BHARATHIAR UNIVERSITY, COIMBATORE.

B.Sc. MICROBIOLOGY WITH NANOTECHNOLOGY DEGREE COURSE

COMPULSORY DIPLOMA IN DIAGNOSTIC MICROBIOLOGY

SCHEME OF EXAMINATION - CBCS PATTERN (AFFILIATED COLLEGES)

For the students admitted during the academic year 2009 – 2010 batch onwards

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<th>Part</th>
<th>Study Components</th>
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* - Students has to submit a record of work done during their training period which will be evaluated through viva voce along with the core practical III examination.

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.

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

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SEMESTER - I
CORE PAPER I : FUNDAMENTALS OF MICROBIOLOGY

UNIT – I

UNIT – II
Microscopy and Staining -Microscopy – Principles and application – Bright field, Dark field, Phase contrast, Fluorescence, SEM & TEMS- Specimen preparation of electron microscopy – freeze etching- Staining- Stains and Staining reactions – Types of staining – Simple, Differential (Gram’s, Spore, AFB_), Capsule staining, Nuclear and Flagella staining– Albert.

UNIT – III

UNIT – IV
Culture techniques -Media preparation -Solid and Liquid- Types of Media – Crude, Semi Synthetic, Synthetic, Enriched, Enrichment, Selective, Differential and Special Purpose Media (one eg for each type). Anaerobic culture technique— Wright’s tube, Roll tube, McIntosh fildes jar method -Pure culture technique – Tube dilution, Pour, Spread, Streak and Micromanipulator.

UNIT – V

References
SEMESTER -II
CORE PAPER II : MICROBIAL DIVERSITY

UNIT – I

UNIT – II
Taxanomy of Eubacteria and Actinomycetes – Detailed classification upto genus level with general characters of each group – Bergey’s Manual and its importance.

UNIT – III
Taxanomy of Photosynthetic Eubacteria and Archaeabacteria- General characteristics.

UNIT – IV
Taxanomy of Fungi (Alexopolous) -General Characteristics-Life Cycles of Mucor, Neurospora, Agaricus, Dictyostelium.

UNIT – V

References

SEMESTER -II
CORE PAPER III : CELL BIOLOGY

UNIT – I

UNIT – II
UNIT III
Cell division in Bacteria – Binary fission - Cell division of Eukaryotes – Mitosis and Meiosis.

UNIT IV

UNIT V
Archaebacterial cell wall and cell membranes of Methanogens - Halophiles - Thermoacidiphiles.

References

SEMESTER II
CORE PRACTICAL 1
1. Laboratory precautions
2. Preparation of cleaning solutions
3. Antiseptics and disinfectants
4. Principles of aseptic techniques
5. Culture media preparation – Liquid and Solid medium
6. Selective and differential media
7. Methods of sterilization and testing of sterility
8. Enumeration of Bacteria, Fungi and Actinomycetes from soil
9. Pure culture techniques – pour plate, spread plate and looping method
10. Phenol co-efficient test
11. Cultural characteristics of microorganisms-colony morphology on nutrient agar slants, nutrients broth
12. Maintenance and preservation of cultures
13. Staining of bacteria-Simple, Negative, Gram, Spore and AFB, Fungal wet mount –LCB-Slide culture method
14. Isolation of halophiles and thermophiles
15. Cultivation of anaerobic micro organisms – Wrights tube – McIntosh fildes jar
16. Micrometry
References


SEMESTER –III
CORE PAPER IV : MICROBIAL PHYSIOLOGY

UNIT – I
Nutrition: Nutritional requirements of microorganisms – Autotrophs, Heterotrophs, Photoautrophs, Chemoautotrophs, Copiotrophs, Oligotrophs, Endospore formation in Bacteria.

UNIT – II

UNIT -III

UNIT- IV
Anaerobic respiration – sulphur , nitrogenous compounds and Co2 as final electron acceptor- Fermentation – alcoholic, propionic and mixed 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 PAPER V: BASICS OF MATERIAL SCIENCE

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

REFERENCE:
SEMESTER IV
CORE PRACTICAL II

1. pH measurements
2. Spectrophotometry
3. Protein estimation (Lowry et al / Bradford)
4. Paper chromatography
5. Thin layer chromatography
6. Electrophoresis - Proteins
8. Extraction of pigments
10. Preparation of Buffers – Acidic and Alkaline range
11. Preparation of Molar solutions
12. Preparation of 0.1 and 1 Normal solutions

SEMESTER -V
CORE PAPER VI - MICROBIAL GENETICS

UNIT-I
DNA-the genetic material, RNA-the genetic material, characters of a genetic material, chemistry & molecular structure of DNA, special structure of DNA, structure and types of RNA.

UNIT-II
Bacterial chromosome, organization of genes in prokaryotes, DNA—replication in prokaryotes – Meselson and Stahl experiment- mechanism & enzymology of replication – theta replication & rolling circle replication.

UNIT-III

UNIT-IV
Mutation-spontaneous and induced-mutagen & mutagenesis – DNA repair mechanism.

UNIT-V
Genetic exchange – transduction(specialized & generalized), transformation, conjugation & Hfr mapping, genetic recombination.
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-autoimmunity-mechanisms and autoimmune response diseases.

UNIT -IV
Quantitative study of antigen-antibody reactions –agglutination, precipitation ELISA-radioimmune assay(RIA)-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.

UNIT - IV
Fermented food – pickled cucumber, saurkraut, soysauce, Bread, Idli – Fermented dairy products – Yoghurt and cheese.

UNIT - V
Food borne diseases – food poisoning and food borne infections – bacterial and mycotoxins- Investigation of food poisoning outbreaks- food standards, quality control.

References

SEMESTER – V

CORE PAPER IX - INTRODUCTION TO NANOMATERIALS

UNIT I
Introduction and Classification: What is nanotechnology – Classification of Nanostructures - 1D, 2D and 3D nanomaterials – Nanoscale Architecture.

UNIT II
UNIT III

UNIT IV

UNIT V

REFERENCE:

SEMESTER -VI
CORE PAPER X - NANOBIO TECHNOLOGY

UNIT I
Biological Inspired Concepts: Biological Networks – Biological Neurons – The Function of Neuronal Cell – Biological neuronal cells on silicon – Modelling of Neuronal cells by VLSI circuits.

UNIT II

UNIT III
Nanobiometrics: Introduction – lipids as nano-bricks and mortar- Self assembled nanolayers - the bits that do things - proteins – DNA Computer

UNIT IV

UNIT V
Nanoanalytics: Quantum dot Biolabelling – Nanoparticle Molecular labels – Analysis of Biomolecular Structure by AFM.
REFERENCE:

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
Microbial decomposition; cellulose,Hemi cellulose, lignin, pectin and chitin. –Factors influencing degradation- acetate utilization -bioconversion of organic wastes- sugarcane wastes- coir pith composition- composting, principles and Applications- conversion process

UNIT- III

UNIT- IV
Water microbiology, algae, phytoplankton- eutrophication- water treatment - Primary, secondary and tertiary. Drinking water- Portability- 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 – BIOMEDICAL APPLICATIONS OF NANOMATERIALS

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

REFERENCE:
SEMESTER VI
CORE PRACTICAL III

1. Isolation of Nucleic acids
2. Isolation of drug resistant mutants using UV and Chemical agents
3. Induction of Lac Operon – ONPG method
4. Isolation of \textit{E. coli} plasmid DNA by agarose gel electrophoresis
6. Identification of clinically important fungi – \textit{Candida albicans}, \textit{Cryptococcus neoformans} and \textit{Aspergillus}
7. Methylene blue reduction test
8. Microbial analysis of spoiled food – Bread and Vegetables
10. Direct microscopic examination of curd – observation of lactobacilli
11. Enzyme production and assay – protease and amylase
12. Alcohol production / wine
13. Immobilization- Demonstration
14. Isolation of free living nitrogen fixers – \textit{Azotobacter}, \textit{Azospirillum} – Phosphate solubilizers – Rhizobium from nodule
15. Observation of parasites – \textit{Entamoeba}, \textit{Plasmodium}, \textit{Ascaris}, \textit{Taenia}.
16. Isolation and titration of coliphages
17. Cultivation of animal viruses in embryonated eggs.

DIPLOMA IN DIAGNOSTIC MICROBIOLOGY
SEMESTER III - DIPLOMA PAPER I

ORGANIZATION OF CLINICAL MICROBIOLOGY LABORATORY

UNIT – I

UNIT – II
Laboratory safety. General safety considerations – biohazards and practices specific to microbiology – classification of biological agents on the basis of hazards.

UNIT – III
Special precautions for specific areas of clinical Microbiology – Bacteriology, Mycobacteriology, Mycology, Parasitology, Virology and Serology.
UNIT – IV

UNIT – V
Management of clinical Microbiology laboratory – general approaches– rapid detection – speeding up of identification results and susceptibility results – computerization.

References
1. Diagnostic Microbiology, Bailey & Scott, s, 1990 8th edn. The Mosby Company.
2. Medical laboratory manual for tropical countries, Microbiology by Monica chees brough (ELBS) Tropical health technology butter worth’s, 1985.

DIPLOMA PAPER II
SEMESTER IV - DIAGNOSTIC MICROBIOLOGY – I
(BACTERIOLOGY AND SEROLOGY)

UNIT – I

UNIT – II
Cultivation and isolation of viable pathogens – Media used – differential, selective, enrichment and enriched media.

UNIT – II
Cultivation and isolation of viable pathogens – Media used – differential, selective, enrichment and enriched media.

UNIT – III
Biochemical tests – identification of organisms - Susceptibility testing, reporting of results and interpretation.

UNIT – IV
Serology – Antigen - antibody reactions – Agglutinations (blood grouping, WIDAL), Precipitation (VDRL), Immunodiffusion – mono and double immunodiffusion, Immunoelectorophoresis (rocket, counter current).
UNIT – V
Advanced techniques – automated methods – ELISA, RIA. Applications of Nucleic acid hybridization, PCR and blotting in diagnosis.

References


DIPLOMA PAPER III
SEMESTER V - DIAGNOSTIC MICROBIOLOGY –II
(VIROLOGY, MYCOLOGY AND PARASITOLOGY)

UNIT –I
Laboratory methods in basic Mycology – Collection and transport of clinical specimens – Direct Microscopic examination, culture media and incubation, Serological tests for fungi – Antifungal susceptibility testing

UNIT –II
Laboratory methods for parasitic infections – Diagnostic techniques for faecal, gastrointestinal and urino-genital specimen.

UNIT –III

UNIT –IV
Laboratory methods in basic virology- detection of viral antigen (fluorescent antibody and solid phase immunoassays). Viral Serology- Special consideration- Hepatitis and AIDS.

UNIT –V
Viral culture- Media and cells used – Specimen processing – isolation and identification of viruses.

References

**SEMESTER VI**
**DIPLOMA PAPER IV**

**DIPLOMA PRACTICAL –I**

2. Processing of specimen
   2.1- Gram’s Staining
   2.2- Motility
   2.3-Culturing techniques-McConkey agar, Blood agar, Chocolate agar, Mannitol salt agar and XLD agar
4. Susceptibility testing- Kirby Bauer method.

**DIPLOMA PRACTICAL –II**

1. Slide agglutination -Blood grouping
2. Tube agglutination- WIDAL
3. Precipitation – RPR
4. Immunodiffusion- Radial, Ouchterlony’s
5. Immunoelectrophoresis- Rocket and Counter current
6. ELISA
7. SDS-PAGE
8. Western blot
9. Observation of fungi- LCB or KOH mount
10. Observation of parasites- Entamoeba, Plasmodium, Ascaris, Taenia
ELECTIVE I – A

RECOMBINANT DNA TECHNOLOGY

UNIT –I
Nucleic acid purification – DNA, RNA; Nucleic acid modifying enzymes - Endonucleases, ligases, methylases, phosphatase, kinase – mode of action.

UNIT –II
Prokaryotic Vectors: Plasmid based - Natural (PSC101, PSF2124, PMB1), Artificial (pBR322, pUC); Phage based - phage and its derivatives, M13; Hybrid - Phagemid, Phasmid, Cosmid, BAC, YAC, Eukaryotic vectors: Ti plasmid, retrovirus.

UNIT –III
Gene Transfer Technique: Physical – Biolistic, DNA microinjection: Chemical- Calcium chloride, DEAE Method; Biological – Transfection, transformation; Selection – direct and indirect.
Techniques in rDNA: PCR, Blotting, RFLP, RAPD, Microarray, DNA finger printing, cDNA library, genomic library – methodology

UNIT IV

UNIT -V
Pharmaceutical products : Interferons, Human growth hormone; Vaccines – sub unit vaccines; monoclonal antibody. Human genome project; gene therapy; Bioethics in recombinant DNA technology.

References

ELECTIVE II – B: VIROLOGY

UNIT -I
UNIT II

UNIT-III

UNIT -IV
Viruses of Eukaryotes- Reproduction of animal and plant viruses- Viruses of Algae, fungi and viruses- viruses and cancer.

UNIT- V
Human viral infections- pathogenicity and diagonalosis of Hepatitis (A.B). Mumps, AIDS, Rabies, Influenza, Measles, Rubella, Herpes simplex I&II..

References

ELECTIVE II – C : BIOINSTRUMENTATION – PRINCIPLES AND APPLICATIONS

UNIT – I
Autoclave, Hot air oven, Incubator, Water Bath, Laminar air flow, BOD incubator, Centrifuges – Bench top, High sped, Ultra centrifuge.

UNIT – II
pH meter, Conductivity meter, Lyophilizer, McIntosh anaerobic jar, Biosensor, Metabolic shaker.

UNIT -III

UNIT –IV

UNIT-V
Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality, PPM- Ammonium sulphate precipitation.
References
2. Dean, Willard and Merrit, Instrumental Methods of analysis Asian Ed.

ELECTIVE II – A : FERMENTATION TECHNOLOGY

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

UNIT -II
Fermentation- submerged and solid state- component parts of a CSTR- types of Fermentors (Tower, cylindroconical & airlift) – batch fermentation – continuous Fermentation.

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
ELECTIVE II – B : DAIRY MICROBIOLOGY

Unit I

Unit II
Milk and milk products – Definitions, composition, food and nutritive value of milk, properties of milk and its constituents. Dairy Products Production: Overview and Fluid Milk Products, Concentrated and Dried Milk Products, condensed milk, evaporated milk, whole and skimmed milk powder, cultured Dairy Products: Cheese, yogurt, fermented beverages, Whipped Cream, Ice Cream, Butter, Whey Products, fermented milks,

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 food with reference to Aspergillus species.

Unit – IV

Unit V
Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, EPA, HACCP, ISI. HACCP – Food safety, safety of dairy products, control of hazards

References
3. Applied dairy microbiology edited by Elmer Marth and James Steele.

ELECTIVE II – C: PLANT BIOTECHNOLOGY

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:
Dr. U. Sathyanarayana – Biotechnology. Books and Allied Publications


ELECTIVE III – A : MEDICAL MICROBIOLOGY

UNIT- I
Infections- sources of infections- types of infections - methods of infections- definitions- epidemic, pandemic, endemic diseases - Epidemiology of infectious diseases, infectious diseases cycle- investigation of epidemics - control of epidemics.

UNIT- II
Morphology, pathogenicity and laboratory diagnosis - Gram positive organisms - *Staphylococcus aureus, Streptococcus pyogenes, Bacillus anthracis, Clostridium tetani*, *Gram negative organisms* – *Escherichia coli, Klebsiella, Shigella, Pseudomonas, Vibrio cholerae*.

UNIT- III

UNIT -IV

UNIT -V
Antibiotics and chemotherapeutic agents - Mechanism of actions – Drug resistance – Antimicrobial susceptibility testing - Disc diffusion - Kirby Bauer.

References

**ELECTIVE III – B : 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**

ELECTIVE III – C : 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:
Mushroom cultivation and Composting- Cultivation of Agaricus campestris, Agaricus bisporus, and Volvariella volvacea; Preparation of compost, filling tray beds, spawning, maintaining optimal temperature, casing, watering, harvesting, storage. Biofertilizers- Historical background, Chemical fertilizers versus biofertilizers, organic farming. Rhizobium sp, Azospirillum sp, Azotobacter sp, as Biofertilizers.

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:
Industrial Microbiology- L.E.Casida, jr, New age International publication.
Entrepreneurial Development in India- By Arora
Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology- K.R.Aneja, New age International publication.
Medical Microbiology, Virology and Immunology is one of the most important sciences studied by medical students. It is the fundamental knowledge that prepares students to learn another medical disciplines. This textbook is recommended for students studying discipline Microbiology, Virology and Immunology in English in medical universities of the Russian Federation. Text is adapted for students studying in English as a foreign language. The studied material is presented systematically in the form of lectures for study. The textbo 4. Immunology Examinations, questions, etc. 5. Physicians' Licenses United States Examinations Study guides. I. Tan, Michael J. II. Rosenthal, Ken S. Microbiology and Immunology. Rapid Review Microbiology and Immunology can be an important part of your training for the USMLE exam. Success on the exam requires more than a thorough knowledge of the subject. As with any big challenge a race, match, or championship game a positive winning attitude as well as mental, physical, and emotional preparedness are necessary. Make sure to go into the exam strong. Hanging Drop Preparation is the useful technique employed in the laboratory for the microscopic examination of living microorganisms (viable organisms), especially the bacteria without staining them and to see their motility due to flagella. Flagella is the organ of locomotion in Bacteria and various types of arrangement of Flagella is found in the bacteria which causes the variation in motility of bacteria as some a highly motile and some are slightly motile. Affiliations Department of Medicine, University of Cambridge, Addenbrooke’s Hospital, Cambridge, United Kingdom, Clinical Microbiology and Public Health Laboratory, Health Protection Agency Microbiology Services, Addenbrooke’s Hospital, Cambridge, United Kingdom, The Wellcome Trust Sanger Institute, Wellcome Trust Genome Campus, Hinxton, Cambridge, United Kingdom, Department of Pathology, University of Cambridge, Cambridge, United Kingdom. Whole genome sequencing (WGS) promises to be transformative for the practice of clinical microbiology, and the rapidly falling cost and turnaround time mean that this will become a viable technology in diagnostic and reference laboratories in the near future. Scheme of examination. cbcs pattern (affiliated colleges). For the students admitted during the academic year 2010-2011 batch onwards. Examinations 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).