

**ST. JOSEPH'S COLLEGE OF ARTS & SCIENCE  
(AUTONOMOUS)  
(Affiliated to Thiruvalluvar University, Vellore)  
CUDDALORE-1**



**PG & RESEARCH DEPARTMENT OF MICROBIOLOGY**

**B.Sc. MICROBIOLOGY  
ALLIED AND ELECTIVE COURSES  
(ACADEMIC YEAR 2022-2023)**

**CURRICULUM TEMPLATE, SYLLABUS AND  
B.Sc. MICROBIOLOGY**

ST. JOSEPH'S COLLEGE OF ARTS & SCIENCE (AUTONOMOUS), CUDDALORE - 1					
B.Sc. Microbiology (Batch 2020-2021)					
PART	CODE	SUBJECT	HOURS	CREDITS	Max. Marks
<b>SEMESTER I</b>					
I	LT101T / LH101S / LF101	TAMIL - I / HINDI - I / FRENCH - I	4	3	100
II	LE101T	FUNCTIONAL ENGLISH - I	4	3	100
III		PROFESSIONAL ENGLISH - I	3	3	100
III	19MB101	FUNDAMENTALS OF MICROBIOLOGY	3	3	100
III	19MB102	MICROBIAL TAXONOMY	3	3	100
III	19ABC101	BASIC BIOCHEMISTRY	4	4	100
III	MBP201S	BASIC TECHNIQUES IN MICROBIOLOGY	4	-	-
III	19ABCP11	BIOCHEMISTRY PRACTICAL	3	2	100
IV	VE101T	VALUE EDUCATION	2	2	100
		<b>Total</b>	<b>30</b>	<b>23</b>	<b>800</b>
<b>SEMESTER II</b>					
I	LT202T / LH202S / LF202	TAMIL - II / HINDI - II / FRENCH - II	4	3	100
II	LE202T	FUNCTIONAL ENGLISH - II	4	3	100
III		PROFESSIONAL ENGLISH - II	3	3	100
III	19MB203	GROWTH AND NUTRITION OF MICROORGANISMS	3	3	100
III	19MB204	MICROBIAL METABOLISM	3	3	100
III	19ABC202	ADVANCED BIOCHEMISTRY	4	4	100
IV	EPD201T / EBT201	DYNAMICS OF PERSONALITY / BASIC TAMIL	2	2	100
III	MBP201S	BASIC TECHNIQUES IN MICROBIOLOGY	4	3	100
III	19ABCP22	BIOCHEMISTRY PRACTICAL	3	2	100
		<b>Total</b>	<b>30</b>	<b>26</b>	<b>900</b>
<b>SEMESTER III</b>					
I	LT303T / LH303S / LF303	TAMIL - III / HINDI – III / FRENCH - III	4	3	100
II	LE303T	FUNCTIONAL ENGLISH - III	4	3	100
III	19MB305	IMMUNOLOGY	4	3	100
III	19MB306	MOLECULAR BIOLOGY	3	3	100
III	19AZMB31	CLASSICAL GENETICS & BIostatISTICS	5	4	100
III	MBP402	BASIC EXPERIMENTS IN IMMUNOLOGY & MICROBIAL GENETICS	4	-	-
III	19AZMP31	ALLIED ZOOLOGY PRACTICAL - I	3	2	100
IV	AOBI301	BIOINSTRUMENTATION	3	2	100
		<b>Total</b>	<b>30</b>	<b>20</b>	<b>700</b>

SEMESTER IV					
I	LT404T / LH404S / LF404	TAMIL - IV / HINDI – IV / FRENCH - IV	4	3	100
II	LE404T	FUNCTIONAL ENGLISH - IV	4	3	100
III	19MB407	IMMUNOTECHNOLOGY	4	3	100
III	19MB408	MICROBIAL GENETICS	4	3	100
III	19AZMB42	APPLIED ENTOMOLOGY	4	4	100
IV	EVS401S	ENVIRONMENTAL SCIENCE	3	2	100
III	MBP402	BASIC EXPERIMENTS IN IMMUNOLOGY & MICROBIAL GENETICS	4	3	100
III	19AZMP42	ALLIED ZOOLOGY PRACTICAL - II	3	2	100
		<b>Total</b>	<b>30</b>	<b>23</b>	<b>800</b>
SEMESTER V					
III	New Course	INDUSTRIAL MICROBIOLOGY	5	4	100
III	New Course	MEDICAL BACTERIOLOGY	5	4	100
III	New Course	MEDICAL PARASITOLOGY	4	3	100
III	New Course	ENVIRONMENTAL MICROBIOLOGY	4	3	100
III	New Course	FOOD & DAIRY MICROBIOLOGY	4	3	100
III	New Course	ALGAL TECHNOLOGY	2	2	100
III	New Course	SSC* – A – Bioremediation / B – Public Health / C – Microbial Enzymes / D – Marine Microbiology / E – Food Safety	-	2	100
III	MBP603S	APPLIED MICROBIOLOGY PRACTICAL	3	-	-
III	MBP604S	MEDICAL MICROBIOLOGY PRACTICAL	3	-	-
		<b>Total</b>	<b>30</b>	<b>21</b>	<b>700</b>
SEMESTER VI					
III	New Course	BIOTECHNOLOGY	5	4	100
III	New Course	MEDICAL VIROLOGY	5	4	100
III	New Course	SOIL AND AGRICULTURAL MICROBIOLOGY	4	3	100
III	New Course	MEDICAL MYCOLOGY	4	3	100
III	New Course	CLINICAL MICROBIOLOGY	4	3	100
III	New Course	COMPUTER APPLICATIONS IN BIOLOGY	2	2	100
III	MBP603S	APPLIED MICROBIOLOGY PRACTICAL	3	3	100
III	MBP604S	MEDICAL MICROBIOLOGY PRACTICAL	3	3	100
		<b>Total</b>	<b>30</b>	<b>25</b>	<b>800</b>
V	EU601	EXTENSION ACTIVITIES	-	2	-
				<b>140</b>	<b>4700</b>

\* SSC – Self Study Course – Students have to choose one course from the list. One faculty member will be the mentor for each course.

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

**Objective:**

- To make the students understand the basic principles in Microbiology
- To enable the students understand the Sterilization process

**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)**

Microscopy - 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 Books**

- Prescott, L. M., J. P. Harely and D. A. Klain, Microbiology, 2003 (5<sup>th</sup> Edition) McGraw Hill, New York.

**Reference Books**

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

**E-Reference**

- <http://www.microbeworld.org>

<b>YEAR - I</b>	<b>MICROBIAL TAXONOMY</b> <b>(For those students who are admitted in the year 2019 - 2020 onwards)</b>	<b>19MB102</b>
<b>SEMESTER - I</b>		<b>HRS/WK - 3</b>
<b>CORE - II</b>		<b>CREDITS - 3</b>

**Objective:**

- To make the students understand the concept of classification
- To enable the students appreciate the diversity of microorganisms

**Unit - 1**

**(9 Hrs)**

Classification - Haeckel's, Whitaker's - Prokaryotes and eukaryotes - Evolution of microorganisms - Taxonomical ranks, Binomial Nomenclature - Characteristics used in Taxonomy

**Unit - 2**

**(9 Hrs)**

Outline of bacterial classification according to Bergey's manual - Brief account of important groups of bacteria - Archaeobacteria, Spirochetes, *Mycoplasma*, Actinomycetes, Photosynthetic bacteria, Cyanobacteria, Methanogenic bacteria, Sulfate utilizing bacteria.

**Unit - 3**

**(9 Hrs)**

Fungi - characteristics, morphology, reproduction, physiology, classification - Fungi of special interest - *Mucor*, *Rhizopus*, *Penicillium*, *Neurospora*, *Agaricus*, *Saccharomyces*, *Candida*, Lichens, mycorrhiza

**Unit - 4**

**(9 Hrs)**

Algae - occurrence, importance, characteristics, classification - Algae of special interest - *Chlamydomonas*, *Euglena*, *Volvox*, diatoms - Protozoa - occurrence, free-living, symbiotic, morphology, reproduction, classification - Protozoa of special interest - *Amoeba*, *Paramecium*

**Unit - 5**

**(9 Hrs)**

Viruses - general characteristics, morphology, classification - viruses of bacteria, plants, animals, human beings - T4 phage, TMV, rabies, HIV as examples.

**Text Books**

- Prescott, L. M., J. P. Harely and D. A. Klain, Microbiology, 2003 (5<sup>th</sup> Edition) McGraw Hill, New York.

**Reference Books**

- Michael J. Pelzar, Jr., E.C.S. Chan, Noel R. Krieg, Microbiology, 1993 (Fifth edition), Tata McCraw Hill, New Delhi.
- Roger Y. Stanier, John L. Ingraham, Mark L. Wheelis, Page R. Painter, Microbiology 1987 (5<sup>th</sup> Edition), Macmillan.

**E-Reference**

- [www.asm.org](http://www.asm.org)

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

**Objective:**

- To make the students understand the basic principles of Microbial growth

**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 Books**

- Schlegel, H.G., 1993. General Microbiology, (7<sup>th</sup> Edition), Press Syndicate of the University of Cambridge.

**Reference Books**

- Caldwell, D.R., 1995. Microbial Physiology & Metabolism, USA.Wm.C. Brown Communications, Inc.
- Dawes, I. W. and Sutherland L.W. 1992. Microbial Physiology, (2<sup>nd</sup> Edition), Oxford Blackwell Scientific Publications.

<b>YEAR - I</b>	<b>MICROBIAL METABOLISM</b> <b>(For those students who are admitted in the year</b> <b>2019 - 2020 onwards)</b>	<b>19MB204</b>
<b>SEMESTER - II</b>		<b>HRS/WK - 3</b>
<b>CORE - IV</b>		<b>CREDITS - 3</b>

**Objective:**

- To make the students understand the basic principles of Microbial Physiology

**Unit - 1** **(9 Hrs)**

Principles of energetics – oxidation-reduction reactions – respiratory chain

**Unit - 2** **(9 Hrs)**

Energy production by anaerobic process (Glycolysis, Pentose phosphate pathway, ED Pathway, Fermentation)

**Unit - 3** **(9 Hrs)**

Energy production by aerobic process (TCA, catabolism of lipids, catabolism of proteins)

**Unit - 4** **(9 Hrs)**

Energy production by aerobic process (respiration without oxygen, heterotrophic CO<sub>2</sub> fixation, glyoxylate cycle)

**Unit - 5** **(9 Hrs)**

Energy production by photosynthesis (cyclic, non-cyclic), Mechanism of ATP synthesis - Bioluminescence

**Text Books**

- Schlegel, H.G., 1993. General Microbiology, (7<sup>th</sup> Edition), Press Syndicate of the University of Cambridge.

**Reference Books**

- Moat, A.G. and J. W. Foster, 1995. Microbial Physiology, (3<sup>rd</sup> Ed.). Wiley - LISS, A John Wiley & sons. Inc. Publications,.
- Dawes, I. W. and Sutherland L.W. 1992. Microbial Physiology, (2<sup>nd</sup> Edition), Oxford Blackwell Scientific Publications.



<b>I B.Sc. Microbiology</b>	<b>MICROBIOLOGY PRACTICAL</b> <b>For the students admitted in the year</b> <b>2019 - 2020 onwards</b>	<b>MBP201S</b>
<b>SEMESTER - I &amp; II</b>		<b>HRS/WK - 4</b>
<b>CORE PRACTICAL - 1</b>		<b>CREDITS - 3</b>

**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**

6. Catalase test
7. Oxidase test
8. Indole test
9. Methyl red test
10. Voges – Proskauer test
11. Citrate utilization test
12. Triple sugar iron agar test
13. Urease test

**Pure culture technique**

14. Media preparation
15. Pour plate method
16. Spread plate method
17. Quadrant streaking

**LIST OF SPOTTERS**

1. Inoculation loop
2. Inoculation needle
3. L – rod
4. Robertson cooked meat medium
5. Macconkey agar
6. EMB agar
7. Na slant with liquid paraffin
8. Na stab with liquid paraffin
9. Dark field microscopy

10. Stage micrometer
11. Ocular micrometer
12. Chlamydomonas
13. Spirochetes
14. Laminar air flow chamber
15. Incubator
16. Autoclave
17. Hot air oven
18. Inoculation hood
19. Colorimeter
20. pH meter
21. Anaerobic jar
22. Volvox
23. Gram positive cocci
24. Gram negative bacilli
25. Spore staining
26. Acid fast bacilli
27. Indole test
28. Methyl red test
29. Voges – Proskauer test
30. Citrate utilization test
31. Triple sugar iron agar test
32. Urease test
33. Na slant with Pseudomonas
34. Membrane filter
35. Meta chromatic granules

<b>YEAR - II</b>	<b>IMMUNOLOGY</b> <b>For the students admitted in the year</b> <b>2019 - 2020 onwards</b>	<b>19MB305</b>
<b>SEMESTER - III</b>		<b>HRS/WK - 4</b>
<b>CORE - V</b>		<b>CREDITS - 3</b>

**Objective:**

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

**Unit 1: (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

**Unit 2: (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

**Unit 3: (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, Deficiencies of the complement system

**Unit 4: (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

**Unit 5: (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 Books**

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

**Reference Books**

- Tizard, I. R. Immunology. 1995 (4<sup>th</sup> Edition), Saunders College Publishing.
- Weir, D.M. and J. Stewart. Immunology. 1997 (8<sup>th</sup> Edition), Churchill Livingstone, New York.
- Mark Peakman and Diego Vergani. 1<sup>st</sup> magazine, 1997, Basic and Clinical Immunology. Churchill Livingstone, New York.

<b>YEAR - II</b>	<b>MOLECULAR BIOLOGY</b> <b>For the students admitted in the year</b> <b>2019 - 2020 onwards</b>	<b>19MB306</b>
<b>SEMESTER - III</b>		<b>HRS/WK - 3</b>
<b>CORE - VI</b>		<b>CREDITS - 3</b>

**Objective:**

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

**Unit 1: (9 Hrs)**

Basic concepts of Molecular biology: Nucleic acid as Genetic material- Griffith experiment, Hershey & Chase- Central dogma of Molecular biology, structure and functions of Nucleic acid: Nucleosides and Nucleotides, purines and pyrimidines.

**Unit 2: (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.

**Unit 3: (9 Hrs)**

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

**Unit 4: (9 Hrs)**

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

**Unit 5: (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, 4Th/Ed by Malacinski, Jones & Bartlett, 2015
- Principles of Molecular Biology, Veer Bala Rastogi, 2016.

**Reference Books**

- Benjamin Lewin, Gene VIII, 2003 (8<sup>th</sup> Edition) Oxford University Press.
- Twyman, R M., Advanced Molecular Biology – A concise Reference, 1998, Viva Books Private Ltd., New Delhi.
- Introduction to Molecular Biology, 2010, Peter Paoella. Tata McGraw-Hill Publishing Company.

<b>YEAR - II</b>	<b>IMMUNOTECHNOLOGY</b> <b>For the students admitted in the year</b> <b>2019 - 2020 onwards</b>	<b>19MB407</b>
<b>SEMESTER - IV</b>		<b>HRS/WK - 4</b>
<b>CORE - VII</b>		<b>CREDITS - 3</b>

**Objective:**

To make the students understand the applications of immune reactions

**Unit 1: (12 hrs)**

**Antigen – Antibody Reactions** – Antigen-antibody titer - Complement fixation test (CFT), Neutralization tests, Opsonization, Radioimmunoassay (RIA), Enzyme immunoassay (EIA), Enzyme linked immunosorbent assay (ELISA), Chemiluminescence immunoassay (CLIA), Immunoelectroblot / Western blot techniques, Immunochromatographic tests, Immunoelectron microscopic tests, Immunofluorescence.

**Unit 2: (12 hrs)**

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

**Unit 3: (12 hrs)**

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

**Unit 4: (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.

**Unit 5: (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 Books**

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

**Reference Books**

- Tizard, I. R. Immunology. 1995 (4<sup>th</sup> Edition), Saunders College Publishing.
- Weir, D.M. and J. Stewart, Immunology, 1997 (8<sup>th</sup> Edition), Churchill Livingstone, New York.

- Mark Peakman and Diego Vergani. 1<sup>st</sup> magazine, 1997, Basic and Clinical Immunology. Churchill Livingstone, New York.

<b>YEAR - II</b>	<b>MICROBIAL GENETICS</b> <b>For the students admitted in the year</b> <b>2019 - 2020 onwards</b>	<b>19MB408</b>
<b>SEMESTER - IV</b>		<b>HRS/WK - 3</b>
<b>CORE - VIII</b>		<b>CREDITS - 3</b>

**Objective:**

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

**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 – properties of a phage-infected bacterial culture – specificity in phage infection. Host restriction and modification - **Phage genetics I:** phage T4 – Phage mutants, Genetic mapping of phage T4, features of the T4 life cycle. **Phage genetics II:** phage  $\lambda$  –  $\lambda$  DNA and its gene organization, outline of the life cycle of  $\lambda$ ,  $\lambda$  DNA replication and phage production, recombination in the  $\lambda$  life cycle.

**Unit – 5**

**(9 Hrs)**

**Phage genetics III:** Lysogeny – Immunity and repression – lyogenization and prophage insertion – prophage excision – Polylysogeny. **Phage genetics IV:** Transduction – DNA transfer by means of transduction – co-transduction and linkage – properties of specialized transducing particles.

**Text Books**

- Freifelder, D., Microbial Genetics. 1987, Narosa Publishing House, New Delhi.
- Streips, U. N. and R. E. Yasbin, Modern Microbial Genetics, 2002 (2<sup>nd</sup> Edition), Wiley-Liss, Inc., New York.

**Reference Books**

- Benjamin Lewin, Gene VIII, 2003 (8<sup>th</sup> Edition) Oxford University Press.
- Twyman, R M., Advanced Molecular Biology – A concise Reference, 1998, Viva Books Private Ltd., New Delhi.
- Freifelder's Essentials of Molecular Biology, 4Th/Ed by Malacinski, Jones & Bartlett, 2015



<b>II B.Sc. Microbiology</b>	<b>BASIC EXPERIMENTS IN IMMUNOLOGY &amp; MICROBIAL GENETICS</b> <b>For the students admitted in the year 2019 - 2020 onwards</b>	<b>MBP402</b>
<b>SEMESTER – III &amp; IV</b>		<b>HRS/WK - 4</b>
<b>CORE PRACTICAL - 2</b>		<b>CREDITS - 3</b>

**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 & blood clot
2. Eosinophil
3. Monocyte
4. Lymphocytes
5. Neutrophils
6. Widal test
7. Single Radial Immuno diffusion

8. Immuno electrophoresis test
9. Latex agglutination test
10. Counter Immuno electrophoresis
11. ASO antigen
12. RPR antigen
13. Haemocytometer
14. ELISA plate
15. Normal saline
16. Widal O, H antigen
17. Anti A, B and D reagent
18. Electrophoresis Horizontal tank
19. EDTA
20. Leishman stain
21. Pasteur pipette
22. Micro pipette
23. Water bath
24. Trisodium Citrate
25. Rocket Immuno Electrophoresis
26. Ouchterlony method
27. *Electrophoresis power pack*
28. Gel puncture
29. RBC pipette
30. WBC pipette
31. ABO blood grouping
32. Centrifuge
33. VDRL shaker

<b>YEAR – III</b>	<b>FOOD AND INDUSTRIAL MICROBIOLOGY</b>	<b>MB505S</b>
<b>SEMESTER - V</b>	<b>For the students admitted in the year 2015-16</b>	<b>HRS/WK - 5</b>
<b>CORE - 5</b>	<b>onwards</b>	<b>CREDIT - 3</b>

**Objective:**

To make the students understand the importance of microbes in food industry.

**Unit – 1 (15 Hrs)**

Food as a substrate for microorganisms - Principles of food preservation - asepsis - removal of microorganisms - high temperature - low temperature-drying- food additives - radiation - General principles of Contamination, spoilage and preservation - canned food. - Food-borne infections and intoxications - Food borne disease outbreaks - laboratory testing - preventing measures - Food sanitation – Plant sanitation - quality control - HACCP

**Unit – 2 (15 Hrs)**

Food fermentations – bread, malted beverages, idly, fermented vegetables, pickles, Oriental fermented foods - Milk and milk products - fermented dairy products - butter, cheese, yogurt, acidophilus milk - Spoilage and defects of fermented dairy products - Milk-borne diseases.

**Unit – 3 (15 Hrs)**

General concepts - screening and strain development strategies - raw materials used in media production media optimization – foaming - fermentation equipment and its uses – types of fermenters - Types of fermentation - batch, continuous, dual or multiple, surface, submerged, aerobic, anaerobic

**Unit – 4 (15 Hrs)**

Downstream process – recovery and purification of products – sterilization – development of inocula - scale up processes - Production of alcohol and beverages – Ethanol, beer and wine, vinegar - Organic acids - lactic acid, citric acid

**Unit – 5 (15 Hrs)**

Industrial production of enzymes - amylase, proteinase, - Amino acid production - glutamic acid and lysine - Production of antibiotics - penicillin, streptomycin – Role of precursors - Production of Vitamins - riboflavin, cyanocobalamin

**Text Books**

- Frazier W. C. and D.C, Westhoff, Food Microbiology, 1988 (4<sup>th</sup> Edition), Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Casida, L.E. *Industrial Microbiology*. 1968, New Age International (P) Ltd., Publishers, New Delhi.
- Patel, A.H., *Industrial Microbiology*, 1985, Macmillan India Ltd., New Delhi.

**Reference Books**

- Doyle, M. P., L. R. Beuchat and T. J. Montville, Food Microbiology -Fundamentals and Frontiers, 2001 (2<sup>nd</sup> Edition), ASM Press. Washington, D.C.
- Jay, J. M., Modern Food Microbiology. (4<sup>th</sup> Edition), 1996, CBS Publishers and Distributors.
- Crueger W. and A Crueger, *Biotechnology*, 2000 (2<sup>nd</sup> Edition), Panima Publishing Corporation, New Delhi.
- Reed, G, *Prescott & Dunn's Industrial Microbiology*, 1982 (4<sup>th</sup> Edition), CBS Publishers Distributors, Delhi.

<b>YEAR – III</b>	<b>MEDICAL BACTERIOLOGY</b>	<b>MB507S</b>
<b>SEMESTER - V</b>	<b>For the students admitted in the year 2015-16</b>	<b>HRS/WK - 5</b>
<b>CORE - 6</b>	<b>onwards</b>	<b>CREDIT - 3</b>

**Objective:**

To make the students understand the medical importance of bacteria.

**Unit – 1 (15 Hrs)**

General attributes and virulence factors of bacteria causing infections - Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis and prevention of infections caused by the following organisms - *Staphylococci*, *Streptococci*, *Pneumococci*, *Neisseria meningitidis* and *N. gonorrhoeae*, *Corynebacterium*

**Unit – 2 (15 Hrs)**

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

**Unit - 3 (15 Hrs)**

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

**Unit - 4 (15 Hrs)**

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

**Unit - 5 (15 Hrs)**

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

**Text Books**

- Ananthanarayanan, R and C.K.J. Panicker. *Text Book of Microbiology*, 2000 (6<sup>th</sup> Edition), Orient Longman Private Ltd., Chennai.
- Greenwood, D., R.C.B. Slack, and J.F. Peutherer, *Medical Microbiology* 1997 (15<sup>th</sup> Edition), Churchill Livingstone. New York.

**Reference Books**

- Brooks, G.F., Janet S. Butel, Stephen A, Jawwetz, Melnick & Adlerberg's *Medical Microbiology*, 21<sup>st</sup> Edition, Prentice Hall International Inc. 1998,
- Murray. P.R., G.S, Kobayashi, M. A. Pfaller and K. S. Rosenthal, *Medical Microbiology*, 1993, (2<sup>nd</sup> Edition), Mosby St. Louis.

<b>YEAR – III</b>	<b>MEDICAL PARASITOLOGY</b> <b>For the students admitted in the year 2015-16</b> <b>Onwards</b>	<b>MB508S</b>
<b>SEMESTER - V</b>		<b>HRS/WK - 5</b>
<b>CORE - 7</b>		<b>CREDIT - 3</b>

**Objective:**

To make the students understand the medical importance of parasites.

**Unit - 1 (15 Hrs)**

Introduction – Definition – Host parasite relationship – Transmission of parasites – Pathogenesis – Clinical diagnosis – Laboratory diagnosis – Treatment.

**Unit - 2 (15 Hrs)**

*Entamoeba histolytica, Entamoeba coli, Giardia intestinalis, Trichomonas vaginalis, Leishmania donovani, Trypanosoma cruzi*

**Unit - 3 (15 Hrs)**

*Plasmodium falciparum, Plasmodium vivax, Cryptosporidium, Balantidium coli, Pneumocystis carinii.*

**Unit - 4 (15 Hrs)**

*Taenia saginata, Taenia solium, Schistoma haematobium, Fasciola hepatica, Trichuris trichura.*

**Unit - 5 (15 Hrs)**

*Ancylostoma duodenale, Enterobium vermicularis, Ascaris lumbricoides, Wuchereria bancrofti, Brugia malayi.*

**Text Books**

- Parija, S. C, *Text Book of Medical Parasitology*. 1996, All India Publishers and Distributors Regd., Chennai.
- Ananthanarayan. R. and C.K.J. Panicker, *Text Book of Microbiology*, 2000 (6<sup>th</sup> Edition), Orient Longman Private Ltd., Chennai.

**Reference Books**

- Franklin A. Neva and Harold W. Brown, *Basic and Clinical Parasitology*, 1994, VI Edition, Appleton & Lange, Norwalk, Connecticut.
- Ichhpujani, R.L. and R. Bhatia. *Medical Parasitology* 3<sup>rd</sup> Edition, 2002, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.

<b>YEAR – III</b>	<b>ENVIRONMENTAL MICROBIOLOGY</b> <b>For the students admitted in the year 2015-16</b> <b>Onwards</b>	<b>EMB509S</b>
<b>SEMESTER - V</b>		<b>HRS/WK - 5</b>
<b>ELECTIVE – 1 A</b>		<b>CREDIT - 3</b>

**Objective:**

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

**Unit – 1 (15 Hrs)**

Microbiology of air - droplet nuclei, aerosols - enumeration of microorganisms in air- air sanitation - Laboratory hazards - airborne diseases

**Unit - 2 (15 Hrs)**

Aquatic microflora - lakes, ponds, rivers, ocean, estuary, ground water -significance – study of aquatic microflora - Waterborne diseases - Eutrophication

**Unit - 3 (15 Hrs)**

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 - 4 (15 Hrs)**

Water pollution – indicators water pollution - BOD - COD – techniques for the study of water pollution - Composting

**Unit - 5 (15 Hrs)**

Interaction among microbial populations (Neutralism, commensalisms, parasitism, antagonism) – bioleaching – Symbiotic relationship with animals

**Textbooks**

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

**Reference Books**

- Mitchell, R (ed) *Environmental Microbiology*. 1992, John Wiley, New York.
- Grant W. D. and Long P.E., *Environmental Microbiology*, 1981 Blackie and Son Ltd., Glasgow

<b>YEAR – III</b>	<b>MOLECULAR TAXONOMY AND PHYLOGENY</b> <b>For the students admitted in the year 2015-16</b> <b>Onwards</b>	
<b>SEMESTER - V</b>		<b>HRS/WK - 5</b>
<b>ELECTIVE – 1 B</b>		<b>CREDIT - 3</b>

**Objective :** To make the students understand the importance of molecular taxonomy and phylogeny

**Unit - 1** (15Hrs)

**Microbial Taxonomy:** Introduction of microbial taxonomy- morphological taxonomy- biochemical taxonomy- molecular taxonomy -Numerical taxonomy- Morphological phylogeny.

**Unit - 2** (15Hrs)

**Biochemical and Molecular taxonomy:** Chemotaxonomy-Fatty acid, Protein finger printing- Isozyme typing-Molecular taxonomy- G+C content-DNA-DNA hybridization.Plasmid profiles, RFLP, RAPD, STRR & LTRR-r RNA based finger printing methods.

**Unit - 3** (15Hrs)

**16S r RNA based finger printing:** Types of r RNA-23S r RNA, 16S r RNA and 5S r RNA- Importance of 16S r RNA in microbial identification and taxonomy-Methods of 16S r RNA/r DNA fingerprinting - amplification of 16S r DNA usingPCR-Plasmid isolation-Dot blot/ Southern blot hybridization using specific probes-sequencing of 16S r DNA using chain termination method.

**Unit - 4** (15Hrs)

**Sequence analysis:** Submission of r DNA sequences in Gen Bank-Bankit & sequin guidelines- NCBI-EMBL –DDBJ-Retrieving sequences -Designing primers and probes-Sequence comparison- Alignment and data base searching- ClastalW-FASTA-BLAST-DNA barcoding.

**Unit-5** (15Hrs)

**Molecular Phylogeny:** Introduction to molecular phylogeny-tree terminology-software programs for making phylogenetic trees-MEGA-PHYLIP-Cladogram –additive trees, ultrametric trees, rooted trees, unrooted trees and tree shapes.

**Text books:**

- Roderic D.M.Page, Edward C.Holmes (1998) Molecular Evolution: A Phylogenetic Approach Blackwell publishing, USA
- Sandy B Primrose Richard m.Twynam, (2005) Principles of Genome analysis and Genomics, Blackwell Publishing, USA

**Reference Books:**

- Brendan Wren, Nick Dorrel.2002.Functional microbial genomics(vol 33)(Methods in Microbiology), Academic press, UK.
- .S.B.Primrose.Principles of Genome analysis: A guide to mapping and sequencing DNA from different organisms(paper back Jan 1998).

<b>YEAR – III</b>	<b>APPLIED MICROBIOLOGY</b> <b>For the students admitted in the year 2015-16</b> <b>onwards</b>	<b>EMB510S</b>
<b>SEMESTER - V</b>		<b>HRS/WK - 4</b>
<b>ELECTIVE – II A</b>		<b>CREDIT - 3</b>

**Objective:**

To make the students familiar with application of microbes in agriculture and bioremediation.

**Unit - 1 (12Hrs)**

Algal technology - Spirulina cultivation - Factors affecting Biomass production - Requirements for growth of Spirulina - Algal tanks - Avoiding contamination - Mass cultivation of Spirulina - Semi - Natural Lake system, Artificial built cultivation system - Clean water system - Harvesting the Biomass & Product recovery - Benefits from Spirulina.

**Unit - 2 (12Hrs)**

Mushroom production - Mushroom biology - classification and types -Edible and poisonous mushrooms - Spawn and spawning - culture media - Preservation and storage of cultures - Crop management after spawning - casing, fruiting, harvesting -Processing - Mushroom recipes

**Unit - 3 (12Hrs)**

Biofertilizers - Bacteria – Bacterization - Mass cultivation of *Rhizobium* -*Azotobacter*-*Azospirillum* and phosphate solubilizers - Blue green algae- Algalization, Mass cultivation of Blue green algae. *Azolla* as Biofertilizer, Mycorrhizae as biofertiliser.

**Unit - 4 (12Hrs)**

Biogas production – Introduction – interaction between various microbial groups – factors affecting production – design of digester – distribution of anaerobic organisms – methanogens and methanogenesis – alternate feed stock and other wastes – kinetics of fermentation – use of spent slurry.

**Unit – 5 (12Hrs)**

Bioremediation – Clean-up Biotechnology – Microbial removal of metal ions – Soil Bioremediation – Removal of oil spill – Biodegradation of hydrocarbons – Genetically modified organisms.

**Text Books**

- Pathak, V.N., N.Yadav and M.Gaur, *Mushroom – Production and processing technology*, 2000, Agrobios, Jodhpur.
- SubbhaRao, N S. *Biofertilizers in Agriculture and Forestry*, 1995 (3<sup>rd</sup> Edition), Oxford & IBH Publishing Co, Pvt. Ltd. New Delhi.

**Reference Books**

- Sharma, A.K., *Biofertilizers for Sustainable Agriculture*, 2002, Agro bios India.
- Singh, H., *Mushrooms - The Art of Cultivation*, 1991, Sterling Publishers Pvt. Ltd. New Delhi.



<b>YEAR – III</b>	<b>DAIRY MICROBIOLOGY</b> <b>For the students admitted in the year 2015-16</b> <b>onwards</b>	
<b>SEMESTER - V</b>		<b>HRS/WK - 4</b>
<b>ELECTIVE – II B</b>		<b>CREDIT - 3</b>

**Objective:** To study about the microorganisms associated with milk, dairy products and to learn about fermented dairy products.

**Unit-1** **(12Hrs)**

Microorganisms of milk and milk products - Factors affecting the growth of microorganisms - Types of microorganism in milk and dairy products like butter, cheese, ice cream, yoghurt, whey - Examination or assessing microbial load of milk and milk products- Quantitative and Qualitative test

**Unit-2** **(12Hrs)**

Preservation of milk and milk products – Pasteurization - Sterilization- Radiation- Ionizing Radiation- Chemicals.

**Unit-3** **(12Hrs)**

Types of Microbial spoilage of milk and milk products - spoilage of milk, butter, cheese, yoghurt, raw milk-dry milk, ice cream, whey.

**Unit-4** **(12Hrs)**

Fermentation of milk and milk products - Fermentation of milk, kefir, koumiss, yoghurt – Fermentation of whey in industrial uses - Lactic acid production - Alcoholic fermentation of whey and yeast delactosed whey - Synthesis of vitamins - Diseases spread by microorganisms through milk.

**Unit-5** **(12Hrs)**

Milk and milk product processing - Milk sanitation - Cleaning and sanitization of milking utensils - Microbiological standards and guidelines - Quality control - Dairy plant waste disposal – treatment - preventing dairy wastes.

**Text books:**

- William C. Frazier and Dennis C. Westhoff. Food Microbiology. Mc Graw Hill Education.
- N. Ramanathan. A text Book on Food Microbiology. Omsakthi Pathipagam.

**Reference books:**

- Robinson, R. 1990. Dairy microbiology. 2<sup>nd</sup> Edition. Elsevier Applied Science Pub.
- Yadav, J.S., Sunitha, G and V.K. Batish. 1993. Comprehensive Dairy Microbiology. Metropolitan Book Co., New Delhi.

<b>YEAR – III</b>	<b>SOIL AND AGRICULTURAL MICROBIOLOGY</b> <b>For the students admitted in the year 2015-16 onwards</b>	<b>MB611</b>
<b>SEMESTER - VI</b>		<b>HRS/WK - 5</b>
<b>CORE - 8</b>		<b>CREDIT - 3</b>

**Objective:**

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

**Unit - 1 (15 Hrs)**

Soil – physical and chemical properties - Introduction to soil microorganisms - bacteria, algae, fungi, actinomycetes, protozoans, nematodes and viruses - Role of microbes in soil fertility - Winogradsky column.

**Unit - 2 (15 Hrs)**

Microbial interactions with plants - Mycorrhizae, Rhizosphere, Phyllosphere - Plant growth promoting bacteria - Organic matter decomposition - humus formation - Biodegradation of pesticides and pollutants in soil

**Unit - 3 (15 Hrs)**

Biogeochemical cycles - carbon, phosphorus, sulphur and nitrogen cycles - Nitrogen fixation – symbiotic and free living - Biofertilizers (Examples and advantages) - Biopesticides (Examples and advantages)

**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, Red rot of sugarcane and Tikka disease of groundnut as examples

**Unit - 5 (15 Hrs)**

Diseases caused by viruses - Tungro virus, 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 nematodes – Root knot of vegetables as example – Seed borne diseases.

**Text Books**

- G. Rangaswami, A. Mahadevan. *Diseases of crop plants in India* 4<sup>th</sup> Edition. 1999, Prentice - Hall of India Private Ltd., New Delhi.
- G. Rangaswami, D. J Bagyaraj, *Agricultural Microbiology* 2<sup>nd</sup> Edition, 1998, Prentice - Hall of India Private Ltd., New Dethi.

**Reference Books**

- Atlas & Bartha, *Microbiology - Fundamentals and Applications* 1998, Benjamin/Cummings Publishing Company, Inc., California.
- Alexander.M. 1961. *Introduction to Soil Microbiology*, John Wiley A Sons, Inc. New York & London.

<b>YEAR – III</b>	<b>BIOTECHNOLOGY</b> <b>For the students admitted in the year 2015-16</b> <b>onwards</b>	<b>MB612S</b>
<b>SEMESTER - VI</b>		<b>HRS/WK - 5</b>
<b>CORE - 9</b>		<b>CREDIT - 3</b>

**Objective:**

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

**Unit - 1** **(15 Hrs)**

Definition and history - Recombinant DNA technology - Enzymes involved - Restriction endonucleases, RNases, Ligases, Polymerases - Cloning vectors – Types and examples - pBR 322, lambda phage vectors - DNA ligation

**Unit – 2** **(15 Hrs)**

Chemical synthesis of DNA - DNA sequencing - cDNA - Hybridisation techniques - PCR - Genomic library

**Unit - 3** **(15 Hrs)**

Enzyme technology - Enzyme immobilisation, Products, Applications - Biotechnological potentials of Seaweeds, Microalgae –Biofuel - Hydrogen gas as fuel from Microorganisms

**Unit - 4** **(15 Hrs)**

Genetic engineering of plants - Electroporation - Gene gun - Particle bombardment - Ti plasmid vectors - Applications - Transgenic plants - Insect resistant, Stress tolerant, Virus resistant plants, genetically modified foods

**Unit - 5** **(15 Hrs)**

Transgenic animals - Retroviral vector method, DNA micro injection method – Applications of rDNA technology – Recombinant products – insulin, tPA, vaccines - Gene therapy - Patents - IPR

**Text Books**

- Gupta, P.K., *Elements of Biotechnology*, 1996, Rastogi and company, Meerut.
- Ratledge C. and B. Kristiansen, *Basic Biotechnology*, 2001 (2<sup>nd</sup> Edition), Cambridge University Press, United Kingdom.

**Reference Books**

- Old, R.W. and S.B. Primrose, *Principles of Gene manipulation*, V. Edition, 1994, Blackwell Science, Oxford.
- Glick, B.R. and J.J. Pasternack, *Molecular Biotechnology*, Panima Publishing Corporation, New Delhi, Bangalore, Indian Edition.

<b>YEAR – III</b>	<b>MEDICAL MYCOLOGY AND VIROLOGY</b> <b>For the students admitted in the year 2015-16</b> <b>onwards</b>	<b>MB613S</b>
<b>SEMESTER - VI</b>		<b>HRS/WK - 5</b>
<b>CORE - 10</b>		<b>CREDIT - 3</b>

**Objective:**

To make the students understand the medical importance of viruses.

**Unit – 1 (15 Hrs)**

Introduction – Characteristics of fungi - Morphology - Dimorphic yeasts - Classification of medically important fungi - Laboratory diagnosis of fungal infections - Antifungal agents - Superficial cutaneous mycosis – *Malssezia* infections, Tinea nigra, Piedra, dermatophytoses

**Unit – 2 (15 Hrs)**

Subcutaneous mycoses - Mycotic mycetoma, - Systemic mycoses – Histoplasmosis, Blastomycosis, Coccidioidomycosis, Paracoccidioidosis - Opportunistic systemic mycoses - Aspergillosis, Penicilliosis - Yeasts of medical importance- *Candida*, *Cryptococcus* - Mycotoxicoses

**Unit - 3 (15 Hrs)**

General properties of viruses - Outline of animal tissue culture - Virus-Host interactions – Classification - Prions - antiviral agents - Morphology, pathogenesis, laboratory diagnosis and control of the following viruses - Pox viruses - Herpes viruses, Adeno viruses, Picorna viruses

**Unit - 4 (15 Hrs)**

Orthomyxo viruses, Paramyxo viruses - Arboviruses, Rhabdo viruses. Hepatitis viruses

**Unit – 5 (15 Hrs)**

Rubella virus, Rota virus, Oncogenic viruses, Retro viruses

**Text Books**

- Jagadish Chander, *Text Book of Medical Mycology*, 2002 (2<sup>nd</sup> Edition), Mehta Publishers, New Delhi.
- Timhury, M.C. *Notes on Medical Virology*, 1997, Pearson Professional Limited, London.

**Reference Books**

- Ananthanarayan. R. and C.K.J. Panicker, *Text Book of Microbiology*, 2000 (6<sup>th</sup> Edition), Orient Longman Private Ltd., Chennai.
- Brooks, G. F., Janet S. Butel, Stephen A, Jawetz, Melnick fe Adlerberg's *Medical Microbiology*. 21<sup>st</sup> Edition. Prentice Hall International Inc. 1998
- L Collier and J. Oxford, *Human Virology*, 2000, 2nd Edition, Oxford University Press, Oxford

<b>YEAR – III</b>	<b>COMPUTER APPLICATIONS IN BIOLOGY</b> For the students admitted in the year 2015-16 onwards	<b>EMB615S</b>
<b>SEMESTER - VI</b>		<b>HRS/WK - 4</b>
<b>ELECTIVE – III A</b>		<b>CREDIT - 3</b>

**Objective:**

To make the students understand the application of computers in biology.

**Unit – 1 (15 Hrs)**

Introduction to computers – Types of computers – Generation – Applications of computers – Input and Output devices – ROM, RAM- Internet

**Unit– 2 (15 Hrs)**

Introduction to Bioinformatics – Definition – History – Biological databases (generalized and specialized) – Nucleic acid sequence databases (EMBL, NCBI, DDBJ) – sequence format (types, FASTA format) – Protein sequence databases (SWISS – PROT, PIR) – Structure databases (PDB)

**Unit – 3 (15 Hrs)**

Sequence homology – Alignment – Global vs. local alignment – Dot-matrix representation – BLAST – multiple sequence alignment (CLUSTAL W)

**Unit – 4 (15 Hrs)**

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

**Unit - 5 (15 Hrs)**

Concept of Genomics and Proteomics – Comparative genomics – Functional genomics – DNA micro arrays – DNA chips – Protein array

**Text Books**

- Alexis Leon and Mathews Leon, *Fundamentals of information Technology*, Leon Tech World.
- Mani, K. and N. Vijayaraj. *Bioinformatics for beginners*, 2002, Kalaikathir Achagam, Coimbatore.

**Reference Books**

- Sawyer S.C., B.K. Williams and S.E. Hutchinson, *Using Information Technology - A Practical Introduction to Computers and Communications*. 1999, (3<sup>rd</sup> Edition), McGraw-Hill International Editions.
- Brown. S M., *Bioinformatics: A Biologist's Guide to Biocomputing and the Internet*. 2000, Ealton Publishing, Natick.

<b>YEAR – III</b>	<b>GENERAL HYGIENIC AND SANITARY PRACTICES</b> For the students admitted in the year 2015-16 onwards	
<b>SEMESTER - VI</b>		<b>HRS/WK - 5</b>
<b>ELECTIVE – III A</b>		<b>CREDIT - 3</b>

**Objective:** To make the students understand the importance of hygiene and sanitary practices

**Unit - 1:** (15Hrs)

Introduction – Distribution of microbes in nature – Common disease caused by microbes – Control of disease causing microbes.

**Unit - 2:** (15Hrs)

Water Quality and control – Water pollution – Criteria for drinking water – sanitary surveys – Bacteriological evidence for pollution – Water borne diseases – Control methods.

**Unit - 3:** (15Hrs)

Hygienic practices in Industries – Factory and hospital hygiene – Sterilization control.

**Unit -4:** (15Hrs)

Microflora of fresh food – Spoilage of food – preservation – Microbiological safety – HACCP system.

**Unit - 5:** (15Hrs)

Immunization – Schedule – routine – individual immunization.

**Text books:**

- Purohit SS, AK Salvja, HN Kakarni (2004) – Pharmaceutical Microbiology, 1<sup>st</sup> edition, Agrobios (India).
- Joseph.C.Daniel. Environmental Aspects in Microbiology. Bright Sun Publications.

**Reference books:**

- Pelczar JR, Chan ECS & Kreig NR (2006) – Microbiology 5<sup>th</sup> edition – Tara Mc Graw Hill, New Delhi.
- Frazier, Food microbiology, 4<sup>th</sup> edition, Tata Mc Grow hill, New Delhi.

<b>YEAR – III</b>	<b>CLINICAL MICROBIOLOGY</b> <b>For the students admitted in the year 2015- 16 onwards</b>	<b>EMB616S</b>
<b>SEMESTER - VI</b>		<b>HRS/WK - 5</b>
<b>ELECTIVE – IV A</b>		<b>CREDIT - 3</b>

**Objective:**

To make the students familiar with clinical diagnosis of various microbial diseases.

**Unit - 1** **(12 Hrs)**

Organization of the Clinical Bacteriology lab - Quality assurance - Safety in Microbiology laboratory – Safety levels – Good Laboratory Practices

**Unit - 2** **(12 Hrs)**

General approach to clinical specimens for microbiologic examination -Collection and transport of specimens (urine, pus, CSF, sputum, body fluids) - culture containers - Antimicrobial sensitivity testing

**Unit - 3** **(12Hrs)**

General principles, media and isolation techniques involved for anaerobic bacteria - serological techniques in Diagnostic Microbiology - Hospital acquired infections - infection committee - Hospital waste disposal

**Unit – 4** **(12 Hrs)**

Vector borne diseases – Zoonotic diseases – Sexually transmitted diseases

**Unit - 5** **(12 Hrs)**

Laboratory animal management – Animal house – Rabbit, guinea pig, mice - Ethical committee

**Text Books**

- Finegold, S.M. & Ellen Jo Baron, *Bailey and Scott's Diagnostic Microbiology*, 1986 (7<sup>th</sup> Edition), C, V. Mosby Company, USA.
- Colliee, J. G., A.G. Fraser, B.P, Marmion and A. Simmons. Mackie & Mc Cartney *Practical Medical Microbiology*, 1996 (14<sup>th</sup> Edition), Churchill Livingstone, USA.

**Reference Books**

- Mims, C.A. *Mims' Pathogenesis of Infectious diseases*, 1995 (4<sup>th</sup> Edition), Academic Press, London
- Koneman. E. W. S D.Allen., V .R Do well and H.M. Sommers (eds) 1990. *Color Atlas and Textbook of diagnostic Microbiology*, J.B.Lippincott Co., Philadelphia.

<b>YEAR – III</b>	<b>VETERINARY MICROBIOLOGY</b> <b>For the students admitted in the year 2015- 16 onwards</b>	
<b>SEMESTER - VI</b>		<b>HRS/WK - 4</b>
<b>ELECTIVE – IV B</b>		<b>CREDIT - 3</b>

**Objective:** To learn about the different diseases caused in animals by various animal pathogens , treatment and its control measures.

**Unit-1** **(12Hrs)**

General characteristics of bacteria causing animal disease - Pathogenic bacteria - Defense mechanism of the host – Actinobacillosis – Anthrax – Tuberculosis - Bovine mastitis - symptoms, diagnosis, treatment and control - Haemorrhagic septicaemia.

**Unit-2** **(12Hrs)**

Pathogenic fungi - Characteristics epidemiology of fungal diseases - Types of fungal diseases, symptoms, diagnosis, treatment and control of Mycotic diseases of animals.

**Unit-3** **(12Hrs)**

Definition - Parasites, host, vector, parasitism, effect of parasitism on the host - protozoan parasites - Trypanosomes, Leishmania, Plasmodium - diagnosis, treatment and control. Miscellaneous protozoan parasites - Amoebae, Ciliates.

**Unit-4** **(12Hrs)**

General properties of virus, purification of virus particles and reaction of viruses to physical and chemical agents Classification, cultivation and replication of viruses. Viral genetics and interaction. Viral haemagglutination, interference and inclusion bodies. Oncogenic and latent viruses.

**Unit-5** **(12Hrs)**

Picornavirus group - Foot and Mouth disease virus - Enveloped viruses of animals - Reovirus group - African horse sickness virus - Blue tongue virus. Toga virus group - Swine fever viruses - Mucosal disease virus - Paramyxovirus group, Pseudo virus group, Bovine Rhinotracheitis virus .

**Text books:**

- Prof.S.N .Sharma . Dr. S.C. Adlakha . Text book of Veterinary Microbiology. Vikas publishing house. Pvt.ltd.
- D.scott Mc Vey. Melissa Kennedy .M.Chengappa .Veterinary Microbiology . Wiley-Blackwell publishers. 3<sup>rd</sup> edition.

**Reference books:**

- P.J.Quinn. B.K. Markey. F.C. Leonard . Veterinary Microbiology and Microbial Disease. Wiley-Blackwell publishers. 2<sup>nd</sup> edition.
- Dwight.C.Hirsh, N.James MacLachlan. Richard .L. Walker Veterinary Microbiology. Wiley-Blackwell publishers. 2<sup>nd</sup> edition.



<b>III B.Sc. Microbiology</b>	<b>APPLIED MICROBIOLOGY PRACTICAL</b>	<b>MBP603S</b>
<b>SEMESTER - V &amp; VI</b>	<b>For the students admitted in the year</b>	<b>HRS/WK - 3</b>
<b>CORE PRACTICAL - 3</b>	<b>2015 - 2016 onwards</b>	<b>CREDITS - 3</b>

### **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 blue mount
7. *Mucor* Lactophenol cotton blue mount
8. BOD bottle
9. Membrane filter
10. Trickling filter
11. Lactophenol cotton blue stain
12. Methylene blue for MBRT
13. Yeast
14. Bread
15. Vinegar
16. Mushroom
17. *E coli* on EMB agar
18. Lactose fermenting colonies on Mac Conkey agar
19. YEMA medium
20. Root nodule
21. Cross section of root nodule
22. MPN Preliminary test - Lauryl tryptose broth with durhams tube
23. MPN Confirmed test - Brilliant green lactose bile broth with Durham's tube
24. Curd
25. Milk
26. Milk sample with Methylene blue in screw cap tube
27. Teasing needle
28. *Lactobacillus* on Ovgall Agar
29. Staph. aureus on Baird parker agar

<b>III B.Sc. Microbiology</b>	<b>MEDICAL MICROBIOLOGY PRACTICAL</b> <b>For the students admitted in the year</b> <b>2015 - 2016 onwards</b>	<b>MBP604S</b>
<b>SEMESTER - V &amp; VI</b>		<b>HRS/WK - 3</b>
<b>CORE PRACTICAL - 4</b>		<b>CREDITS - 3</b>

### **LIST OF EXPERIMENTS**

1. Type Study of the following bacteria
  - (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* from feces
3. Throat Swab
4. Urine Culture
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. Robertsons cooked meat medium
10. Stormy fermentation
11. Negribodies
12. Mosquito (Vector borne diseases)
13. Acid Fast Bacilli
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* on TCBS
22. Blood agar with hemolytic/ non hemolytic
23. Mac Conkey agar with LF/ Non LF
24. Growth of *Salmonella* on SS agar
25. Antibiotic Sensitivity test
26. Metachromatic granules
27. *Ascaris* male & female
28. Cyst of *Balantidium coli*
29. Microfilaria of *Wucheriria bancrofti*
30. Rat flea
31. *Salmonella typhi* biochemicals
32. NIH swab
33. *Pneumococci*

## QUESTION PAPER PATTERN (FOR UG CORE AND ELECTIVE COURSES)

### THEORY EXAMINATION

#### Continuous internal assessment (CIA) (25 marks)

Two internal Examinations	15 marks
Assignment / Seminar	10 marks
Attendance	5 marks
<b>Total</b>	<b>25 marks</b>

#### External Examination (75 marks)

Time: 3 hours  
Max. Marks: 75

##### **Part - A     10 X 1 = 10 Marks**

(MCQ pattern, without choice, 2 questions from each unit)

##### **Part - B     5 X 3 = 15 Marks**

(Short answer type - not exceeding 50 words, 5 out of 7 Questions have to be answered, not more than 2 questions from each unit)

##### **Part - C     5 X 10 = 50 Marks**

(Essay type answers - not exceeding 750 words, either or choice, 1 question from each unit)

### PRACTICAL EXAMINATION (UG)

#### Continuous internal assessment (CIA) (40 marks)

Based on the periodical evaluation of record and experiments assessed by the staff in charge.

#### External Examination (60 marks)

6 Hrs. Exam, 3 Hrs. per day on two consecutive days  
Total Marks: 60

One Major experiment	- 20 marks
One Minor experiment	- 10 marks
Viva voce	- 10 marks
Spotters	- 10 marks
Record	- 10 marks
<b>Total</b>	<b>- 60 marks</b>

# **CURRICULUM TEMPLATE, SYLLABUS AND QUESTION PAPER PATTERN**

**ALLIED AND ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS**

<b>II B.Sc Bio-Chemistry</b>	<b>PRINCIPLES OF MICROBIOLOGY</b> <b>For the students admitted in the year</b> <b>2015-2016 onwards</b>	<b>AMBC301</b>
<b>SEMESTER – III</b>		<b>HRS/WK - 5</b>
<b>ALLIED THEORY – 1</b>		<b>CREDIT - 4</b>

**Objective:**

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

**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 the environment

### **Text Books**

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

### **Reference Books**

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



<b>II B.Sc (Bio-Chem)</b>	<b>ALLIED MICROBIOLOGY PRACTICAL</b> <b>(For the students admitted from the year</b> <b>2015-16)</b>	<b>AMBCP01</b>
<b>SEMESTER - III</b>		<b>HRS/WK - 3</b>
<b>ALLIED PRACTICAL - 1</b>		<b>CREDIT - 2</b>

**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. EMB Agar
11. Spirochetes
12. Eyepiece
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

<b>III B.Sc. ZOOLOGY</b>	<b>BIOFERTILIZER TECHNOLOGY</b> <b>For the students admitted from the</b> <b>year 2018-19 onwards</b>	
<b>SEMESTER - V</b>		<b>HRS/WK - 4</b>
<b>ELECTIVE</b>		<b>CREDIT - 3</b>

Objective:

- To enlighten the students with the knowledge of microbial inoculants
- To highlight the role of microorganisms in soil fertility and plant growth promotion
- To understand the process of isolation, production, formulation, method of application and quality control of bio-fertilizers

**UNIT-1: SOIL MICROORGANISMS AND PLANTS (12 hrs)**

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, importance of biofertilizers in agriculture; Plant Growth Promoting Rhizobacteria (PGPR) and their products - Cytokinin, Gibberellic acid, IAA, HCN and Siderophore.

**UNIT-2: NITROGEN FIXERS (12 hrs)**

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: NUTRIENT SOLUBILIZERS AND MOBILIZERS (12 hrs)**

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

**UNIT-4: PRODUCTION TECHNOLOGY (12 hrs)**

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: FORMULATION OF BIOFERTILIZERS (12 hrs)**

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**

- Subba Rao N.S. 1999. Soil Microbiology, 4<sup>th</sup> Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India
- Bagyaraj D.J. and G. Rangasamy. 2002. Agricultural Microbiology, 2<sup>nd</sup> Edition, Prentice Hall, New Delhi, India

**Reference Books**

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

## QUESTION PAPER PATTERN (FOR ALLIED AND ELECTIVE COURSES)

### THEORY EXAMINATION

#### **Continuous internal assessment (CIA) (25 marks)**

Two internal Examinations	15 marks
Assignment / Seminar	10 marks
Attendance	5 marks
<b>Total</b>	<b>25 marks</b>

#### **External Examination (75 marks)**

Time: 3 hours

Max. Marks: 75

#### **Part - A     10 X 1 = 10 Marks**

(MCQ pattern, without choice, 2 questions from each unit)

#### **Part - B     5 X 3 = 15 Marks**

(Short answer type - not exceeding 50 words, 5 out of 7 Questions have to be answered, not more than 2 questions from each unit)

#### **Part - C     5 X 10 = 50 Marks**

(Essay type answers - not exceeding 750 words, either or choice, 1 question from each unit)

### PRACTICAL EXAMINATION

#### **Continuous internal assessment (CIA) (40 marks)**

Based on the periodical evaluation of record and experiments assessed by the staff in charge.

#### **External Examination (60 marks)**

3 Hrs. Exam

Total Marks: 60

Two experiments (Each 15 marks)	- 30 marks
Viva voce	- 10 marks
Spotters	- 10 marks
Record	- 10 marks
<b>Total</b>	<b>- 60 marks</b>