0	
CO5	3	3	3	5	5	4	4	4	3.8	
Mean Overall Score									3.6	

Result: The score of this course is 3.6 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit-1 **(15 Hrs)**

Soil – physical and chemical properties; soil microorganisms - bacteria, algae, fungi, actinomycetes, protozoans, nematodes and viruses – Influence of soil and environmental factors on soil microflora - Role of microbes in soil fertility - Winogradsky column.

Unit-2 **(15 Hrs)**

Microbial interactions with plants - Mycorrhizae, Rhizosphere, Phyllosphere, Spermosphere- Plant growth promoting bacteria – Mechanisms of plant growth promotion - Organic matter decomposition - humus formation - Biodegradation of pesticides in the soil

Unit-3 **(15 Hrs)**

Biogeochemical cycles - carbon, phosphorus, sulphur, Iron and nitrogen cycles; Nitrogen fixation – symbiotic and free living; Biofertilizers - Types (bacterial and algal), Examples and advantages; Biopesticides - types (bacterial, fungal and viral), Examples and advantages; Mass multiplication of microbial Bioinoculants

Unit– 4 **(15 Hrs)**

Plant pathogenic microorganisms - Disease symptoms, mode of entry, control measures - Diseases caused by bacteria – bacterial Wilt of potato- Citrus canker, leaf blight of paddy as examples - Diseases caused by fungi - False smut of paddy, Leaf smut of rice, wheat rust, Red rot of sugarcane and Tikka disease of groundnut asexamples

Unit-5 **(15 Hrs)**

Diseases caused by viruses - Tungrovirus, Virus diseases of papaya and sugarcane – Bunchy disease of banana – Leaf curl of tomato as example - Diseases caused by *Mycoplasma* - Little leaf of brinjal as example – Diseases due to Phytoplasma - Sugarcane grassy shoot disease as example - Diseases due to nematodes – Root knot of vegetables as example – Seed bornediseases.

Text Books

- Diseases of crop plants in India. 1999 (4th Edition). G. Rangaswami, A. Mahadevan. Prentice – Hall of India Private Ltd., NewDelhi.
- Agricultural Microbiology. 1998 (2ndEdition). G. Rangaswami,D.J Bagyaraj. Prentice -Hallof India Private Ltd., New Delhi, India

Reference Books

- Microbiology - Fundamentals and Applications. 1998. Atlas and Bartha. Benjamin/Cummings Publishing Company, Inc.,California.
- Introduction to Soil Microbiology. Alexander. M. 1961. John Wiley Sons, Inc. New York &.London.
- Fundamental Agricultural Microbiology. 2017. Aneja, K.R. International private limited, Chennai,India
- Fundamental of Plant Pathology. 2013. Ravichandra, N.G. PHI publishers, New Delhi, India
- A Textbook of Plant Pathology. 2020. Sambamurty, A.V.V.S. Dreamtech Press, New Delhi,India

YEAR – III	MEDICALVIROLOGY	19MB614
SEMESTER - VI	(For the students who are admitted in theyear 2019 – 2020 andonwards)	HRS/WK - 5
CORE - 14		CREDITS - 4

Objective: To make the students understand the medical importance of viruses and their diseases.

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: Understands the basic properties and medical importance of viruses.
CO 2: Learns viral infections caused by contagious group of viruses.
CO 3: Acquires knowledge about respiratory borne viruses.
CO 4: Gains knowledge on pandemic viral diseases and sporadic viral diseases.
CO 5: Learns the importance of Retro viruses in detail and other viral infections in children.

SEMESTER: VI	COURSE CODE: 19MB614					COURSE TITLE: MEDICAL VIROLOGY			HOURS: 5	CREDITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3	4	4	4	3	3	3	4	3.5	
CO2	3	4	4	4	4	3	3	4	3.4	
CO3	3	3	3	4	3	4	4	4	3.5	
CO4	3	4	4	4	4	3	4	4	3.7	
CO5	3	4	3	3	4	4	4	4	3.6	
Mean Overall Score									3.5	

Result: The score of this course is 3.5 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit-1 **(15 Hrs)**

General properties of viruses – Cultivation of virus - Virus-host interactions – Classification –Nomenclature of viruses - Prions - Antiviral agents - Viral vaccines- Mode of transmission ofviruses

Unit-2 **(15 Hrs)**

Pox viruses **-** Herpes viruses - Adeno viruses - Picorna viruses

Unit-3 **(15 Hrs)**

Orthomyxo viruses – Paramyxo viruses **-** Corona viruses

Unit-4 **(15 Hrs)**

Arboviruses - Rhabdoviruses - Hepatitis viruses

Unit-5 **(15 Hrs)**

Rubella virus –Rota virus- Oncogenic viruses – Retro viruses

Text Books

- Human Virology. 2006 (3rd edition). Collier L and Oxford J. Oxford University Press Inc., New York.
- Ananthanarayan and Paniker's Text Book of Microbiology. 2017 (10thedition). Reba Kanungo. Universities Press (India) Private Limited,Hyderabad.

Reference Books

- Introduction to Modern Virology. 2007 (6thedition). Dimmock N.J, Easton A.J and Leppard K.N. Blackwell Publishing Ltd., Oxford,London.
- Jawetz, Melnick and Adelberg's Medical Microbiology (28th Edition). Stefan Riedel, Stephen A Morse, Timothy A Mietzner and Steve Miller, 2019, McGraw-Hill Company, NewYork.
- Fields Virology. 2013. (5thedition). David M. Knipe and Peter M. Howley. Lippincott Williams & Wilkins,Philadelphia.
- Virology- Principles and Applications. 2013 (2ndEdition). Carter J.B andSaunders V.A. John Wiley and Sons Limited, West Sussex, UK.
- Notes on Medical Virology. 1997 (11th Edition). Timbury M.C. Churchill Livingstone, London.

YEAR – III	MEDICAL MYCOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB615
SEMESTER - VI		HRS/WK - 5
CORE - 15		CREDITS - 4

Objective: To make the students understand the medical importance of fungi.

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: Acquires knowledge aboutthe laboratory diagnosis and treatment of fungal diseases.
CO 2: Attains knowledge about superficial and cutaneous mycoses.
CO 3: Learns about subcutaneous mycoses.
CO 4: Understands systemic mycoses.
CO 5: Gains knowledge about opportunistic fungal infections and mycotoxicoses

SEMESTER: VI	COURSE CODE: 19MB615					COURSE TITLE: MEDICAL MYCOLOGY			HOURS: 5	CREDITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	4	4	3	4	3.5	4	4	4	3.81	
CO2	3	3.5	3	3.5	4	4	3.5	3.5	3.5	
CO3	4	3.5	3.5	3.5	4	4	4	3.5	3.75	
CO4	3.5	4	3	3.5	3.5	4	4	4	3.68	
CO5	3.5	3.5	3.5	4	3.5	3.5	3.5	4	3.62	
Mean Overall Score									3.67	

Result: The score of this course is 3.67 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit-1 **(12 Hrs)**

Introduction – General properties of fungi – Morphological classification of fungi - Classification of fungal diseases - Pathogenesis of fungal infection – Laboratory diagnosis offungal disease –Antifungal

Unit-2 **(12 Hrs)**

Superficial mycoses – Pityriasis versicolor, Tinea nigra, Black piedra, White piedra - Cutaneous mycoses - Dermatophytosis

Unit-3 **(12 Hrs)**

Subcutaneous mycoses – Mycetoma, Sporotrichosis, Chromoblastomycosis, Rhinosporidiosis

Unit-4 **(12 Hrs)**

Systemic mycoses – Histoplasmosis, Blastomycosis, Coccidioidomycosis, Paracoccidioidomycosis,Cryptococcosis.

Unit-5 **(12 Hrs)**

Opportunistic mycoses – Candidiasis, Aspergillosis, Penicillosis, Zygomycosis, Mycotoxicoses.

Text Books

- Text Book of Mycology. 2018 (4th edition). Jagdish Chander. Jaypee Brothers Medical Publishers Private Limited, New Delhi.
- Ananthanarayan and Paniker's Text Book of Microbiology. 2017 (10thedition). Reba Kanungo. Universities Press (India) Private Limited,Hyderabad.

ReferenceBooks

- Jawetz Melnick & Adelberg's Medical Microbiology. 2019 (28thEdition). Stefan Riedel, Stephen A. Morse, Timothy A. Mietzner, Steve Miller. Mc GrawHill.
- Medical Microbiology. 2008 (6th Edition). Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller. Mosby - Elsevier.
- Medical Microbiology. 2012. (18thEdition). David Greenwood, Richard Slack, Michael Barer and W. L. Irving. ChurchillLivingstone.
- Text Book of Microbiology and Immunology (2ndedition). Subhash Chandra Parija,2012, Elsevier India, NewDelhi.
- Essentials of Medical Microbiology. 2008 (4th edition). Rajesh Bhatia and Rattan Lal Ichhpujani, Jaypee Brothers Medical Publishers Private Limited, NewDelhi.

YEAR – III	BIOTECHNOLOGY (For the students who are admitted in the year 2019 – 2020 and onwards)	19MB616
SEMESTER - VI		HRS/WK - 5
CORE - 16		CREDITS - 4

Objective: To make the students understand the basic principles and techniques involved in gene technology

Course Outcomes:

Upon successful completion of the course, the student:

CO1: Understands the basics of recombinant DNA technology and cloning vectors.

CO2: Gains knowledge about the DNA and its amplification.

CO3: Acquires knowledge about enzymes and biofuels.

CO4: Understands the usage of plants and exploitation of them through genetic modification

CO5: Understands the usage of animals and exploitation of them through genetic modification, patenting and intellectual property rights.

SEMESTER: VI	COURSE CODE: 19MB616					COURSE TITLE: BIOTECHNOLOGY			HOURS: 5	CREDITS: 4
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3	4	4	4	3.5	3	3.5	4	3.62	
CO2	3	4	4	4	4	3	4	3.5	3.68	
CO3	4	3	3.5	3	3	4	3.5	3	3.37	
CO4	3.5	4	4	4	4	3	4	4	3.81	
CO5	3	4	4	4	4	4	4	4	3.87	
Mean Overall Score									3.67	

Result: The score of this course is 3.67 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit-1 **(15Hrs)**

Definition and history – Recombinant DNA technology – Restriction endonucleases- Cloning vectors – pBR322, Cosmids - M13 phage vector and its applications – DNA ligation.

Unit-2 **(15Hrs)**

Chemical synthesis of DNA – DNA sequencing– Hybridisation techniques - Southern and Northern blotting techniques – Colony hybridization - PCR – Genomic library.

Unit-3 **(15Hrs)**

Enzyme technology – Enzyme immobilization, products, Applications - Biofuel –Hydrogen gas as fuel from Microorganisms – Biodiesel.

Unit-4 **(15Hrs)**

Genetic engineering of plants – Electroporation – Gene gun –Particle bombardment- Ti plasmid vectors –Cauliflower mosaic virus as cloning vector - Applications- Transgenic plants –Insect resistant, Virus resistant plants, genetically modified foods.

Unit-5 **(15Hrs)**

Transgenic animals –Retroviral vector method, DNA microinjection method –Applications of r DNA technology – Recombinant products –insulin, tPA, Interferons – Gene therapy – Patents – IPR.

Text Books

- Elements of Biotechnology. 1996. Gupta, P.K. Rastogi and Company,Meerut.
- Basic Biotechnology. 2001 (2nd edition). Ratledge C. and B. Kristiansen. Cambridge University press, UnitedKingdom.

Reference Books

- Principles of Gene Manipulation. 1994 (5th Edition).Old, R.W. and S.B.Primrose. Blackwell Science,Oxford.
- Molecular Biotechnology - Principles and Applications of Recombinant DNA technology. 2010 (4thEdition). Glick, B. R., Pasternack J.J. and Patten C.L.ASM Press.
- Genetics- A Molecular Approach. 2004. Brown, T.A. Chapman Hall,London.
- Biotechnology Expanding Horizons. 2021. Singh, B.D. Kalyani Publishers,Ludhiana.

YEAR – III	COMPUTER APPLICATIONS IN BIOLOGY	EMB615S
SEMESTER - VI	(For the students who are admitted in the year 2019 – 2020 and onwards)	HRS/WK - 4
ELECTIVE		CREDITS - 3

Objective: To make the students understand the applications of computers in biology

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: Understands basics of computers and importance ofinternet.
CO 2: Knowledge to access data from various biologicaldatabases.
CO 3: Comprehends the concept of sequence alignment using algorithms.
CO 4: Analyzes biological data using softwares and tools.
CO 5: Understands the applications of genomics and proteomics in biology.

SEMESTER: VI	COURSE CODE: 19EMB62A					COURSE TITLE: COMPUTER APPLICATIONS IN BIOLOGY			HOURS: 4	CREDITS: 3
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	4	4	3	4	3.5	4	4	4	3.81	
CO2	3	3.5	3.5	3.5	4	4	3.5	4	3.62	
CO3	4	3.5	3.5	4	4	4	3.5	3.5	3.75	
CO4	3.5	4	3	3.5	3.5	4	4	4	3.68	
CO5	3.5	3.5	3.5	4	3.5	3.5	3.5	4	3.62	
Mean Overall Score									3.69	

Result: The score of this course is 3.69 (High)

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit– 1 **(12Hrs)**

Introduction to computers – Types of computers – Generation – Applications of computers – Input and Output devices – ROM, RAM- Internet: Types of Network – LAN, WAN & MAN - Web services - World Wide Web, URL - Uses ofInternet.

Unit–2 **(12Hrs)**

Introduction to Bioinformatics – Definition – Biological databases (generalized and specialized) – Literature database (PubMed, BioMed Central)- Nucleic acid sequence databases (EMBL, NCBI, DDBJ) – sequence format (GenBank, FASTA format) – Protein sequence databases (SWISS-PROT, PIR) – Structure databases (PDB).

Unit– 3 **(12Hrs)**

Sequence alignment: Similarity, identity and homology – Pairwise Alignment, gaps, gap-penalties – Basic concepts of scoring matrices – PAM and BLOSUM- Global vs. local alignment – Dot-matrix representation -BLAST – multiple sequence alignment (CLUSTAL W).

Unit– 4 **(12Hrs)**

Phylogenetic analysis (phylogenetic tree, softwares) – Gene finding (methods and tools) – Protein prediction – Molecular visualization (tools, RasMol, Chime) - Automated DNA Sequencing – Human Genome Project

Unit-5 **(12Hrs)**

Concept of Genomics and Proteomics – Comparative genomics – Functional genomics – DNA microarrays – Protein arrays - Metagenomics, Cheminformatics – definition, tools used and applications.

Text Books

- Fundamentals of information Technology. 2009 (2nd Edition). Alexis Leon and Mathews Leon. LeonVikas.
- Bioinformatics - A practical approach.2004. Mani, K. and Vijayaraj, N. Aparna Publications, NewDelhi.

Reference Books

- Introduction to Bioinformatics in Microbiology. 2018. Henrick Christensen. Springer Nature SwitzerlandAG.
- Computational Biology &Bioinformatics – A gentle Overview. 2007. AchuthsankarS. Nair.CommunicationsofComputerSocietyofIndia
- Bioinformatics for Dummies. 2007. Jean-michel Claverie Cedric Notredame. Dummies. Wiley Publishing, Inc,Indiana
- Using Information Technology - A Practical Introduction to Computers and Communications. 2015 (11th Edition). Sawyer S. and B. Williams. McGraw-Hill InternationalEditions.
- Bioinformatics - concepts, skills and applications. 2004. Rastogi, S.C., Menderatta, M. and Rastogi, P. CBS Publishers & Distributors, NewDelhi.

III B.Sc. Microbiology	APPLIED MICROBIOLOGY PRACTICAL (For the students who are admitted in the year 2019 – 2020 and onwards)	19MBP603
SEMESTER – V & VI		HRS/WK - 3
CORE PRACTICAL – 3		CREDITS – 3

LIST OF EXPERIMENTS

1. Open plate method
2. Enumeration of bacteria from water sample
3. Coliform count in water (MPN Technique)
4. Presence/Absence test for coliforms in water
5. Microscopic Examination of curd
6. Isolation of *Lactobacillus* and *Staphylococcus* from curd
7. Microscopic examination of fungi by Lactophenol cotton blue method – *Mucor* and *Rhizopus*
8. Microscopic examination of microorganisms in spoiled food
9. Isolation of bacteria from spoiled food
10. Detection of bacteria in milk by SPC
11. Methylene blue reduction test
12. Phosphatase test for Milk
13. Turbidity test for sterilized Milk
14. Cross section of root nodule

LIST OF SPOTTERS

1. Butter
2. Cheese
3. Canned food
4. Spoiled vegetable
5. Spoiled bread
6. *Rhizopus* - Lactophenol cotton bluemount
7. *Mucor*- Lactophenol cotton bluemount
8. BOD bottle
9. Membrane filter
10. Trickling filter
11. Lactophenol cotton bluestain
12. Methylene blue forMBRT
13. Yeast
14. Bread
15. Vinegar
16. Mushroom
17. *E coli*on EMB agar
18, Lactose fermenting colonies on Mac Conkey agar
19. YEMAmedium
20. Rootnodule
21. Cross section of rootnodule
22. MPN Preliminary test - Lauryl tryptose broth with Durhams tube
23. MPN Confirmed test - Brilliant green lactose bile broth with Durhams tube

24. Curd
25. Milk
26. Milk sample with Methylene blue in screw captube
27. Teasingneedle
28. *Lactobacillus* on Oxgall Agar
29. Staph. aureus on Baird parkeragar

III B.Sc. Microbiology	MEDICAL MICROBIOLOGY PRACTICAL (For the students who are admitted in the year 2019 – 2020 and onwards)	19MBP604
SEMESTER – V & VI		HRS/WK - 3
CORE PRACTICAL – 4		CREDITS – 3

LIST OF EXPERIMENTS

1. Type Study of the followingbacteria
   - *(i) Staphylococcus aureus*
   - (ii). *Streptococcus pyogenes*
   - *(iii) E.coli*
   - *(iv) Klebsiella pneumoniae*
   - *(v). Proteus vulgaris*
   - *(vi). P.mirabilis*
   - *(vii). Salmonella typhi*
   - (viii). *S. paratyphi A*
   - (ix). *S. paratyphi B*
   - *(x). Shigella dysenteriae*
   - *(xi). Pseudomonas aeruginosa*
2. Enrichment culture technique
   - (i). *Salmonella* from feces
   - (ii). *Shigella* fromfeces
3. ThroatSwab
4. UrineCulture
5. Antimicrobial Sensitivity test - Kirby Bauer method
6. Germ tube test for *Candida albicans*
7. Wet mount examinations of stool sample for parasites (*E. histolytica* and *Giardia*)
8. Lactophenol cotton blue mounting of *Aspergillus* and *Penicillium*

LIST OF SPOTTERS

1. Trophozoite of *E.histolytica*
2. Cyst of *E.histolytica*
3. Trophozoite of *G.lamblia*
4. Cyst of *G. lamblia*
5. Tapeworm
6. Roundworm
7. Lab animals – Guinea pig, Mouse,Rabbit
8. Embryonated egg method
9. Robertson cooked meat medium
10. Stormy fermentation
11. Negribodies
12. Mosquito (Vector bornediseases)
13. Acid FastBacilli
14. Germ tube test
15. Pox virus
16. Rabies virus
17. LJ medium

18. *Aspergillus* mount
19. *Pencillium* mount
20. Growth of *E.coli / Klebsiella* on EMB
21. Growth of *Vibrio cholera* onTCBS
22. Blood agar with hemolytic/ non hemolytic
23. Mac Conkey agar with LF/ Non LF
24. Growth of *Salmonella* on SSagar
25. Antibiotic Sensitivity test
26. Metachromatic granules
27. *Ascaris* male & female
28. Cyst of *Balantidiumcoli*
29. Microfilaria of *Wucheriria bancrofti*
30. Ratflea
31. *Salmonella typhi* biochemicals
32. NIH swab
33.Pneumococci

II B.Sc. Biochemistry	ALLIED MICROBIOLOGY	AMBC302
SEMESTER – III		HRS/WK - 5
ALLIED THEORY		CREDIT - 4

Objective: To make the students to understand the basic principles of microbiology.

Course outcomes:
Upon successful completion of the course, the student:
CO 1: will be able to appreciate the discoveries in Microbiology
CO 2: will be able to apply the principles of various microscopes
CO 3: will be able to explain different methods of sterilization
CO 4: will be able to apply the concept of microbial growth
CO 5: will be able to elaborate on the important groups of microorganisms and their role

Unit– 1 **(15 Hrs)**
Introduction - History and Scope of Microbiology- Shape and Size of bacterial cells - Structure of bacterial cell -Structure and functions of cell organelles (Cell wall, structures found outside the cell wall and within the cell wall) - Structure of Endospore

Unit– 2 **(15 Hrs)**
Microscopy - Simple, Compound, Dark field, Phase contrast, Fluorescent, Electron Microscopes - Staining - Classification Microorganisms - Haeckel's, Whitaker's - Prokaryotes and eukaryotes - Taxonomical ranks - Binomial Nomenclature - Characteristics used in Taxonomy

Unit– 3 **(15 Hrs)**
Sterilization - Physical agents - Moist heat, Dry heat, Radiation, Filtration -Chemical agents - Phenols and phenolic compounds, Alcohols, Gaseous agents - Antibiotics – Classification, Mode of action - Antifungal and antiviral agents – examples

Unit– 4 **(15 Hrs)**
Motility of bacteria - Nutrient requirements of microorganisms - Growth factors - Nutritional types - Culture media – Pure culture - Microbial growth - Growth curve – Measurement of Microbial growth - Continuous culture - Environmental factors affecting growth - Bacterial reproduction

Unit– 5 **(15 Hrs)**
Brief description of important groups of bacteria - Archaeobacteria, Spirochetes, Mycoplasma, Actinomycetes, Photosynthetic bacteria, Cyanobacteria, Methanogenic bacteria, Sulfate utilizing bacteria - General characteristics of Algae, Fungi, Protozoa and viruses - Human diseases and the pathogen involved – Role of microorganisms in theenvironment

Text Books

- Microbiology. 1993 (Fifth edition). Michael J. Pelzar. Jr., E.C.S. Chan, Noel R. Krieg. Tata McCraw Hill., New Delhi.
- Microbiology. 2003(5th Edition). Prescott, L. M., J. P. Harely and D.A. Klain McGraw Hill, NewYork.

Reference Books

- Microbiology. 1992. (5th edition). Roger Y. Stanier, John L. Ingraham, Mark L. Wheelis, Page R. Painter.Macmillan.
- Principles of Microbiology. 1997(2nd Edition).Atlas R. A.. Iowa, Wm. C. Brown Publishers.
- Foundations in Microbiology. 1999. (3rdEdition). Talaro K. P. and A. Talaro. WCB McGrawHill

II B.Sc.Biochemistry	ALLIED MICROBIOLOGY PRACTICAL	AMBCP301
SEMESTER – III		HRS/WK - 3
ALLIED PRACTICAL		CREDIT - 2

Objective: To enable the students learn the basic staining procedures in Microbiology

Microscopy

1. Simple staining
2. Gram staining – Gram positive cocci
3. Gram staining – Gram negative bacilli
4. Acid-fast staining
5. Spore staining
6. Capsule staining
7. Motility – Hanging drop method
8. Observation of Fungi (*Penicillium, Aspergillus, Mucor, Rhizopus*) – LPCB mount, Algae (*Chlorella, Spirogyra*) and Protozoa (*Amoeba, Paramecium*), Yeast (*Saccharomyces cerevisiae*) – Gram staining
9. Media preparation and culture technique (Demonstration only)

LIST OF SPOTTERS:

1. Inoculation loop
2. Inoculation needle
3. Anaerobic jar
4. Hot air oven
5. Autoclave
6. Laminar air flow
7. Incubator
8. MacConkey Agar
9. TCBS Plate
10. EMBAgar
11. Spirochetes
12. Eye piece
13. Objective lens
14. Membrane filter
15. Acid Fast Bacilli
16. Gram positive cocci
17. Gram negative rods
18. Gram positive yeast
19. Spore staining
20. *Aspergillus*
21. Dark field microscopy
22. NA slant with liquid paraffin
23. Water bath
24. L –rod
25. pH meter
26. Crystal violet
27. *Chlamydomonas*
28. Mushroom
29. Immersion oil
30. Centrifuge

II B. Sc. Zoology	ALLIED MICROBIOLOGY For the students admitted from the year 2016-17 onwards	19AMB404
SEMESTER - IV		HRS/WK - 5
ALLIED THEORY		CREDIT - 4

Objective: To make the students to understand the basic principles of microbiology.

Course outcomes:
Upon successful completion of the course, the student:
CO 1: will be able to appreciate the discoveries in Microbiology
CO 2: will be able to apply the principles of various microscopes
CO 3: will be able to explain different methods of sterilization
CO 4:will be able to apply the concept of microbial growth
CO 5: will be able to elaborate on the important groups of microorganisms and their role

Unit– 1 **(15 Hrs)**
Introduction - History and scope of Microbiology - Shape and Size of bacterial cells - Structure of bacterial cell -Structure and functions of cell organelles (Cell wall, structures found outside the cell wall and within the cell wall) - Structure of Endospore

Unit– 2 **(15 Hrs)**
Microscopy - Simple, Compound, Dark field, Phase contrast, Fluorescent, Electron Microscopes - Staining – Classification Microorganisms - Haeckel's, Whitaker's - Prokaryotes and eukaryotes - Taxonomical ranks - Binomial Nomenclature - Characteristics used in Taxonomy

Unit– 3 **(15 Hrs)**
Sterilization - Physical agents - Moist heat, Dry heat, Radiation, Filtration -Chemical agents - Phenols and phenolic compounds, Alcohols, Gaseous agents - Antibiotics – Classification, Mode of action - Antifungal and antiviral agents – examples

Unit– 4 **(15 Hrs)**
Motility of bacteria - Nutrient requirements of microorganisms - Growth factors - Nutritional types - Culture media – Pure culture - Microbial growth - Growth curve - Measurement of microbial growth - Continuous culture - Environmental factors affecting growth - Bacterial reproduction

Unit– 5 **(15 Hrs)**
Brief description of important groups of bacteria - Archaeobacteria, Spirochetes, Mycoplasma, Actinomycetes, Photosynthetic bacteria, Cyanobacteria, Methanogenic bacteria, Sulfate utilizing bacteria - General characteristics of Algae, Fungi, Protozoa and viruses - Human diseases and the pathogen involved – Role of microorganisms in theenvironment

Text Books

- Microbiology.1993 (Fifth edition). Michael J. Pelzar.. Jr., E.C.S. Chan, Noel R. Krieg. Tata McCraw Hill., New Delhi.
- Microbiology. 2003 (5thEdition).Prescott, L. M., J. P. Harely andD. A. Klain McGraw Hill, NewYork.

Reference Books

- Microbiology. 1992. (5th edition). Roger Y. Stanier, John L. Ingraham, Mark L. Wheelis, Page R. Painter.Macmillan.
- Principles ofMicrobiology. 1997(2nd Edition). Atlas R. A. Iowa, Wm. C. Brown Publishers.
- Foundations in Microbiology. 1999. (3rd Edition). Talaro K. P. and A. Talaro. WCB McGrawHill

II B.Sc. Zoology	ALLIED MICROBIOLOGY PRACTICAL	19AMP404
SEMESTER – IV	For the students admitted from the year 2016-17 onwards	HRS/WK - 3
ALLIED PRACTICAL		CREDIT - 2

Objective: To enable the students learn the basic staining procedures in Microbiology

Microscopy

1. Simple staining
2. Gram staining – Gram positive cocci
3. Gram staining – Gram negative bacilli
4. Acid-fast staining
5. Spore staining
6. Capsule staining
7. Motility – Hanging drop method
8. Observation of Fungi (*Penicillium, Aspergillus, Mucor, Rhizopus*) – LPCB mount, Algae (*Chlorella, Spirogyra*) and Protozoa (*Amoeba, Paramecium*), Yeast (*Saccharomyces cerevisiae*) – Gram staining
9. Media preparation and culture technique (Demonstration only)

LIST OF SPOTTERS:

1. Inoculation loop
2. Inoculation needle
3. Anaerobic jar
4. Hot air oven
5. Autoclave
6. Laminar airflow
7. Incubator
8. MacConkey Agar
9. TCBS Plate
10. EMB Agar
11. Spirochetes
12. Eye piece
13. Objective lens
14. Membrane filter
15. Acid Fast Bacilli
16. Gram positive cocci
17. Gram negative rods
18. Gram positive yeast
19. Sporestaining
20. *Aspergillus*
21. Dark field microscopy
22. NA slant with liquid paraffin
23. Water bath
24. L –rod
25. pH meter
26. Crystal violet
27. *Chlamydomonas*
28. Mushroom
29. Immersion oil
30. Centrifuge

III B.Sc. ZOOLOGY	BIOFERTILIZER TECHNOLOGY	20EZ513A
SEMESTER - V	For the students admitted from the year 2018-19 onwards	HRS/WK - 4
ELECTIVE		CREDIT - 2

Objective: To enable the student, learn the importance of biofertilizers and their production

- To enlighten the students with the knowledge of microbialinoculants
- To highlight the role of microorganisms in soil fertility and plant growthpromotion
- To understand the process of isolation, production, formulation, method of application and quality control ofbio-fertilizers

Course Outcomes:
Upon successful completion of the course, the student:
CO 1: will be able to appreciate the role of soil microorganisms
CO 2: will be able to describe various nitrogen fixing organisms
CO 3: will be able to explain different nutrient solubilizingbacteria
CO 4: will be able to gain knowledge on production of biofertilizers
CO 5: will be able to elaborate on the formulation of biofertilizers

SEMESTER: V	COURSE CODE: 20EZ513A					TITLE OF THE PAPER: BIOFERTILIZER TECHNOLOGY			HOURS: 4	CREDITS: 2
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3		
CO1	3	2	5	5	4	4	4	5	4.0	
CO2	2	2	5	5	3	3	5	5	3.7	
CO3	2	2	4	5	4	3	5	5	3.7	
CO4	4	2	4	4	4	3	4	4	3.6	
CO5	4	2	4	4	4	3	5	5	3.8	
Mean Overall Score									3.7	

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit– 1 **(12 Hrs)**

Soil microorganisms and plants: Important groups of soil microorganisms - Bacteria, Fungi, Algae, Protozoa, and Viruses - Microbial interactions in soil- positive and negative interactions - Rhizosphere – Phyllosphere -Spermosphere - R:S ratio; Biofertilizers-definition,types,importanceofbiofertilizersinagriculture;PlantGrowthPromotingRhizobacteria (PGPR) and their products - Cytokinin, Gibberellic acid, IAA, HCN and Siderophore.

Unit– 2 **(12 Hrs)**

Nitrogen fixers: Biological nitrogen fixation (BNF) - mechanism of BNF - Symbiotic

nitrogen fixation - legume symbiosis- *Rhizobium*- characters and classification, nodulation- Free living nitrogen fixation - BGA, *Azolla, Azospirillum, Azotobacter*, *Glucanoacetobacter* and Frankia.

Unit– 3 **(12 Hrs)**

Nutrient solubilizers and mobilizers: Solubilization of insoluble P, K, Zn and Si; Important solubilizing bacteria and fungi - Mycorrhizal bioinoculants – classification - Ectomycorrhizae – Endomycorhizae -VAM- Taxonomy of mycorrhizae – role of mycorrhizae.

Unit– 4 **(12 Hrs)**

Production technology: Isolation and mass multiplication of Nitrogen fixers (*Rhizobium*), P, K, Zn and Si solubilizing organisms (*Pseudomonas*), BGA, *Azollae* and Mycorrhizae - Carrier materials – selection, sterilization and preparation of carrier materials – fermenters.

Unit– 5 **(12 Hrs)**

Formulation of Biofertilizers: Carrier based, gel based and liquid based biofertilizers - Quality control of different formulations – Problems and constraints in production- Methods of application and recommendations

Text Books

- Soil Microbiology.199 (4th Edition). Subba Rao N.S. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India
- Agricultural Microbiology. 2002(2nd Edition).Bagyaraj D.J. and G. Rangasamy. Prentice Hall, New Delhi, India

Reference Books

- Microbes as Bio-fertilizers and their production Technology. 2015. Borkar S.G. Wood Head Publishers, NewDelhi.
- Biofertilizers: Commercial production Technology and quality control. 2017. Hyma P. Random publishers, New Delhi
- Biofertilizer Manual. 2006. FNCA (Forum for Nuclear Cooperation in Asia) Biofertilizer Project Group. Published by Japan Atomic Industrial Forum.

II B.Sc. CHEMISTRY	FOOD PROCESSING TECHNOLOGY (For those students admitted in the year 2020 – 21 and onwards)	NMEFT401
SEMESTER - IV		HRS/WK - 3
NME		CREDITS - 2

Objective: To make the students understand food processing and preservation methods

Course Outcomes:
Upon successful completion of the course, the student:
CO1:could understand the principles of food preservation and processing
CO2:could obtain knowledge about preservation of food at various temperatures
CO3:could acquire knowledge about food preservation by radiation
CO4:could comprehend government regulations and policies on food control
CO5:could gain knowledge about processed foods

SEMESTER: III	COURSE CODE: 20AOFT301				TITLE OF THE PAPER: FOOD PROCESSING TECHNOLOGY			HOURS: 3	CREDITS: 2
COURSE OUTCOMES	PROGRAMME OUTCOMES (PO)					PROGRAMME SPECIFIC OUTCOMES (PSO)			MEAN SCORE OF COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	
CO1	4	3	4	4	3	4	3	3	3.50
CO2	3	3	4	4	3	4	4	4	3.62
CO3	4	4	3	4	3	4	4	3	3.62
CO4	3	4	3	4	3	3	2	3	3.12
CO5	3	4	4	4	3	4	4	4	3.75
Mean Overall Score									3.5

Association	1%-20%	21%-40%	41%-60%	61%-80%	81%-100%
Scale	1	2	3	4	5
Interval	0<=rating<=1	1.1<=rating<=2	2.1<=rating<=3	3.1<=rating<=4	4.1<=rating<=5
Rating	Very Poor	Poor	Moderate	High	Very High

This Course is having **HIGH** association with Programme Outcomes and Programme SpecificOutcomes.

Unit-1 **(9Hrs)**
Principles of preservation and processing of foods; classification of foods by ease of spoilage; principles of food preservation, methods of food preservation – asepsis, removal of microorganisms, maintenance of anaerobic conditions.

Unit-2 **(9Hrs)**
Preservation of food by use of high and low temperature- Factors affecting heat resistance (Thermal death time); heat penetration, heat treatments employed in processing foods, canned foods; low temperature storage, chilling and freezing, freezing of foods and its consequences.

Unit-3 **(9Hrs)**

Preservation of foods by - drying- Methods of drying, treatments of foods before drying, procedures after drying, intermediate moisture foods; Preservation of foods by additives antimicrobial preservatives, added preservatives, developed preservatives;Preservation of foods by radiation - Ultra violet radiation, ionizing radiations, gamma rays and cathode rays; microwave processing.

Unit-4 **(9Hrs)**

Food Adulteration; Food sanitation - Microbiology of the food product, good manufacturing practices, Hazard Analysis Critical Control Points, health of employees; Food control – enforcement and control agencies – international agencies (FAO, WHO, FDA & ISO); national agencies (Agmark, ISI, BIS).

Unit-5 **(9Hrs)**

Processed foods – Jam, canned fruit juices, pickles, Bread, Seafoods, Dairy products - Market milk, Special milk, Cream, Butter, Ice Cream, Cheese, Dried milk products; Packaging of milk and milk products

Text Book:

- Food Microbiology. 5th Edition, 2013. William C. Frazier, Dennis C. Westhoff, N. M. Vanitha. McGraw-Hill Education(India).
- Food Microbiology, 4th Edition, 2015. Adams, M.R., Moss, M.O and McClure, P. J. RSC Publication, CPI Group (UK) Ltd., Croydon,UK.

Reference Books:

- Outlines of Dairy Technology. 1991. Sukumar De. Oxford University Press.
- A First Course in Food Analysis. 1999. A.Y. Sathe. New Age International (P) Limited, Publishers, New Delhi.
- The Microbiological Safety and Quality of Food. 2000. Barbara M. Lund, Baird-Parker, Gould G.W. An Aspen publication, Maryland,U.S.A.