Department of Microbiology

Faculty of Allied Health Sciences

SGT UNIVERSITY

Shree Guru Gobind Singh Tricentenary University

Gurgaon-122505

Syllabus

B.Sc. Microbiology

Duration: 3 years (6 Semester)

W.e.f. Academic Session 2020-21

SEMESTER I
INTRODUCTION TO MICROBIAL WORLD

L T P -- CREDITS
3 1 0 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

(A). History of development of Microbiology

Development of microbiology as a discipline, Spontaneous generation *vs*. biogenesis, development of various microbiological techniques, concept of fermentation, establishment of fields of medical microbiology, immunology and environmental microbiology with special reference to the work of following scientists : Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff, Norman Pace, Carl Woese and Ananda M. Chakraborty.

(B). Classification and characterization

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Differences between prokaryotic and eukaryotic microorganisms.Morphology ofacellularmicroorganisms (Viruses, Viroids, Prions) and cellular microorganisms (Bacteria, Algae, Fungi and Protozoa).

Unit 2

(A). Bacteria and Virus

- Brief introduction to eubacteria, archaebacteria (extremophiles).
- General characteristics and structure of the following: TMV, T4 and λ phage, lytic and lysogenic cycles.

(B). Algae, fungi and protozoa

- History of phycology, General characteristics of algae including occurrence, thallus organization, pigments, flagella, vegetative, asexual and sexual reproduction.
- History of mycology, General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism.
- General characteristics of protozoa - *Amoeba, Paramoecium and Giardia*

PRACTICAL

L T P -- CREDITS
– 2
EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1. Study of the life history of the following scientists and their contributions with the help of their photographs: Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff and Ananda M. Chakraborty.

2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven) used in the microbiology laboratory.

3. Study of the following algae by preparing temporary mounts: *Chlamydomonas*and *Spirogyra*.

4. Study of the following fungi by preparing temporary mounts: *Rhizopus*and *Aspergillus.*

5. Study of the following protozoans using permanent mounts/photographs: *Amoeba, Paramecium and Giardia*.

6. Introduction to light microscope

7. Simple staining

8. Gram’s staining

SEMESTER I

MYCOLOGY AND PHYCOLOGY

L T P -- CREDITS
3 1 0 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

(A). Classification and application of fungi: General classification and economic importance of fungi with examples in agriculture, environment, industry, medicine, food, bioremediation (of wood, paper, textile, leather), mycotoxins

(B).Life cycle, structure and occurrence – (i) Cellular slime molds (ii) True slime mold (iii) Oomycetes (iv) Chytridiomycetes (v) Zygomycetes (vi) Ascomycetes (vii)Basidiomycetes (viii) Deuteromycetes

Unit 2

(A). Classification and application of algae: General classification and economic importance of algae with examples in agriculture, environment, industry and food.

(B).Life cycle, thallus organisation and occurrence - (i) Chlorophyceae (ii) Charophyceae (iii) Diatoms (iv) Xanthophyceae (v) Phaeophyceae (vi) Rhodophyceae: (vii) Cyanobacteria

(C). Lichens

PRACTICAL

MYCOLOGY, PHYCOLOGY

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1. Preparation of Potato Dextrose Medium

2. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides:

- *Mucor,*
- *Saccharomyces,*
- *Penicillium,*
- *Agaricus*
- *Alternaria*

3. Study of the following genera through temporary and permanent slides:

- *Volvox,*
- *Coleochaete,*
- *Vaucheria,*
- *Ectocarpus,*
- *Polysiphonia*
- *Nostoc*

SEMESTER I
CHEMISTRY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit - I
(Inorganic Chemistry)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds.Polarizingpower and polarizability.Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment
Covalent bonding: VB Approach Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of, linear, trigonal planar, square planar, tetrahedral, trigonalbipyramidal and octahedral arrangements. Hydrogen bonding and its effect of physical and chemical properties.

Unit - II
Physical Chemistry

Acids-Bases and Ionic Equilibria
Modern concepts of acids and bases: Arrhenius theory, Bronsted and Lowry's concept, Lewis concept with typical examples, applications and limitations. Strengths of acids and bases (elementary idea). Ionization of weak acids and bases in aqueous solution, ionization constants, Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization. pH scale, common ion effect.

Chemicals Kinetics: Rate, order and molecularity of a reaction, rate constants of first and second order reactions, half life period, influence of temperature on reaction rate, activation energy, determination of order of a reaction.
Unit - III
Fundamentals of Organic Chemistry

Basic organic chemistry:
Concept of hybridization of carbon. Cleavage of a covalent bond: homolysis and heterolysis. Electronic effects and their applications (inductive, electromeric, hyperconjugation and resonance).Structure and stability of reactive intermediates (carbocations, carbanions and free radicals).Relative strength of carboxylic acids (aliphatic, aromatic and halo-substituted aliphatic), alcohols, phenols and nitro-phenols.Relative basic strength of amines (aliphatic and aromatic).

Stereochemistry
Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations.Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis-trans*nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit - IV
Chemistry of Biomolecules

Carbohydrates
Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.
Amino Acids, Peptides and Proteins
Classification, and General Properties of amino acids, *Preparation of Amino Acids:* Strecker synthesis, using Gabriel's phthalimide 20 synthesis. Zwitter ion, isoelectric point and Electrophoresis.Ninhydrin test.Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme).

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

Section A: Inorganic Chemistry (Minimum 10 experiments to be performed by student)

Volumetric Analysis:

1. Estimation of a strong acid (HCl) by titrating it with standardized NaOH.
2. Estimation of oxalic acid by titrating it with KMnO4.
3. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
4. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.
5. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
6. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

Section B: Physical Chemistry

Surface tension measurement (use of organic solvents excluded)
Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
Viscosity measurement (use of organic solvents excluded)
Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

Kinetic studies:
To study the specific reaction rate of the acid- catalyzed hydrolysis of methyl acetate at room temperature.

Section C: Organic Chemistry

1. Qualitative analysis of sugars (Reducing & Non reducing sugars, Monosachharides and Disaccharides) and amines.
2. Separation of a mixture of two Amino Acids using Paper Chromatography.
3. Separation of a mixture of two sugars using Paper Chromatography.

SEMESTER I
COMMUNICATION SKILL AND PERSONALITY DEVELOPMENT

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit I
Listening Comprehension

- Speeches
- Interviews
- audio-video clippings followed by exercises
- Introduction to Communication
- Importance of Communication
- Barriers to Communication and ways to overcome them

Unit II
Conversation Skills

- Greetings and introducing oneself
- Framing questions and answer
- Role play
- Buying: asking details etc
- Word formation strategies
- Vocabulary building: Antonyms, Synonyms, Affixation, Suffixation, One word substitution

Unit III
Reading Comprehension

- Simple narration and Stories
- Simple Passages
- Newspaper and articles clippings
- Note Making
- Paragraph Writing
- Comprehension
- Report Writing: types, characteristics
- Introduction to Letter Writing

Unit IV:

Pronunciation

- Pronunciation
- Syllable and Stress
- Intonation and Modulation

UNIT V

Writing Comprehension

- Letters: types, format, style
- Précis Writing
- Paragraph: Order, Topic sentence, consistency, coherence
- Report and Proposal

Project Writing: Features, Structure

SEMESTER II
BACTERIOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

(A). Bacterial cell - organization and structure

- Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella,fimbriae and pili.Composition and detailed structure of gram positive and gram-negativecell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), spheroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall.Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids and endospore: structure, formation, stages of sporulation.

(B).Bacterial cell – nutrition, reproduction and sterilization

- Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media
- Sterilization and Disinfection: Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation Chemical methods of microbial control: disinfectants, types and mode of action
- Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate.

Unit 2

(A). Important Archeae and Eubacteria:

- **Archeae:** General characteristics, phylogenetic overview. Methanogens- *Methanobacterium*. Thermophiles- *Thermococcus, Pyrococcus*. Halophiles- *Halobacterium, Halococcus*

- **Eubacteria:**Morphology, pathogenesis and economic importance of following groups -

  Gram negative(13) : Chlamydiae, Spirochetes, Rickettsia, Rhizobium, Agrobacterium, Neisseria, Enterobactericeae family, Salmonella, Pseudomonas, Vibrio, Haemophilus, Helicobacter, Camplylobacter

Gram positive(10) : Staphylococcus, Streptococcus, Mycoplasma, Clostridium, Lactobacillus, Bacillus, Corynebacterium, Mycobacterium, Listeria, Actinomyces.

(B). Techniques, scope and applications of Microbiology:

- Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures;
  An overview of scope of Microbiology.

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1. Preparation of different media: synthetic media BG-11, Complex media-nutrient agar, McConkey agar, EMB agar.
2. Acid fast staining-permanent slide only.
3. Capsule staining
4. Spore staining.
5. Isolation of pure cultures of bacteria by streaking method.
6. Estimation of CFU count by spread plate method.
7. Motility by hanging drop method.
8. Microscopy- Theoretical knowledge of Light and Electron microscope.
9. Study of the following techniques through electron / photo micrographs: Fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching, shadow casting.(Demo)

SEMESTER 2

VIROLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

(A). Introduction and viral taxonomy: History of viruses, definition of viruses, general properties of viruses, viroids, virusoids, satellite viruses and prions. Classification and nomenclature of viruses.

(B). Structure and salient features of viral genomes: Capsid symmetry**,** enveloped and non-enveloped viruses. TMV, Hepatitis B virus, Picornavirus, Rhabdovirus, Retrovirus, Influenza virus.

(C).Isolation, cultivation of viruses, applications of virology.

Unit 2

(A). Bacteriophages: Definition, structure and cycle of T4 and lambda phage.

(B).Viral replication and oncogenic viruses : Viral multiplication,Types of oncogenic DNA and RNA viruses. Concepts of oncogenes, proto oncogenes**,**tumor suppressor genes.

(C). Transmission, prevention and control of viral diseases: Persistent and non-persistent mode. Antiviral compounds, interferons and viral vaccines.

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1. To study structure of important animal viruses (rhabdo, influenza, paramyxo, Hepatitis B & retroviruses) using electron micrographs/photographs

2. To study structure of important plant viruses (caulimo, gemini, tobacco ring spot, cucumber mosaic & alpha-alpha mosaic viruses) using electron micrographs/photographs

3. Study of cytopathic effects using photographs

4. Viral vaccines and their applications

SEMESTER II
CELL BIOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

An overview of cell and cell organelles:

- Prokaryotic and eukaryotic cells, cell size and shape, molecules of cell, cell membranes and cell proteins.
- Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, transport across nuclear envelope, chromatin: molecular organization, nucleolus and rRNA processing.
- The endoplasmic reticulum, golgi apparatus, lysosomes, mitochondria, chloroplast, peroxisomes.

Unit 2

Cytoskeleton and cell movement:

- Structure and organization of actin filaments; actin, myosin and cell movement;
- intermediate filaments; microtubules.
- Mechanism of vesicular transport.
- The plasmamembranestructure;
- Transport of small molecules,
- Endocytosis.
- Bacterial and Eukaryotic Cell Wall;
- the extracellular matrix and cell matrix interactions; cell-cell interactions.

Unit 3

Tools and Techniques of cell biology:

- Microscopic-Principles of Light microscopy; Phase contrast microscopy; Confocal microscopy; Electron microscopy (EM)- scanning EM and scanning transmission EM (STEM); Fluorescence microscopy.
- Analytical- Flow cytometry- flurochromes, fluorescent probe and working principle; Spectrophotometry; Mass spectrometry; X-ray diffraction analysis.
- Separation-Sub-cellular fractionation- differential and density gradient centrifugation; Chromatography- paper, thin-layer, gel-filtration, ion-exchange, affinity and High-Performance Liquid Chromatography (HPLC).

Unit 4

(A).Cell signaling, cell Cycle, cell death and renewal:

Signaling molecules and their receptor; functions of cell surface receptors; Intracellular signal transduction pathway; signaling networks. Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase, Meiosis and Fertilization. Programmed Cell Death, Stem Cells and Maintenance of adult tissues, Embryonic Stem Cells and Therapeutic cloning.

(B). Cancer and mutation: Development and Causes of Cancer, Tumor Viruses, Oncogenes, Tumor Suppressor genes, Cancer Treatment- molecular approach. Mutation, types of mutation.

SEMESTER 2
ENVIRONMENTAL SCIENCE

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1:

The Multidisciplinary nature of environmental studies

- Definition, scope and importance.
- Need for public awareness.

Natural Resources

Renewable and non-renewable resources: Natural resources and associated problems.

- Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
- Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Unit 2:

Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.

Biodiversity and its conservation

- Hot-spots of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts

- Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Unit 3:

Environmental Pollution

Definition, causes, effects and control measures of:-

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Fireworks, their impacts and hazards
- Pollution case studies.
- Disaster management : floods, earthquake, cyclone and landslides.

Unit 4 :

Social Issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Consumerism and waste products.
- Environmental Legislation (Acts and Laws)
- Issues involved in enforcement of environmental legislation

Human Population and the Environment

- Population growth, variation among nations with case studies
- Population explosion – Family Welfare Programmes and Family Planning Programmes
- Human Rights.
- Value Education.
- Women and Child Welfare.

SEMESTER III

MICROBIAL ECOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1: Microorganisms habitat and their role in biogeochemical cycles and succession pattern

- *Terrestrial Environment*: Soil characteristics,
  Soil microflora**.***Aquatic Environment*: Stratification &Microflora of Freshwater & Marinehabitats**.** *Atmosphere*: Stratification of the Atmosphere, Aeromicroflora, Dispersal ofMicrobes**.***Animal Environment*: Microbes in/on human body (Microbiomics) & animal(ruminants) body. *Extreme Habitats*: Extremophiles: Microbes thriving at high & lowtemperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrientlevels.
- *Carbon cycle: Nitrogen cycle* Ammonification, nitrification, denitrification& nitrate reduction. *Phosphorous cycle*: Phosphate immobilization and phosphate solubilization. *Sulphur Cycle* Microbes involved in sulphur cycle.
- Succession of microbial communities in the decomposition of plant organicmatter.

Unit 2: Microbial Interactions

- *Microbe–Microbe Interactions*
  Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation, Biocontrol agents
- *Microbe–Plant Interactions:* Roots, Aerial Plant surfaces, Biological Nitrogen fixation (symbiotic/nonsymbiotic- biofertilizers)
- *Microbe–Animal Interactions :*Role of Microbes in Ruminants, Nematophagus fungi, Luminescent bacteria as symbiont.

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1.To study the effect of pH on the growth of *E. coli*

2. Effect of different nitrogen sources on growth of *E. coli*.

3.Effect of different carbon sources on growth of *E. coli*.
4.Analysis of soil –

- pH,
- moisture content,
- water holding capacity,
- percolation,
- capillary action

SEMESTER III
MOLECULAR BIOLOGY I

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1: Nucleic acids and genome structure

DNA as the carrier of genetic information, key experiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis, Genomics. DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology - linking number, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes.RNA Structure, Organelle DNA - mitochondria and chloroplast DNA. Genome Sequence and Chromosome Diversity, Chromosome Duplication and Segregation, The Nucleosome, Chromatin structure- Euchromatin, Heterochromatin.

Unit 2: DNA replication and repair

Chemistry of DNA synthesis, general principles - bidirectional replication, Semiconservative, Semi discontinuous, RNA priming, Various models of DNA replication including rolling circle, D-loop (mitochondrial), Θ (theta) mode of replication, replication of linear ds-DNA, replicating the 5'end of linear chromosome. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory proteins. Replication Errors, DNA Damage and their repair.

PRACTICAL
MOLECULAR BIOLOGY I

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1. Preparation of culture medium (LB) for *E.coli (both solid and liquid)* and raise culture of *E.coli*.
2. Genomic DNA isolation from *E.coli*.

3. Preparation of competent cells.(*E.coli* culture)

4.Demonstration of antibiotic resistance. (Culture of *E.coli*containing plasmid (pUC 18/19) in LB medium with/without antibiotic pressure and interpretation of results).

5. Transformation of plasmid DNA into competent cells of *E. coli.*

SEMESTER III
MICROBIAL PHYSIOLOGY AND METABOLISM I

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1: Microbial growth, measurement of microbial growth and effect of temperature on growth

Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxie growth curve. Measurement of cell numbers, cell mass and metabolic activity. Temperature - temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure.

Unit 2: Microbial transport and metabolism

Diffusion - Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron. Chemolithotrophic metabolism- Physiological groups of aerobic and anaerobic chemolithotrophs.Hydrogen oxidizingbacteria and methanogens.Phototrophic metabolism- Historical account of photosynthesis, diversity of phototrophic bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. Carbondioxide fixation: Calvin cycle and reductive TCA cycle.

SEMESTER III
FUNDAMENTALS OF COMPUTER SCIENCE

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

1. **Introduction**:
   What are computers, Application areas, Characteristics & limitations, Evolution of computers, Classification& generations of computers, Data representation in computer memory (numbering system)

2. **Computers Architecture /Organization:**
   Basicarchitecture, Functional Block diagram, Types of computers on the basis of purpose, Signal and Portability.

3. **Hardware:**
   CPU their generations and performance parameters, Input, output and storage devices.
   Primary (Main) Memories (RAM, ROM, Types of RAM and ROM, Cache Memory, Registers and types of registers, Storage Evaluation Criteria, Memory Capacity),
   Secondary Storage Devices: (Magnetic Disk, Floppy and Hard Disk, USBs, Optical Disks CD-ROMs)

4. **Software:**
   Types: System Software (Machine Level Languages, Operating Systems, Device Specific Drivers), Higher Level Languages, and Applications.
5. Languages: Machine Language, Assembly Languages, Programming Languages. Use of Compilers, Assemblers, Linkers, Loaders and interpreters in programming languages
6. Operating System: Booting/Start Up Procedure of machines, Introduction to Operating System, Functions and Classification of Operating Systems, Basic introduction to DOS, UNIX/LINUX OS, Windows
7. HTML, Use of Multimedia, Computer aided teaching and testing
   Application Software MS office (Word, Excel and Powerpoint)

8. **Basic Introduction to Computer Networks:**
   Data Communication, Network devices (Hub, Switches, Modems, and Routers etc), LAN, LAN topologies, WAN, MAN, Internet: Introduction, Basics of E-mail, Web browsers (IE, Google Chrome, and Mozilla Firefox),

9. Structure of Universal Resource Locator, Domains (.com, .in, .country specific, .org and rationale behind them), IP address, Backbone network, Network connecting devices, HTTP, DNS, Network Security and Search Engine.

SEMESTER IV
PLANT PATHOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1: Host pathogen interaction

- ***Microbial Pathogenicity*** **:**Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration,cell membrane permeability, translocation of water and nutrients, plant growth andreproduction).
- ***Genetics of Plant Diseases*** **:**Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis,types of plant resistance: true resistance– horizontal & vertical, apparent resistance.

Unit 2: Plant diseases- types and control

Concept of plant disease- microbial plant diseases, types of plant pathogens, pathogenicity, symptoms, economic losses. Principles & practices involved in the management of plant diseases by different methods

- *Important diseases caused by fungi*
  White rust of crucifers - *Albugo candida*
  Downy mildew of onion - *Peronospora destructor*
  Late blight of potato - *Phytophthorainfestans*
  Powdery mildew of wheat - *Erysiphegraminis*
  Ergot of rye - *Clavicepspurpurea*
  Black stem rust of wheat - *Pucciniagraministritici*
  Loose smut of wheat - *Ustilagonuda*
  Wilt of tomato - *Fusariumoxysporum*f.sp. *lycopersici*
  Red rot of sugarcane - *Colletotrichumfalcatum*
  Early blight of potato - *Alternariasolani*
- *Important diseases caused by phytopathogenic bacteria*
  Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, bacterial cankers of citrus
- *Important diseases caused by phytoplasmas*

Aster yellow, citrus stubborn

- *Important diseases caused by viruses*
  Papaya ring spot, tomato yellow leaf curl, banana bunchy top, rice tungro
- *Important diseases caused by viroids*
  Potato spindle tuber, coconut cadangcadang

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1.Isolation of microbes (bacteria & fungi) from soil (28.C & 45.C)

2.Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.

3.Detection (qualitative) of the presence of enzymes (dehydrogenase, amylase, urease) in soil.

4.Isolation of *Rhizobium* from root nodules of legumes

5.Isolation of *Azotobacter/Azospirillum*from soil

6.Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action

7.Isolation of microbes (bacteria & fungi) from soil (28.C & 45.C)

8.Isolation of phosphate solubilizers from soil

9.Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.

8.Study of important diseases of crop plants by cutting sections of infected plant material - *Albugo, Puccinia*, *Ustilago, Fusarium, Colletotrichum.*

SEMESTER IV
MOLECULAR BIOLOGY II

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1: Transcription and Translation

- Mechanism of Transcription (Prokaryotes and Eukaryotes) - RNA Polymerase and the transcription unit**,**
- Translation (Prokaryotes and Eukaryotes)

Assembly line of polypeptide synthesis - ribosome structure and assembly, various steps in protein synthesis. Charging of tRNA, aminoacyltRNAsynthetases. Proteins involved in initiation, elongation and termination of polypeptides.
Inhibitors of protein synthesis.

Unit 2: Regulation of transcription and translation

- Transcription Regulation in Prokaryotes: Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp*operons. Eukaryotes: Conserved mechanism of regulation, Eukaryotic activators, Signal integration, combinatorial control, transcriptional repressors, signal transduction and control of transcriptional regulator, Gene Silencing
- Regulation of translation: translation-dependent regulation of mRNA and Protein Stability.
- Regulatory RNAs:Riboswitches, RNA interference, miRNA, siRNA, Regulatory RNA and X inactivation

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1.Restriction enzyme digestion of genomic DNA from *E.coli*.

2.Isolation of plasmid DNA and genomic DNA together from *E.coli*. and restriction enzyme digestion.

3.Restriction enzyme digestion (*EcoR*I) of genomic and plasmid DNA.

4.Estimation of size of a DNA fragment after electrophoresis using DNA markers.

5.Construction of Restriction digestion maps from data provided.

6.Demonstration of DNA fingerprinting

SEMESTER IV

MICROBIAL PHYSIOLOGY AND METABOLISM II

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1: Enzymes and regulation

Enzymes:Importance, structure and classification of enzymes. Apoenzyme and cofactors.Prosthetic group, coenzyme and metal cofactors. Active site and its salient features. Mechanism of enzyme action. Activation energy, Lock and key hypothesis, induced fit.

Enzyme kinetics and inhibition.Substrate saturation curve, Michaelis-Menten kinetics, Lineweaver-Burke plot.Effect of pH and temperature on enzyme activity.Enzyme unit, specific activity, turnover number. Irreversible and reversible inhibition: competitive and non-competitive inhibition.Enzyme regulation. Synthesis: introduction of enzyme induction and repression. Activity: allostery, covalent modification and feedback inhibition. Multienzyme: pyruvate. dehydrogenase complex, isozymes: lactate dehydrogenase.

Unit 2: Microbial energetics and nitrogen fixation

Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, and TCA cycle. Anaplerotic reactions, gluconeogenesis, glyoxylate cycle.Mitochondrial and bacterial electron transport.Oxidation-reduction potential and energetic of electron transport.Components of respiratory chain, and their inhibitors.Anaerobic respiration, denitrification, nitrate/nitrite respiration. Oxidative phosphorylation: ATP synthesis and ATP synthase. Uncouplers, inhibitors and ionophores.Chemical coupling, conformational coupling and chemiosmotic hypotheses. Fermentations: alcohol fermentation, Pasteur effect, lactate and butyrate fermentation, Fermentation balances, branched versus linear fermentation pathways. Nitrogen Fixation - Physiology of nitrogen cycle. Assimilatory and dissimilatory nitrate reduction, biological nitrogen fixation.Nitrogen fixers and mechanism of nitrogen fixation, properties of nitrogenase, and ammonia assimilation.Genetics of nitrogen fixation and regulation of nitrogenase activity and synthesis.Alternate nitrogenase.

SEMESTER IV
GENETICS AND GENOMICS I

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1: Introduction to Mendelian genetics

Mendel's work on transmission of traits, genetic variation, molecular basis of genetic information.Interrelation between the cell structure and the genetics function.Mitosis, Meiosis (explaining Mendel's ratios).Principles of Inheritance, Chromosome theory of inheritance, Pedigree analysis, Incomplete dominance and codominance. Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance. Linkage and crossing over, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.

Unit 2

Mutation and sex determination: Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy. Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, Attached X method, DNA repair mechanisms. Chromosomal mechanisms, Environmental factors effecting sex determination, Barr bodies, Dosage compensation.

B.Sc. Microbiology, IV Semester Credits: 4

ADVANCES IN CROP BIOTECHNOLOGY

UNIT I

Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement.

UNIT II

Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc) and biotic (insect pests, fungal, viral and bacterial diseases, weeds, etc) stresses; Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc); edible vaccines, etc.

UNIT III

Molecular breeding: constructing molecular maps; integrating genetic, physical and molecular maps; diversity assessment and phylogenetic analysis; molecular tagging of genes/traits; selected examples on marker- assisted selection of qualitative and quantitative traits.

UNIT IV

Discussion on application of molecular, transformation and genomic tools for the genetic enhancement in some major field crops such as rice, wheat, cotton, maize, soybean, oilseeds, sugarcane etc.

Suggested Readings

Specific journals and published references.

SEMESTER V
IMMUNOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

(A). History and introduction to immune cells and organs: Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa . Concept of Innate and Adaptive immunity; Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

(B). Antigens and antibodies: Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies.

Unit 2

(A). Major histocompatibility complex, complement system, immune response: Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways) Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement activation. Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance.

(B). Immunological disorders and techniques: Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Characteristics of tumor antigens. Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy, RIST, RAST, MLR

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1.Identification of human blood groups.

2.To perform Total Leukocyte Count of the given blood sample.

3.To perform Differential Leukocyte Count of the given blood sample.

4.To separate serum from the blood sample (demonstration).

5.To perform immunodiffusion by Ouchterlony method.

6.To perform DOT ELISA.

7.To perform immunoelectrophoresis.

SEMESTER V
FOOD AND DAIRY MICROBIOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS
Unit 1

(A). Food as a substrate and food preservation: Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.

(B). Microbial spoilage and fermented foods: Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.

Unit 2
(A). Food borne diseases: Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum*and mycotoxins; Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli*, Salmonellosis, Shigellosis, *Yersinia enterocolitica*, *Listeria monocytogenes*and *Campylobacter jejuni*

(B). Food sanitation and water potability: Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS
1.MBRT of milk samples and their standard plate count.

2.Alkaline phosphatase test to check the efficiency of pasteurization of milk.

3.Isolation of any pathogenic bacteria (*Staphylococcus* or *Salmonella*) from food products.

4.Isolation of spoilage microorganisms from spoiled vegetables/fruits.

5.Isolation of spoilage microorganisms from bread.

6.Preparation of Yogurt/Dahi.

7.Determination of potability and feacal contamination of water samples by presumptive test/MPN test, confirmed and completed tests

SEMESTER V
BIOTECHNOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1: Introduction to biotechnology and basic DNA cloning

Milestones in genetic engineering and biotechnology. Simple cloning of DNA fragments, Vectors: Definition and properties. *E. coli* expression vectors-lac, tac and T7 promoter based vectors. Yeast expression vectors - pET yeast vectors, YIp, YEp and YCp vectors. Baculovirus based vectors. Ti based vectors (Binary and Cointegrated vectors) and cloning using linkers and adaptors. Transformation of DNA by chemical method and electroporation.

Unit 2

(A). Construction of genomic libraries: Genomic and cDNA libraries: Preparation and uses. Screening of libraries by colony hybridization and colony PCR.

(B). DNA sequencing and product of DNA technology: Maxam-Gilbert's and Sanger's method. Automated sequencing.Human genome sequencing project. Human protein replacements-insulin, hGH and Factor VIII. Human therapies - tPA, interferon, antisense molecules. Bttransgenics-rice, cotton, brinjal

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis.
2. Ligation of DNA fragments.
3. Demonstration of PCR.
4. Demonstration of DNA sequencing.
5. Interpretation of sequencing gel electropherograms.

SEMESTER V
GENETICS AND GENOMICS II

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

(A). Genetic analysis and genome dynamics:

- Conjugation; Transformation; Transduction,
- Recombination.
- Prokaryotic transposable elements- IS elements,
- Composite transposons, Uses of transposons;

(B). Genomics, bioinformatics and proteomics:

- Human genome project;
- Evolution and Comparative Genomics.
- Introduction to Bioinformatics, Gene and protein databases; Sequence similarity and alignment

Unit 2

(A). Genomic analysis:

- Genetic analysis using mutations,
- forward genetics, genomics,
- reverse genetics,
- RNAi,
- functional genomics and system biology.

(B). Population and evolutionary genetics:

- Allele frequencies,
- Genotype frequencies,
- Hardy-Weinberg Law,
- role of natural selection,
- mutation, genetic drift.
- Genetic variation and Speciation

SEMESTER V
RESEARCH METHODOLOGY AND BIOSTATISTICS

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

UNIT I

1. Introduction of research, Research ethics, Clinical issue in research, pilot survey, inclusion and exclusion criteria.
2. Research problems(questionnaire and schedule), hypotheses and type of errors, review of literature, measurement of scaling, principle of measurements of reliability and validity,
3. Sampling designing, Criteria for good samples, data types, Descriptive and analytical research.

UNIT II

1. Introduction of Biostatistics
2. Meaning, definition, characteristics of statistics
3. Parameters and Statistics, Sources of data
4. Descriptive and inferential statistics
5. Variables and their types

Unit III

Raw & array data, frequency distribution, Basic principles of graphical representation Types of diagrams - histograms, frequency polygons, frequency polygon, cumulative frequency curve, Normal probability curve .
Measurement of Central Tendency: Definition and calculation of mean - ungrouped and grouped data, Meaning & calculation of median for ungrouped and grouped data, Meaning and calculation of mode, Comparison of the Mean, Median and mode, Measurement of Dispersion: Range, Quartile deviation, Mean Deviation & Standard Deviation. Concept of Correlation & Regression

Unit IV

Test of significance: t-test, F-test, Z-test, chi square test & test of homogeneity (Normal distribution) Sampling methods, sampling and non-sampling errors

B.Sc. Microbiology, V Semester Credits: 4

ADVANCES IN MICROBIAL BIOTECHNOLOGY

UNIT I

Fermentative metabolism and development of bioprocessing technology, processing and production of recombinant products; isolation, preservation and improvement of industrially important microorganisms.

UNIT II

Immobilization of enzymes and cells; Batch, plug flow and chemostate cultures; Computer simulations; Fed-batch and mixed cultures; Scale-up principles; Down stream processing etc.

UNIT III

Current advances in production of antibiotics, vaccines, and biocides; Steroid transformation; Bioreactors; Bioprocess engineering; Production of non-microbial origin products by genetically engineered microorganisms.

UNIT IV

Concept of probiotics and applications of new tools of biotechnology for quality feed/food production; Microorganisms and proteins used in probiotics; Lactic acid bacteria as live vaccines; Factors affecting delignification; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Single cell protein, Bioinsecticides; Biofertilizers; Recent advances in microbial biotechnology.

Suggested Readings

Specific journals and published references.

SEMESTER VI
MEDICAL MICROBIOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

(A). Microflora of human body, host pathogen interaction: Skin, throat, gastrointestinal tract, urogenital tract. Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection.

(B). Sample processing, diagnostic tools, antimicrobial agents: Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes). Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria.

Unit 2 – Symptoms, pathogenesis, transmission, prophylaxis and control of -

(A). Bacterial and protozoan diseases: *Bacillus anthracis, Corynebacteriumdiphtheriae, Streptococcus pyogenes, Escherichia coli, Salmonella typhi and paratyphi, Shigelladysenteriae, Helicobacter pylori, Vibrio cholerae, Haemophilus influenza, Neisseria gonorrhoeae, Mycobacterium tuberculosis, Treponemapallidum*Protozoan: Malaria, Kala-azar, and Toxoplasmosis

(B). Viral and fungal diseases: Polio, Chicken pox, Herpes, Hepatitis, Rabies, Influenza with brief description of bird and swine flu, Dengue, AIDS, Viral cancers. An overview of emerging viral diseases: Japanese Encephalitis, Ebola, Marburg, SARS, Hanta, Nipah, Chandipura, Chikungunya. Different types of mycoses with particular reference to Dermatomycoses and Opportunistic mycoses.

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1.To identify pathogenic bacteria (any three of *E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus*) based on cultural, morphological and biochemicalcharacteristics.

2.Cultural characteristics on nutrient agar and in nutrient broth, Gram characteristic, motility, presence of endospore and capsule, IMViC, TSI, sugar fermentation, nitrate reduction, urease production, oxidase and catalase tests.

3.To study composition and use of important differential media for identification of pathogenic bacteria

4.EMB agar, McConkey agar, TCBS agar and Salmonella-Shigella agar (any two)

5.To perform antibacterial testing by Kirby-Bauer method

6.To study symptoms of the diseases with the help of photographs - Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis, kaposi's sarcoma), dermatomycoses (ring worms), kala-azar

SEMESTER VI
INDUSTRIAL MICROBIOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS

Unit 1

(A). Introduction, fermentation and fermentors: Brief history and developments in industrial microbiology. Solid-state and liquid-state (stationary and submerged) fermentations; Batch, fedbatch and continuous fermentations. Components of a typical bioreactor, types of bioreactors-Laboratory, pilot- scale and production fermenters; constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter.

(B). Overview on industrial fermentation- measurement of parameters, isolation of strains, media and ingredients: pH, temperature, dissolved oxygen, foaming and aeration. Primary and secondary screening, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract.

Unit 2

(A). Downstream processing: Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying

(B). Microbial production of industrial products: Citric acid, ethanol, penicillin, glutamic acid, riboflavin, enzymes (amylase, cellulase, protease, lipase, glucose isomerase, glucose oxidase), wine, beer, bioinsecticides (Bt) and Steroid transformations

PRACTICAL

L T P -- CREDITS
– 2

EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1. Microbial fermentations for the production and estimation (qualitative and quantitative) of:

(a) Enzyme: Amylase
(b) Amino acid: Glutamic acid
(c) Organic acid: Citric acid
(d) Alcohol: Ethanol
(e) Antibiotic: Penicillin

2. A visit to any educational institute/industry to see an industrial fermentor, and other downstream processing operations

SEMESTER VI

RECOMBINANT DNA TECHNOLOGY

L T P -- CREDITS
3 1 – 4
EXAMINATION: 60 MARKS
INT ASSESSMENT: 40 MARKS
TOTAL MARKS: 100 MARKS
DURATION OF EXAM: 3 HOURS
Unit 1: Tools of recombinant DNA technology

(A). Hosts and enzymes:*Agrobacterium*-mediated delivery *E. coli* strains; Yeast (*Saccharomyces cerevisiae, Pichiapastoris*); Fungi (*Penicillium*, *Aspergillus*); Mammalian cell lines - names and genotypes. Restriction modification systems: Types I, II and III. Mode of action, nomenclature.Application of Type II restriction enzymes in genetic engineering. DNA modifying enzymes and their applications: Terminal deoxynucleotidyltransferase, kinases and phosphatases, DNA ligases and DNA polymerases, reverse transcriptases, bacteriophage RNA polymerases, exonuclease III, BAL31, mung bean nuclease, S1 nuclease.

(B). Vectors: Cloning Vectors- Definition and Properties. Plasmid vectors-pBR and pUC series, Bacteriophage lambda and M13 based vectors. Cosmids.Shuttle vectors.BACs, YACs, MACs.*Mammalian Expression Vectors*- SV40, Vaccinia, Retroviral promoter based vectors.

Unit 2

(A). Gene delivery and amplification of nucleic acids: Microinjection, biolistic method (gene gun), liposome and viral-mediated delivery, *Agrobacterium*-mediated delivery Polymerase chain reaction - enzymes used, primer design. Cloning PCR products.RT-PCR and principles of real time PCR.Ligation chain reaction.

(B). Analytical methods and DNA typing: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot and colony hybridizations. Chromosome walking and

jumping.DNA fingerprinting by RFLP and RAPD. Gel retardation assays. DNA footprinting by DNase I, DNA microarray analysis.SDS-PAGE and Western blotting.Phage display.

PRACTICAL

L T P -- CREDITS
– 2
EXAMINATION: 30 MARKS
INT ASSESSMENT: 20 MARKS
TOTAL MARKS: 50 MARKS

1. DNA isolation and agarose gel electrophoresis
2. Primer designing for PCR.
3. Demonstration of DNA amplification by PCR technique
4. Western blotting technique
5. Southern and northern blotting technique.
6. Demonstration of DNA finger printing by RFLP and RAPD technique.

SEMESTER VI

Technical Writing (2 credits)

A summary and review of minimum5 peer reviewed research paper is to be done on a topic of interest. Every part of paper to be critically reviewed and inference explained in the form of a report. Report of the work to be submitted before commencement of end semester exam along with seminar presentation as part of practical evaluation.

B.Sc. Microbiology, VI Semester
Nano-Biotechnology
Credits: 4

1. Introduction to Nano-Biotechnology; Nanotechnology definition and concepts; Cellular Nanostructures; Nanopores; Biomolecular motors; Criteria for suitability of nanostructures for biological applications

2. Basic characterization techniques; Electron microscopy; Atomic force microscopy; Photon correlation spectroscopy

3. Thin films; Colloidal nanostructures; Nanovesicles; Nanospheres; Nanocapsules

4. Nanostructures for drug delivery, concepts, targeting, routes of delivery and advantages

5. Nanostructures for diagnostics and biosensors; Nanoparticles for diagnostics and imaging; Nanodevices for sensor development

Texts books/References

1. Multilayer Thin Films, Editor(s): GeroDecher, Joseph B. Schlenoff Publisher: Wiley-VCH Verlag GmbH & Co. KGaA ISBN: 3527304401

2. Bionanotechnology: Lessons from Nature Author: David S.Goodsell Publisher: Wiley- Liss ISBN: 047141719X

3. Biomedical Nanotechnology Editor: Neelina H. Malsch Publisher: CRC Press ISBN: 0- 8247-2579-4