

SARDAR PATEL UNIVERSITY
T. Y. B. Sc. - MICROBIOLOGY
MI – 301 Microbial Genetics
(Effective from June 2008)

Unit : 1

- Model systems for studying microbial genetics (*E.coli* & *Yeast*)
- Nature of gene structure and functions.
- Melting curve of DNA and T_m value determination
- Buoyant density of DNA and its relationship with mole % G + C content in DNA.
- Organization of Eukaryotic chromosome & mechanism
- Gene Transcription as 1st step of gene expression – Molecular mechanism of transcription, Role of RNA polymerase, Initiation, Elongation and Termination of RNA synthesis, Post-transcriptional modification of RNA.
- RNA dependent synthesis of RNA & DNA.

Unit : 2

- Replication of DNA:
 - Conservative, Semi-conservative and dispersive mode of replication.
 - Messelson and Stahl experiment.
 - DNA Topology (Super coiling of DNA and Linking number)
 - Enzymes involved in replication of DNA.
 - Molecular mechanism of chromosome replication
 - Models of chromosome replication – Cairn's model, Rolling circle model.
 - Replication of eukaryotic DNA.

Unit : 3

- Translation and Regulation of gene expression:
 - Genetic code:
 - Basic feature of genetic code (biological significance of Degeneracy, Wobble hypothesis, genes within genes, overlapping genes) and Deciphering of genetic code.
 - Gene translation :
 - Ribosomes : their general nature, structure and role in protein synthesis, charging of t-RNAs, initiation, elongation and termination of protein synthesis in prokaryotes.
 - Posttranslational modification of polypeptides.
 - Regulation of gene expression (Lac Operon).

Unit : 4

- DNA mutation and Repair:
 - Types of mutations.
 - Evidence of spontaneous nature of mutation – Fluctuation test, Newcomb's experiment and Replica plating.
 - Methods of isolation of auxotrophic mutants, drug resistant mutants and phage resistant mutants.
 - Mode of action of physical, chemical and biological mutagens (UV rays, Nitrous acid, 5-bromouracil, 2-aminopurin, EMS, EES and Mu phage).

- Reversion of mutation: True reversion, Suppression and types of suppressor mutation.
- DNA repair mechanisms (Photo reactivation, Excision, Mismatch, SOS repair and dealkylation repair).
- Mutagenicity and carcinogenicity test: AMES test.

Unit : 5

- Genetic Recombination:
 - Types of recombination, Holiday model of recombination.
- Modes of gene transfer in bacteria:
 - Transformation: Natural transformation (*Streptococcus pneumoniae* & *Haemophilus influenzae*) competence, DNA uptake, role of natural transformation, artificially induced competence, application of transformation.
 - Conjugation: self transmissible plasmids, F-factor, Hfr and F⁺ strains, process of conjugation, chromosome mobilization, conjugation system in Gram positive bacteria, interrupted mating and mapping of gene.
 - Transduction: generalized and specialized transduction (phage P1 and lambda along with molecular mechanism).
 - Transposons: Structure and types of bacterial transposons- replicative (Tn₃), non-replicative (Tn₁₀), mechanism of transposition.

Unit : 6

- One step growth experiment, Single burst experiment, Doermann's premature lysis experiment.
- Organization of λ genome.
- Multiplication of λ phage (Decision between lytic and lysogeny cycle)
- Phage mutant (Plaque type mutant, Host range mutant and Conditional lethal mutant)
- Phenotypic mixing.
- Host induced modification.
- Viral Complementation.
- Viroids and Prions.

References:

1. Molecular Biology of Gene – Watson *et al.*
2. Genes VI and VII - B. Lewin
3. The genetics of Bacteria and their Viruses – William Hays.
4. Molecular Genetics – Stent & Calendar
5. Molecular Biology – David Freifelder.
6. Microbial Genetics – David Freifelder.
7. Microbiology – Prescott, L. M.
8. General Microbiology – Stanier, R. Y.
9. Principles of Biochemistry – Lehninger, A.
10. Biochemistry – Stryer, L.
11. Biochemistry – Voett & Voett.

SARDAR PATEL UNIVERSITY
T. Y. B. Sc. - MICROBIOLOGY
MI – 302 Tools And Techniques in Molecular Biology
(Effective from June 2008)

Unit : 1

- Basic Organization of Computer (Hardware, Software, Bit, Byte, Computer memory, Binary code, Binary system)
- Biostatistics :
 - Principles of Biostatistics, classification of data, Tabulation and Graphical representation.
 - Measure of Central tendency, Mean, Mode, Median – Merits and Demerits.
 - Measure of dispersion range, Mean deviation, variance and standard deviation.
- Bioinformatics :
 - Introduction to Bioinformatics.
 - Databases.
 - Applications of Bioinformatics.

Unit : 2

- Colorimetry And Spectrophotometry :
 - Principle, Instrumentation method and applications of UV-Visible spectroscopy, Atomic absorption Spectroscopy, Flame photometry, IR spectroscopy.
- Electrophoresis :
 - Principle, Support media, method and applications of electrophoresis separation of protein and nucleic acids (PAGE, SDS-PAGE, Agarose, IEF).

Unit : 3

- Chromatography :
 - Introduction, definition and types of chromatography, general principles underlying chromatographic techniques, working and applications.
 - Thin layer Chromatography.
 - Adsorption chromatography.
 - Ion exchange chromatography.
 - Molecular sieve chromatography.
 - Gas liquid chromatography/ Gas solid chromatography.
 - HPLC
 - Affinity chromatography.
- Centrifugation :
 - Basic principles of sedimentation.
 - Methods and applications of density gradient centrifugation (Rate zonal and Isopycnic) and ultracentrifugation (Introduction and applications).

Unit : 4

- Radio activity and Measurement :
 - Nature of radioactivity, safety aspects and applications.
- Immunological techniques :

- Immunodiffusion, Immunoelectrophoresis.
- RIA, ELISA, Western blotting, Immunofluorescence.
- Immobilization of enzymes and cells – methods and applications.

- Biosensors - their Principle, method and applications.
- Protein purification – case study of membrane bound and soluble protein purification.

Unit : 5

- Outline of genetic manipulations.
- Isolation of Nucleic acids.
- Restriction Endonucleases – Classification and applications.
- Ligases and Ligation (Cohesive and Blunt end ligation).
- Cloning Vectors :
 - Properties of vectors, Plasmid, phage, cosmids, phagemids, BAC and YAC.
- Polymerase Chain Reaction – basic process, advantages, limitations and applications.
- Concept of genomic and c-DNA library preparations.
- Methods for introduction of DNA into host cell: transformation, transduction, tranfection, electroporation and electron gun.

Unit : 6

- Molecular tools for genetic analysis :
 - DNA fingerprinting, DNA Foot printing, RFLP, Northern and Southern hybridization.
- Introduction to Oligonucleotide probes, labeling of probes.
- Detection of recombinant clones – colony hybridization, FISH, use of reporter gene, Marker inactivation.
- Introduction to Genomics and Proteomics.
- DNA and protein sequencing.
- Concept of Microarray.
- Application of genetic engineering.

References :

1. Biotechnology and Genetic Engineering – P.K. Gupta
2. Methods in Biostatistics – B. K. Mahajan
3. Computer fundamentals – P.K. Sinha
4. A Biologist Guide to principles and techniques of practical biochemistry – Wilson & Goulding
5. Practical Biochemistry and Molecular Biology – Wilson & Walker
6. Analytical Biochemistry Separation techniques – P. Palanivelu.
7. Instrument and Analytical techniques – Chatwal and Anand
8. Microbiology – Prescott, L. M.
9. Immunology – Janis Kuby
10. Medical Microbiology – Ananthnarayan and Panicker

11. Genomes 2 – T. A. Brown
12. Biotechnology – B. D. Singh
13. Lehninger's Biochemistry – Nelson and Cox
14. Biochemistry – Stryer, L.
15. Bioinformatics – A Beginners Guide – Notredam and Clavarie.
16. www.Expasy.com
17. www.ncbi.nlm.nih.gov

SARDAR PATEL UNIVERSITY
T. Y. B. Sc. - MICROBIOLOGY
MI – 303 Microbial Biochemistry
(Effective from June 2008)

Unit : 1

- Carbohydrate and Lipid metabolism.
 - EMP, PP & ED pathway of glucose catabolism.
 - Reaction and energies of TCA cycle and its importance.
 - Amphibolic nature of TCA, Anapleuretic reaction and glyoxylate cycle.
 - Regulation of glycolysis and TCA cycle.
 - Beta-oxidation of saturated and unsaturated fatty acids and its energetics.
- Biosynthesis:
 - Gluconeogenesis.
 - CO₂ fixation – Calvin Benson cycle.
 - Biosynthesis of saturated and unsaturated fatty acids.

Unit : 2

- Amino acids and Nucleic acid metabolism:
 - Biosynthesis of amino acids: Aspartate family and Aromatic family
 - de Novo synthesis and Regulation of purine and pyrimidine ribonucleotides.
 - Formation of deoxy ribonucleotides.
- Catabolism:
 - Transamination, oxidative deamination, decarboxylation.
 - Urea cycle , Stickland reaction.
 - Catabolism of purines and pyrimidines.

Unit : 3

- Energy metabolism:
 - Introduction to metabolism.
 - Methods of studying intermediary metabolism
 - Principles of Bioenergetics
 - ATP (Structure, generation, & role)
 - Modes of ATP generation in bacteria: ETC –components and organization.
 - Oxidative phosphorylation – inhibitors of oxidative phosphorylation.
 - Chemiosmotic theory
 - ATP synthase
 - Fermentation and substrate level phosphorylation
 - Anaerobic respiration.
 - Bacterial photosynthesis: photosynthetic apparatus and photophosphorylation.

Unit : 4

- Enzymology:
 - Structure and Properties of enzymes
 - Classification of enzymes

- Strategies for purification of enzymes
- Introduction to active site and enzyme specificity
- Mechanism of Lysozyme.
- Kinetics of first and zero order reaction
- Factors affecting the enzyme action
- M-M equation-Determination of K_m , V_{max} and K_{cat} .
Double reciprocal plots.
- Enzyme activation and enzyme inhibition.
- Multisubstrate reaction (Random orders, sequential and pingpong).
- Role of vitamins as co-enzymes.
- Regulation of enzyme action (Allosteric enzyme and its regulation.
Feed-back inhibition and its variation, Covalent modification, Zymogen).
- Introduction to isoenzymes.

Unit : 5

- Membrane Transport:
 - Membrane structure: fluid mosaic model, Fick's law
 - Nutrient Transport across Membrane: simple diffusion, porins facilitated diffusion, porter molecules, active transport, Sodium-potassium pumps, group translocation.
 - Siderophores (metal transport)
 - Membrane transport receptors.
 - Signal peptides
- Bacteriorhodopsin.
- Biosynthesis of peptidoglycan

Unit : 6

- Concept of chemotherapy:
 - Nature of target site/biochemical system affected by antimicrobial agents
 - Antibiotics inhibiting growth of microorganisms-penicillin, cycloserine. bacitracin, streptomycin. Fusidic acid, puromycin, tetracycline. actinomycin, chloramphenicol, polymixin, amphotericin-B. amantidine, acyclovir, zidovudine, (AZT) and sulphonamides.
 - Mechanism of resistance to antibiotics (penicillin and streptomycin)
- Some related aspects of metabolism in specific microbial system
 - Bioluminescence
 - Chemotaxis
 - Energy metabolism in methanogens
 - Assimilatory reduction of nitrates and sulphate

Reference:

1. Principles of Biochemistry – Lehninger 2nd edition
2. Biochemistry – Zubay, G. L.
3. Biochemistry – Stryer, L.
4. General Microbiology – Stanier, R. Y.
5. Principles of Microbiology – Ronald M. Atlas
6. Biochemistry – Voett and Voett
7. Elementary Microbiology – H. A. Modi

8. Microbiology – Prescott, L. M.
9. Microbiology Vol. I & II – Powar & Daginawala
10. Biochemistry – S. Satyanarayana
11. www.expasy.ch/tools/pathways

SARDAR PATEL UNIVERSITY
T. Y. B. Sc. - MICROBIOLOGY
MI – 304 Immunology and Clinical Microbiology
(Effective from June 2008)

Unit : 1

- Micro flora of healthy human host.
 - Role, origin & establishment.
 - Normal flora of different systems.
 - Gnotobiosis.
- Host Microbe interactions.
 - Pathogenicity, virulence & infection.
 - Microbial adherence.
 - Penetration of epithelial layers.
 - Microbial virulence factors.
 - Nonspecific defences – Phagocytosis, Inflammation, Complement.
- Natural & Acquired immunity.

Unit : 2

- Antigen : properties & Types.
- Antibodies : Structure of Immunoglobulin
 - Immunoglobulin classes
- Antigen-Antibody Reactions :
 - General features
 - Zone phenomenon (Lattice hypothesis)
 - Types of Antigen –Antibody reactions:
 - * Precipitation Reaction in liquid medium: ring test, slide test & tube test
 - * Agglutination-slide & tube agglutination test, Bacterial agglutination, Hemagglutination, Passive agglutination, agglutination inhibition test
 - * Toxin-Antitoxin reactions
 - * Complement fixation test

Unit : 3

- Lymphoreticular System :
 - Primary & Secondary immune organs.
 - Cells of lymphoreticularsystem.
- Immune response : Humoral & cell mediated immune responses.
 - Primary & secondary responses.
- Immune response against T-cell dependent antigens (MHC restriction, APC, Antigen presentation, T & B Cell activation, Cytokines)
- Factors influencing Antibody production.
- Monoclonal Antibodies.
- Clonal selection Theory.
- Genetic basis of Antibody diversity.

Unit :4

- Vaccines

- Immunodeficiency
- Autoimmunity
 - Mechanism
 - Classification of Autoimmune diseases
- Hypersensitivity.
- Transplantation Immunology
 - Classification of Transplants.
 - MHC antigens, HLA typing,
 - Host Vs Graft reaction, Graft Vs Host reaction
 - Immunosuppression.
- Tumor immunology.

Unit : 5

- Hematology: Components of blood & their functions, Hematopoiesis, Homeostasis and anticoagulants.
- Immunohematology – ABO & Rh blood group system; Blood grouping, cross matching, Coomb's test.
- Principles of blood banking & safety in blood transfusion.
- Clinical Biochemistry.
 - Kidney function tests, Significance of Creatinine, urea & uric acid.
 - Liver function tests: Significance of Bilirubin SGPT, SGOT, Alkaline phosphatase, proteins, albumin and globulin.
 - Cardiac function tests: Phosphokinase, Cholesterol, Triglycerides, Serum electrolytes & blood sugar.
- Clinical Microbiology:
 - Collection of specimen, handling & transport.
 - Methods of diagnosis: Microscopic, cultural application of biochemical reactions, Phage typing, Antibigram

Unit : 6

- Principles of Epidemiology.
- Causative agent, Symptoms, pathogenesis, transmission, Laboratory diagnosis, Treatment and prevention of
 - Malaria
 - Tuberculosis
 - Enteric fever (Typhoid)
 - AIDS.

Reference:

1. Textbook of Microbiology – Ananthnarayan & Paniker
2. Medical Microbiology – N. C. Dey
3. Kuby Immunology – Goldby, Kindt & Osborne
4. Medical Laboratory Technology – K. L. Mukherjee
5. Textbook of Medical Laboratory technology – P. B. Godkar
6. Human Physiology – Chatterjee, C. C.
7. Microbiology – Pelczar & Reid
8. Microbiology – Prescott, L.

SARDAR PATEL UNIVERSITY
T. Y. B. Sc. - MICROBIOLOGY
MI – 305 Agricultural and Environmental Microbiology
(Effective from June 2008)

Unit : 1

- Soil Microbiology:
 - Microbial flora of soil
 - Rhizosphere
 - Humus (Definition, Decomposition, Formation, Significance)
 - Carbon Cycle
 - Green House effect
 - Phosphorus Cycle
 - Sulfur Cycle
 - Iron Cycle
 - Methods of studying soil flora

Unit : 2

- Nitrogen Cycle
- Symbiotic and Asymbiotic N₂ fixation
- Nitrogenase (structure, mechanism, /regulation)
- Biofertilizers :
 - Definition, Azotobacter, Rhizobium (including production aspects)
 - Phosphate solubilizing microorganisms
 - Organic matter decomposer
- Biopesticides

Unit : 3

- Microbial Ecology
 - Communities and Ecosystems
 - Population interactions
 - Consortia & Biofilms
 - Study of non-culturable microorganisms.
 - Winogradsky's column

Unit : 4

- Concept of xenobiotics and recalcitrance.
- Biomagnification.
- Biodegradation of environmental pollutants
- Biodegradable polymers
- Biodeterioration of wood, paints and metals
- Bioleaching of copper

Unit : 5

- Water and waste water microbiology:
 - The microbial community in marine and freshwater environment
 - Microbiological analysis of water (include role of indicator microorganism from water analysis)
 - Waste water characteristics :
physical characteristics, total solids.
Inorganic components
Gases
Organic components (BOD, COD & TOC)
 - Waste water treatment process
 - Solid waste disposal: Sanitary land fills, Composting.

Unit : 6

- Plant Microbe interactions
 - General symptoms of plant diseases
 - Pathogenesis, Enzymes, Toxins.
 - Biochemical defense mechanism in plants
 - Transmission of plant diseases

References :

1. Soil Microbiology – M. Alexander
2. Advances in Agriculture Microbiology – N. S. Subbarao
3. Plant Pathology – R. S. Malhotra
4. Plant Pathology – R. S. Singh
5. Modern Plant Pathology – Bilgrami & Dube
6. Principles of Microbiology – R. M. Atlas
7. Microbiology – Pelczar and Reid
8. Biological waste water treatment system – Horan
9. Waste water Engineering – Eddy Metcalf
10. Biofertilizers and Organic farming – Vyas & Modi
11. Microbiology – Prescott, L. M.
12. Microbial Biogeochemistry – J. E. Zajic
13. Introduction to Biodeterioration – D. Allsopp & Kenneth J. Seal

SARDAR PATEL UNIVERSITY
T. Y. B. Sc. - MICROBIOLOGY
MI – 306 Food and Industrial Microbiology
(Effective from June 2008)

Unit : 1

- Characteristics of industrially important microorganisms.
- Screening: Primary screening (organic acid, Enzymes, Vitamins & Amino acid producers), Secondary screening and its significance.
- Strain improvement strategies: Selection of natural variants, induced mutations (Physical & Chemical Mutagen), recombination (in bacteria, parasexual cycle, protoplast fusion) & genetic engineering.
Improvement of strain by modifying properties other than the yield of product.
Regulations of metabolic pathways.
Isolation of mutants producing primary & secondary metabolite.

Unit : 2

- Ideal characteristics of fermentation medium.
- Raw materials of fermentation medium- C, N, Minerals, precursors, metabolic regulators and water.
- Fermentor design.
- Types of Bioreactors – Stirred tank reactors, Fluidized bed reactors, Air-lift fermentor.
- Types of fermentation: Surface & submerged fermentation (batch, fed-batch and continuous fermentation) & solid state fermentation.
- Monitoring & Control of process parameters: Temperature, pH, dissolved oxygen, pressure and foam.

Unit : 3

- Inoculum development and its addition.
- Introduction to mass transfer of oxygen and factors affecting it.
- Sterilization of medium.
- Sterilization of air.
- Sampling.
- Antifoam agents
- Scale up.

Unit : 4

- Separation of cells by filtration and centrifugation.
- Disruption of microbial cells.
- Product recovery by solvent extraction, precipitation, reverse osmosis, ultra filtration and chromatography.
- Quality control of fermentation products : LAL tests for pyrogen testing.
Sterility testing.

- Bioassay of Fermentation products.
- Fermentation economics.

Unit : 5

Fermentative production of:

- Penicillin and its conversion to semisynthetic penicillin.
- Glutamic acid.
- Cyanocobalamine.
- Acetone-butanoi-ethanol.
- Amylase.
- Gluconic acid.
- Beer production.
- Vinegar production.

Unit : 6

- Extrinsic and Intrinsic parameters affecting food spoilage.
- Principles of food preservation: Asepsis, removal of microorganisms, anaerobic condition, high and low temperature, dessication, use of chemical preservatives, food additives and radiation.
- Food poisoning by *Clostridium botulinum* and *Staphylococcus aureus*.
- Spoilage of milk.
- Production of cheese, baker's yeast.

Reference :

1. Industrial Microbiology – Casida, L. E.
2. Industrial Microbiology – A. H. Patel
3. Industrial Microbiology – Prescott & Dunn
4. Principles of Fermentation technology – Stanbury, Whitaker and Hall
5. Microbial technology Vol. I & II – Pepllar and Perlman
6. Food Microbiology – James Jay
7. Food Microbiology – Frazier, W. C.

SARDAR PATEL UNIVERSITY
Microbiology Practical
MI-307
(Effective from June 2008)

1. Study of microbiocidal effect of UV rays.
2. Isolation of antibiotic resistant mutants by grid technique.
3. Isolation of auxotrophic mutants by grid technique.
4. Titration of bacteriophage.
5. Determination of generation time of *E.coli*.
6. Bioassay of streptomycin.
7. Isolation of *Azotobacter*.
8. Isolation of *Rhizobium*.
9. Isolation of Actinomycetes.
10. Screening of Amylase and Organic acid producing organisms.
11. Pure culture study of *E.coli*, *Enterobacter aerogenes*, *Salmonella typhi*,
S. typhi para-B, *Proteus vulgaris*, *Pseudomonas aeruginosa*.
12. Bacteriological analysis of water :
 - Qualitative & Quantitative analysis.
 - Detection of coliform (presumptive, confirmed and completed test).
13. Bacteriological analysis of milk – Qualitative & Quantitative.
14. Demonstration of sterility testing.
15. Demonstration of Winogradsky column.

SARDAR PATEL UNIVERSITY
Microbiology Practical
MI-308
(Effective from June 2008)

1. Blood grouping and cross matching for Blood transfusion.
2. Hemoglobin estimation by Sahli's method.
3. Total count of W.B.Cs.
4. Differential count of leukocytes.
5. Widal slide agglutination test – qualitative (demonstration of quantitative test)
6. Estimation of blood glucose by GOD/POD method.
7. Estimation of serum urea.
8. Estimation of total serum cholesterol.
9. Estimation of serum Creatinine.
10. Chemical analysis of urine.
11. Study of antibiogram of *Salmonella typhi* and determination of MIC of an effective antibiotic.
12. Demonstration of immunodiffusion and Immunoelectrophoresis.
13. Study of permanent slides of malarial parasites.

SARDAR PATEL UNIVERSITY
Microbiology Practical
MI-309
(Effective from June 2008)

1. Estimation of reducing sugar by DNS method.
2. Estimation of reducing sugar in Jaggery by Cole's method.
3. Protein estimation by Folin's method.
4. Ethanol estimation by Dichromate method.
5. Ribose estimation.
6. Measurement of rate of aeration by Sulphite oxidation method.
7. Determination of dissolved oxygen by Wrinkler's method.
8. Estimation of gluconic acid by titrimetric method.
9. Study of progress curve of an enzyme.
10. Separation and identification of amino acids by TLC.
11. Demonstration of isolation of chromosomal DNA.
12. Introduction to Public Health Management in India.