### B.Sc. MICROBIOLOGY DEGREE COURSE

**SCHEME OF EXAMINATION (revised) CBCS PATTERN**

*(AFFILIATED COLLEGES)*

*(For the students admitted from the academic year 2017 – 2018 batch onwards)*

<table>
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<tr>
<th>Part</th>
<th>Course title</th>
<th>Subject Code</th>
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Students should undergo an institutional training for a continuous period of 15 days before semester VI.
@ No University Examinations. Only Continuous Internal Assessment (CIA)
# No Continuous Internal Assessment (CIA). Only University Examinations.

### List of Elective papers (Colleges can choose any one of the paper as electives)

<table>
<thead>
<tr>
<th>Elective – I</th>
<th>A</th>
<th>Recombinant DNA Technology - I</th>
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<td>Applied Plant Biology</td>
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<td>Medical Biochemistry</td>
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Note: In semester V the title of the Core paper IX Recombinant DNA Technology has been changed as Medical Microbiology.
SEMESTER - I

CORE PAPER I: FUNDAMENTALS OF MICROBIOLOGY

UNIT – I

UNIT – II
Microscopy– Principles and application – Bright field, Darkfield, Phase contrast, Fluorescence, Confocal, SEM & TEM- Specimen preparation for Electron microscopy.

UNIT- III
Stricture and organization of bacterial cell wall: Gram positive and Gram Negative bacterial cell wall. Staining – Principles - Types of staining– Simple, Differential (Gram, Spore, AFB), Capsule staining (Negative), Giemsa Staining, LPCB, KOH Mount.

UNIT – IV

UNIT – V
Culture & -Media preparation - Solid and Liquid- Types of Media – Semi-Synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media, Natural components as media and Special Purpose Media (one eg for each type). Anaerobic culture technique – Wright’s tube, Roll tube, Mclntost fildes jar method. Pure culture techniques – Tube dilution, Pour, Spread, Streak plate.

References
SEMESTER -II
CORE PAPER II: ANALYTICAL MICROBIOLOGY

UNIT – I
Buffers, Molar and Normal solutions, pH meter, pH electrodes- colomel and glass electrode.

UNIT – II
Principles and Applications of Autoclave, Hot air oven, Incubator, Laminar air flow chamber / Biosafety cabinets, BOD incubator, Metabolic shaker, Incinerator.

UNIT -III

UNIT –IV
Colorimetry, Turbidometry, Spectrometry – UV & Visible Spectrophotometer. Flame Photometry, AAS.

UNIT-V
Chromatography – Paper, Thinlayer, Column, Ion-exchange, Gas and HPLC. Electrophoresis – SDS – PAGE and Agarose gel electrophoresis, PFG.

References
3. Dean, Willard and Merrit, Instrumental Methods of analysis Asian Ed.
SEMESTER -II
CORE PAPER III: GENERAL BIOLOGY

UNIT – I

UNIT – II

UNIT III
Cell division in Bacteria – Binary fission - Cell division in Eukaryotes – Mitosis and Meiosis. Reproduction in Microbes.

UNIT IV

UNIT V
Human physiology-Digestive System and Excretion, Respiratory System, Nervous System, Muscular System and Cardiovascular System.

References

SEMMESTER II
CORE PRACTICAL 1

1. Laboratory precautions
2. Preparation of cleaning solutions
3. Culture media preparation – Liquid and Solid medium
4. Selective and differential media: Mac conkey and Blood agar
5. Methods of sterilization
6. Pure culture techniques – Pour plate, Spread plate and Looping method
7. Streaking techniques: Simple, Quadrant and continuous
8. Enumeration of Bacteria, Fungi and Actinomycetes from soil
9. Determination of Motility – Hanging drop & SIM agar
10. Cultural characteristics of Microorganisms - Colony morphology on Nutrient agar
11. Slants, Nutrient broth
12. Maintenance and preservation of cultures
14. Paper chromatography
15. Thin layer chromatography
References

SEMESTER –III
CORE PAPER IV: MICROBIAL DIVERSITY

UNIT – I

UNIT - II

UNIT – III
Taxonomy & General Characteristics of Fungi - Life Cycle of Aspergillus, Mucor, Rhizopus and Penicillium - Modes of reproduction & its economic importance.

UNIT – IV
Algae – Morphology & General Characters – Basic knowledge on its reproduction & its economic importance.
Protozoa – General characteristics and the economic importance of Sarcodina, Mastigophora, Rhizopoda, Ciliata, Sporozoa.
UNIT – V
Virus- Morphology, General characteristics, Classification (Baltimore classification) and Multiplication of viruses. The structure of viruses- virion size- General structure properties-helical capsids, icosohedral capsid- nucleic acids- Viral envelopes and enzymes.

References

SEMESTER – IV
CORE PAPER V: MICROBIAL PHYSIOLOGY

UNIT – I

UNIT – II

UNIT -III

UNIT- IV
Anaerobic respiration – sulphur, nitrogenous compounds and CO₂ as final electron Acceptor - Fermentation – alcoholic, propionic and mixed acid fermentation. Lactic acid fermentation.
UNIT - V
Photosynthesis – Oxygenic and Anoxygenic, Carbon dioxide fixation, Biosynthesis of bacterial cellwall, Biosynthesis of aminoacids (Glutamic acid family)- Bioluminescence.

References
SEMESTER IV
CORE PRACTICAL II

1. Protein estimation (Lowry et al)
2. Estimation of Carbohydrates (DNSA method)
3. Micrometry
5. Influence of pH and Temperature on bacterial growth.
6. Cultivation of anaerobic Microorganisms – Wrights tube – McIntosh fildes jar

Physiological characterization:
7. Indole, MR, VP, Citrate utilization tests
8. Carbohydrate fermentation tests – TSI – H₂S production
10. Starch hydrolysis, Gelatin and Casein hydrolysis tests

References:
SEMESTER - V
CORE PAPER VI - MICROBIAL GENETICS

UNIT-I
DNA and RNA as genetic material, Characters of a genetic material, Chemistry & Molecular structure of DNA, Topology of DNA, Structure and types of RNA. Bacterial chromosome, Organization of genes in prokaryotes & Eukaryotes.

UNIT-II

UNIT-III

UNIT-IV
Mutation - spontaneous and induced Mutagen & Mutagenesis – DNA repair mechanism.

UNIT-V

References
SEMESTER -V

CORE PAPER VII - PRINCIPLES OF IMMUNOLOGY

UNIT- I
History and Scope of Immunology - The basis of defence mechanisms - Cell and Organs involved in immune system - Phagocytosis.

UNIT- II
Types of immunity – Antigen – Antibody – types - Complement pathways - Classical and Alternate – Immunoglobins - structure and functions.

UNIT- III
Allergy and Hypersensitivity - Classification types and Mechanisms – Immunodeficiency diseases.

UNIT -IV
Autoimmunity mechanisms and autoimmune response diseases: RA, SLE and Myasthenia Gravis. - Monoclonal antibodies and its applications (Hybridoma technology)

UNIT –V
Immunohematology - Blood transfusion - ABO grouping - Rh factor - Tissue transplantation- HLA typing - Mechanism of acceptance and rejection.

References
SEMESTER –V

CORE PAPER VIII - FOOD MICROBIOLOGY

UNIT – I
Food and Microorganisms – Important microorganisms in food (Bacteria, Mold and yeasts) ; Factors affecting the growth of microorganisms in food – pH, moisture, oxidation – Reduction potential , Nutrient content and Inhibitory substances and biological structure.

UNIT – II

UNIT -III
Spoilage of food - cereals, vegetables, fruits, egg and milk – canned foods and sea foods.

UNIT-IV

UNIT- V
Food borne diseases & Food Quality control Measures – Food poisoning and Food borne infections – Bacterial and Mycotoxins- Investigation of food poisoning outbreaks- food standards, quality control. HACCP, FDA, WHO.

References
SEMESTER – V
CORE PAPER IX
MEDICAL MICROBIOLOGY

UNIT- I

UNIT- II
Morphology, Pathogenicity and laboratory diagnosis- Gram positive & negative coccus - Staphylococcus aureus, Streptococcus pyogenes, Pneumococcus and Neisseria sp.

UNIT- III
Morphology, Pathogenicity and laboratory diagnosis- Gram positive organisms- Bacillus anthracis, Corynebacterium diptheriae, Clostridium botulinum, Clostridium tetani

UNIT- IV
Morphology, Pathogenicity and laboratory diagnosis- Gram negative Organisms - Escherichia coli, Klebsiella, Proteus, Salmonella, Shigella, Pseudomonas, Vibrio cholerae.

UNIT – V
Morphology, pathogenicity and laboratory diagnosis- Mycobacterium tuberculosis, Mycobacterium leprae, Treponema pallidum, Leptospira, Chlamydia, Rickettsiae & Mycoplasma.

References
SEMESTER -VI

CORE PAPER X – INDUSTRIAL MICROBIOLOGY

UNIT –I
Fermentation- Definition & types - Submerged and Solid state. Fermentors & its types (CSTF Tower, cylindroconical & airlift) – Batch fermentation – Continuous fermentation.

UNIT -II
Industrially important strains- Screening methods- Strain development for Improved yield- Mutation, Recombination and protoplast fusion.

UNIT -III

UNIT -IV
Single cell protein- Bakers yeast, spirulina- Details of mushroom development- Oyster (Pleurotus) and Button (Agaricus) mushroom.

UNIT -V
Downstream process- Intercellular and extracellular- Centrifugation, filtration, Floatation- solvent extraction, precipitation- Breakage of cells- physical and Chemical methods.

References
SEMESTER -VI

CORE PAPER XI

ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

UNIT -I
Distribution of microorganisms in nature – Microbial communities in soil- Factors Influencing the microbial density in soil- zymogenous and autochthonous flora in Soil- Microbial associations – symbiotic proto cooperation, Ammensalism, Commensalism, Syntropism, Parasitism and Predation with suitable examples.

UNIT -II

UNIT- III

UNIT- IV
Water microbiology, algae, phytoplankton- eutrophication- Water Pollution (Microbiological) water treatment- Primary, secondary and tertiary. Drinking water- Potability- MPN technique.

UNIT-V
Aero microbiology- aerosol, droplet nuclei, air pollution- sources (Microbiological) – air quality analysis- air sampling devices.

References
SEMESTER -VI

CORE PAPER XII – VIROLOGY

UNIT -I
Early development of virology General Structure, Properties and Classification–cultivation of Viruses- virus purification and assays.

UNIT- II
Reproduction of DNA phages- DNA lytic phages- lytic cycle of T4 phage The one step growth- adsorption to the host cell and penetration- synthesis of Phage nucleic acids and protein assembly of phage particles- release of phage particles.

UNIT-III

UNIT -IV
Viruses of Eukaryotes- Reproduction of animal (Pox and Adeno) and plant viruses (TMV, CMV) - Viruses of Algae, fungi and viruses- viruses and cancer.

UNIT - V

References
SEMESTER VI
CORE PRACTICAL III

1. Isolation of DNA.
2. Isolation of drug resistant mutants using UV and Chemical agents
3. Phenol Coefficient method
4. Isolation of *E. coli* plasmid DNA and detection by agarose gel electrophoresis
5. Methylene blue reduction test
6. Microbial analysis of spoiled food – Bread and Vegetables
7. Identification of fungal food spoilers – *Aspergillus, Mucor, Penicillium, Rhizopus*
8. Direct microscopic examination of curd – observation of lactobacilli
9. Screening and assay of Enzymes – protease and amylase
11. Immobilization- Demonstration
12. Isolation of free living nitrogen fixers – *Azotobacter, Azospirillum* – Phosphate solubilizers – Rhizobium from nodule
13. Isolation of coliphages.
14. Microscopic identification of clinically important fungi – *Candida albicans, Cryptococcus neoformans* and *Aspergillus*
15. MPN Technique – Detection of potability of water.

References:
SEMESTER III
SKILL BASED SUBJECT I
CLINICAL LAB TECHNOLOGY

UNIT – I
Methods of collection of urine, blood, sputum, stool etc. The techniques of preservation of samples. Separation of blood plasma and serum.

UNIT – II
Examination of urine: Sample collection, physical and chemical tests, principles and methods, microscopic examination- crystals, casts, sediments, pregnancy tests.

UNIT – III

UNIT – IV
Tissue reception, labeling, fixation for different tissue and section cutting-Preparation of paraffin blocks (Dehydration, clearing, embedding, blocking)-Handling and care of microtome sharpening of razors, and section cutting-Preparation of common stains. H & E, congored, methyle violet, Leishman stain, Giesma, Papiaicolau, VG, PAS, PASM etc. and staining techniques-Mounting of museum specimens, record keeping, indexing of slides.

UNIT – V
Examination of Stool - Indication, Collection, Container, Transport, Preservation for different types of fecal analysis; Physical, Chemical and Microscopic examination and its significance

References
1. Seiverd, Charles E. Hematology for Medical Technologies. 4th Ed. Lea & Febiger, U.S.,
SEMESTER IV
SKILL BASED SUBJECT II
DIAGNOSTIC MICROBIOLOGY – I
(BACTERIOLOGY AND SEROLOGY)

UNIT – I

UNIT – II
Identification of organisms - Biochemical reaction – Sugar fermentation test - Susceptibility testing – MIC, E test - reporting of results & interpretation.

UNIT – III
Serology – Antigen - antibody reactions – Agglutinations (blood grouping, WIDAL) RPR and Hemaaglutination

UNIT – IV
Precipitation (VDRL), Immunodiffusion – mono and double immunodiffusion, Immunoelectorophoresis (rocket, counter current). ELISA, Radioimmune assay (RIA)

UNIT – V
Advanced techniques – automated methods – ELISA, RIA. Quantitative study of Antigen - Antibody reactions. Immunosensors. CD4, CD8 cell counting, Western blot analysis for HIV.

References
SEMESTER V

SKILL BASED SUBJECT III

DIAGNOSTIC MICROBIOLOGY –II

(VIROLOGY, MYCOLOGY AND PARASITOLOGY)

UNIT –I

UNIT –II

UNIT -III
Etiology and laboratory diagnosis of Urinary tract infection- Meningitis, Diarrhea, Respiratory tract infections.
Pyogenic infections- *Staphylococcus and Pseudomonas: Sexually Transmitted Diseases Bacteria), Nosocomial infections - definition, sources and detection; phage typing, Bacteriocin typing.

UNIT –IV
Laboratory methods in basic Virology- Viral culture- Media and cells used – Specimen processing – isolation and identification of viruses.
Detection of viral antigen (fluorescent antibody and solid phase immunoassays). Viral Serology-Special consideration- Hepatitis and AIDS.

UNIT –V
References

SEMESTER VI
SKILL BASED SUBJECT IV
PRACTICALS IN DIAGNOSTIC MICROBIOLOGY

1. Collection, transport, processing of specimen and Identification of bacteria from clinical specimens – Urine, Blood, Sputum, Pus and Faeces.
2. Slide agglutination - Blood grouping
3. Tube agglutination - WIDAL
4. Precipitation – RPR
5. Immunodiffusion - Radial, Ouchterlony’s
6. Immunoelectrophoresis - Rocket and Counter current
7. ELISA
8. SDS-PAGE
9. Observation of fungi - LCB or KOH mount
ELECTIVE I - A
RECOMBINANT DNA TECHNOLOGY - I

UNIT- I
Gene manipulation – Definition and Application, Restriction Enzymes, Discovery, Types and Mode of Action, Ligases and Methylases, Modifying enzymes- Alkaline Phosphatase, Phospho nucleo Kinase.

UNIT –II
Isolation - Purification of DNA (Chromosomal and Plasmid), Isolation and Purification of RNA, Chemical Synthesis of DNA, Genomic Library and cDNA Library.

UNIT -III
Vectors – Plasmid based Vectors- Natural (PSC101, RSF2124, PMB1), Artificial – pBR322 & pUC 18 Construction: Phage based Vectors- λ (Lamda) phage Vectors and its Derivatives: Hybrid Vectors- Phagemid, Phasmid and Cosmid, BAC and YAC.

UNIT -IV
Gene Transfer Techniques: Physical – Biolistic Method, Chemical- Calcium chloride and DEAE Methods, Biological invitro package method - Screening and Selection of recombinants- Direct Method – Selection by Complementation, -Indirect Methods- Immunological and Genetic Methods.

UNIT- V
PCR, DNA Sequencing (Sanger’s Method) Blotting (Southern, Western, Northern) Techniques, RFLP and Application, - RAPD and Application - Microarray.

References
ELECTIVE I – B
APPLIED PLANT BIOLOGY

UNIT – I
Plant Tissue culture – History, Plant tissue culture media, types, constituents and preparation of media, selection of suitable medium.

UNIT – II
Protoplast culture and somatic hybridization, production of Haploid plants, Somaclonal variations, Clonal propagation (micro propagation) germplasm conservation and cryopreservation.

UNIT – III
Genetic Engineering of plants – Gene transfer methods – vector mediated gene transfer, virus – mediated gene transfer, Direct or Vectorless DNA transfer.

UNIT – IV

UNIT – V
Molecular Marker Aided plant Breeding – Molecular markers, Molecular marker assisted selection, Arid & semi-arid plant Biotech, Green house & Green home technology.

References:
1. Dr. U. Sathyanarayana – Biotechnology. Books and Allied Publications
ELECTIVE I – C

ENTOMOLOGY

Unit I
Brief account of morphology, classification (Major orders) and development (Metamorphosis) of insects. Study of Insect Pest  a. Agriculture pest – Grasshopper, Red Cotton bug, Gram pod borer, Cotton pink bollworm, Cotton spotted bollworm b. Medical pest – House fly, Mosquito, Pediculushumanus c. Veterinary pest – Stable fly, Dog tick, Bird lice d. Stored grain pest – Stored grain weevil, Flour moth e.

Unit II

Unit III
Insect pests of stores grains - Insect vectors of plants, animals and man - other insects affecting the health of man and domestic animals. Application of management strategies for insect/mite pests of small grains, corn, cotton, rice, sorghum, stored products and sunflower; nature and symptoms of damage, life history and habits of common pests.

Unit IV

Unit V
Insect Vectors for Plant and Animal diseases. Three examples each. Molecular Entomology. Pesticides and environmental pollution - precautions in handling pesticides.

References:


ELECTIVE II – A
RECOMBINANT DNA TECHNOLOGY- II

UNIT –I
Microbial synthesis of commercial products-Proteins-Pharmaceuticals – Interferons - Human growth hormone- Antibiotics -Biopolymers.

UNIT –II
Vaccines – Subunit vaccines, Edible vaccine, Recombinant vaccine – Monoclonal antibody. Gene therapy.

UNIT –III
Transgenic plants-Ti plasmid – insect, virus, herbicide resistant plants – microbial insecticides – bacteria, fungi and viruses.

UNIT IV

UNIT -V
DNA finger printing and its Application. Human Genome Project and History and its Application.

References
ELECTIVE II – B : ENTREPRENEURIAL MICROBIOLOGY

UNIT I:
Entrepreneur development, activity, Institutes involved, Government contributions to entrepreneurs, risk assessment. Industrial Microbiology, Definition, scope and historical development.

UNIT II:
Microbial cells as fermentation products- Bakers yeast, food and feed yeasts, Bacterial Insecticides, Legume Inoculants, Mushrooms, Algae. Enzymes as fermentation products-Bacterial and Fungal Amylases, Proteolytic Enzymes, Pectinases, Invertases, and other enzymes.

UNIT III:

UNIT IV:

UNIT V:
Brewing- Media components, preparation of medium, Microorganisms involved, maturation, carbonation, packaging, keeping quality, contamination, by products. Production of Industrial alcohol.

References:
1. Industrial Microbiology- L.E.Casida, jr, New age International publication.
2. Entrepreneurial Development in India- By Arora
ELECTIVE II – C : BIO-MOLECULES

UNIT - I

UNIT - II

UNIT- III

UNIT- IV
Nucleic acids; Structure of Purines and Pyramids; Nucleotides and Nucleosides. DNA: double helix: A, B and Z forms; DNA denaturation and renaturation. RNA: types, unusual bases. DNA as genetic material Structure of chromatids, nucleosome and histones.

UNIT- V
Vitamins and Minerals Vitamins: Definition, Classification. Fat soluble vitamins-sources, structure and physiological functions; Water soluble vitamins-sources, structure and

References

ELECTIVE III– A : DAIRY MICROBIOLOGY

Unit I
Milk - Introduction, composition,. Microorganisms in Milk – Bacteria, Yeasts, Moulds. Starter Cultures – Starter cultures their biochemical activities. (Streptococcus thermophilus, Lactobacillus bulgaricus) Dairy processing unit operations: Pasteurization, UHT treatment, homogenization, Membrane processing, storage, transportation and distribution of milk. Judging and grading of milk and its products.

Unit II

Unit III
Microbiology of fermented milk products - Acid fermented milks (acidophilus milk, yoghurt). Slightly acid fermented milks (Cultured butter milk), Acid-alcoholic fermented milk (Kefir). Fermented milk production with extended self life (labneh)). Milk borne diseases, antimicrobial systems in milk, sources for contamination of milk - bacterial with examples of infective and toxic types –, Clostridium, Salmonella, Shigella, Staphylococcus, Campylobacter, Listeria. Mycotoxins in milk with reference to Aspergillus species.
Unit – IV

Unit V

References
3. Applied dairy microbiology edited by Elmer Marth and James Steele.
ELECTIVE III – B
BIONANOTECHNOLOGY

Unit I:

Unit II:

Unit III:

Unit IV:

Unit V:
Applications of Bionanotechnology- Nanomedicines; Immunotoxins, Liposomes as drug carriers, Gene therapy, Personalised Medicines; Lab on chip concept. DNA Computers, Artificial Life, Hybrid materials, Biosensors.

References:
1. Goodsell - Bionanotechnology
3. Vladimir P Torchilin, Nanoparticles as Drug Carriers. Imperial College Press, North Eastern University, USA. 2006
ELECTIVE III – C:
MEDICAL BIOCHEMISTRY

Unit I
Disorders of carbohydrate metabolism – Diabetes mellitus, Glucose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.

Unit II
Disorders of lipids- Plasma lipo proteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher’s disease, Tay-Sach’s, ketone bodies, β-lipoproteinemia.

Unit III
Disorders of liver and kidney- Jaundice, fatty liver, normal and abnormal functions of liver and kidney, inulin and urea clearance.

Unit IV
Abnormalities in nitrogen metabolism- Uremia, hyperurecemia, porphyria and factors affecting nitrogen balance.

Unit V

References