VIROLOGY

THEORY **Marks: 100**

Unit 1 **Introduction** **(Ch 1 Flint, Ch 1 Wagner and Hewlett) (6 periods)**

Discovery of viruses, nature and definition of viruses, general properties of viruses. Concept of viroids, virusoids, satellite viruses and prions. Theories of viral origin

Unit 2 **Structure of viruses**

(Ch 3 Carter and Saunders, Ch 3 Dimmock *et al*., Ch 4 Flint) (3 periods)

Capsid symmetry, enveloped and non-enveloped viruses

Unit 3 **Isolation, purification and cultivation of viruses (Ch 11 Wagner and Hewlett) (2 periods)**

Unit 4 **Viral Taxonomy**

(Ch 3, 10 Carter and Saunders, Appendices Dimmock *et al*.) (6 periods)

Classification and nomenclature of different groups of viruses infecting microbes, plants and animals

Unit 5 **Salient features of viral genomes** **(5 periods)**

(Ch 4, Dimmock and Primrose, Appendix Flint)

Unusual bases (TMV, T4 phage), overlapping genes (ΦX174, Hepatitis B virus), alternate splicing (Picornavirus), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), ambisense genomes (arenavirus), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (influenza virus) and non segmented genomes (picornavirus), capping and tailing (TMV).

Unit 6 **Bacteriophages** **(6 periods)**

(Ch 5, 9, 15 Dimmock *et al*, Ch 19 Carter and Saunders)

Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda and P1 phage), concept of early and late proteins, regulation of transcription in lambda phage and applications of bacteriophages.

Unit 7 **Viral multiplication and replication strategies** **(8 periods)**

(Ch 5,6, 7, 8, 9, 10 Dimmock *et al*)

Interaction of viruses with cellular receptors and entry of viruses.
Replication strategies of viruses as per Baltimore classification.
Assembly, maturation and release of virions.
Concept of defective particles

Unit 8 **Transmission of viruses** **(Ch 4 Carter and Saunders, Ch 11 Mathews) (2 periods)**

Persistent and non-persistent mode

Unit 9 **Oncogenic viruses** **(Ch 20 Dimmock *et al*., Ch 18 Flint) (3 periods)**

Types of oncogenic DNA and RNA viruses. Concepts of oncogenes, proto-

oncogenes and tumor suppressor genes

Unit 10 Prevention and control of viral diseases

(Ch 21 Dimmock *et al*, Ch 19 Flint) (5 periods)

Antiviral compounds, interferons and viral vaccines.

Unit 11 Applications of Virology

(Ch 23 Dimmock *et al*, Ch 22 Wagner) (1 period)

Use of viral vectors in cloning and expression, Gene therapy and Phage display

Paper 9-MIHP 304
VIROLOGY

PRACTICALS Marks: 50

1. To study structure of important animal viruses (rhabdo, influenza, paramyxo, Hepatitis B & retroviruses) using electron micrographs
2. To study structure of important plant viruses (caulimo, gemini, tobacco ring spot, cucumber mosaic & alpha-alpha mosaic viruses) using electron micrographs
3. To study structure of important bacterial viruses (λ, T4 & ϕX174) using electron micrographs
4. Isolation and enumeration of bacteriophages from water/sewage sample using double agar layer technique
5. Isolation and propagation of animal viruses by cell culture and chick embryo techniques
6. Study of cytopathic effects using photographs
7. To perform local lesion technique for assaying plant viruses

SUGGESTED READINGS

1. Dimmock NJ, and Primrose SB. (1994). *Introduction to Modern Virology*. 4th edition. Blackwell Science Ltd.
2. Dimmock, NJ, Easton, AL, Leppard, KN (2007). *Introduction to Modern Virology*. 6th edition (First Indian reprint 2007), Blackwell Publishing Ltd.
3. Carter J and Saunders V (2007). *Virology: Principles and Applications*. John Wiley and Sons.
4. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). *Principles of Virology, Molecular biology, Pathogenesis and Control*. 2nd edition. ASM press Washington DC.
5. Levy JA, Conrat HF, Owens RA. (2000). *Virology*. 3rd edition. Prentice Hall publication, New Jersey.
6. Wagner EK, Hewlett MJ. (2004). *Basic Virology*. 2nd edition. Blackwell Publishing.
7. Mathews. (2004). *Plant Virology*. Hull R. Academic Press, New York.
8. Nayudu MV. (2008). *Plant Viruses*. Tata McGraw Hill, India.

9. Bos L. 1999 Plant viruses-A text book of plant virology by. Backhuys Publishers.
10. Versteeg J. (1985). *A Color Atlas of Virology*. Wolfe Medical Publication.

Paper 10-MIHT 305

MICROBIAL PHYSIOLOGY AND METABOLISM-I

THEORY **Marks: 100**

Unit 1 **Nutritional classification of microorganisms** based on carbon, energy and electron sources **(Ch 1 Gottschalk, Ch 5 Willey *et al.*) (1 Period)**

Unit 2 **Metabolite Transport** **(Ch 5 Gottschalk, Ch 9 Moat *et al.*) (6 Periods)**
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.

Unit 3 **Microbial Growth**
(Ch 7 Stanier *et al.*, Ch 6 Willey *et al.*) (12 Periods)
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.

Unit 4 **Measurement of microbial growth** **(Ch 7 Willey *et al.*) (2 periods)**
Measurement of cell numbers, cell mass and metabolic activity

Unit 5 **Effect of the environment on microbial growth**
(Ch 18 Moat & Foster, Ch 8 Stanier *et al.*, Ch 6 Willey *et al.*) (8 Periods)
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 6 **Chemolithotrophic metabolism** **(Ch 8 & 9 Gottschalk, Ch 12, 17 Madigan *et al.*) (5 Periods)**
Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogen-oxidizing bacteria and methanogens.

Unit 7 **Phototrophic metabolism** **(Ch 9 Gottschalk) (12 periods)**
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.

Unit 8 **Carbon dioxide fixation** **(Ch 9 Gottschalk) (2 periods)**
Calvin cycle and reductive TCA cycle.

Paper 10-MIHP 305

MICROBIAL PHYSIOLOGY AND METABOLISM-I

PRACTICALS Marks: 50

1. To study and plot the growth curve of *E coli* using turbidometric method and to calculate specific growth rate and generation time.
2. To study and plot the growth curve of *Aspergillus niger* by radial growth measurements.
3. To study the effect of pH on the growth of *E. coli*
4. To study the effect of temperature of *Aspergillus niger* by dry weight method.
5. Demonstration of the thermal death time and decimal reduction time of *E. coli.*

SUGGESTED READINGS

1. Devlin RM. (1975). *Plant Physiology*. 3rd edition, Willard Grant Press.
2. Gottschalk G. (1986). *Bacterial Metabolism*. 2nd edition. Springer Verlag
3. Madigan MT, Martinko JM and Parker J. (2003). *Brock Biology of Microorganisms*. 10th edition. Pearson/ Benjamin Cummings.
4. Moat AG and Foster JW. (2002). *Microbial Physiology*. 4th edition. John Wiley & Sons.
5. Reddy SR and Reddy SM. (2005). *Microbial Physiology*. Scientific Publishers India.
6. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). *General Microbiology*. 5th edition, McMillan Press.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.

Paper 11-CBHT 301

CELL BIOLOGY-I

THEORY **Marks: 100**

Unit 1. An Overview of Cells **(Ch 1 Cooper *et al.*/ Ch 1 Karp)**

Overview of prokaryotic and eukaryotic cells, cell size and shape, Phages, Viriods, Mycoplasma and *Escherichia coli*.

Unit 2. Tools and techniques of Cell Biology

(Ch 1 Cooper *et al.*/ Ch 18 Karp/ Ch 3 De Robertis

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 3. Composition of Cells **(Ch 2 Cooper *et al.*)**

Molecules of cell, cell membranes and cell Proteins.

Unit 4. The Nucleus **(Ch 9 Cooper *et al.*)**

Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin: molecular organization, Nucleolus and rRNA Processing.

Unit 5. Protein Sorting and Transport **(Ch 10 Cooper *et al.*)**

The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport, Lysosomes.

Unit 6. Mitochondria, Chloroplasts and Peroxisomes **(Ch 11 Cooper *et al.*)**

Structural organization, Function, Marker enzymes,Mitochondrial biogenesis, Protein import in mitochondria, Semiautonomous nature of mitochondria and chloroplast, chloroplast DNA, Peroxisomes'assembly

Unit 7. Cytoskeleton and Cell Movement **(Ch 12 Cooper *et al.*)**

Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules.

Paper 11-CBHP 301
CELL BIOLOGY-I

PRACTICALS Marks: 50

1. Separation of nucleic acid bases by paper chromatography.
2. Microscopy- Theoretical knowledge of Light and Electron microscope.
3. Study of the following techniques through electron / photo micrographs: Fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching, shadow casting.
4. Study of structure of cell organelles through electron micrographs.

Permanent slide preparation:

5. Cytochemical staining of DNA-Feulgen.
6. Cytochemical staining of DNA and RNA- Methyl Green Pyronin (MGP).
7. Cytochemical staining of Polysaccharides-Periodic Acid Schiff's (PAS).
8. Cytochemical staining of Total proteins- Bromophenol blue.
9. Cytochemical staining of Histones -Fast Green.

SUGGESTED READINGS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

Paper 12-MBHT 301
MOLECULAR BIOLOGY-I

THEORY **Marks: 100**

Unit 1. Nucleic Acids convey Genetic Information (Ch 2 Watson)

DNA as the carrier of genetic information, Key experiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis, Genomics.

Unit 2. The Structures of DNA and RNA / Genetic Material
(Ch 6 Watson/ Ch 18 Becker)

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.

Unit 3. Genome Structure, Chromatin and the Nucleosome
(Ch 7 Watson/ Ch 18 Becker)

Genome Sequence and Chromosome Diversity, Chromosome Duplication and Segregation, The Nucleosome

Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Regulation of Chromatin Structure and Nucleosome Assembly.

Organization of Chromosomes

Unit 4. The Replication of DNA (Prokaryotes and Eukaryotes)
(Ch 8 Watson/ Ch 19 Becker)

Chemistry of DNA synthesis, general principles - bidirectional replication, Semi-conservative, 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

Unit 5. The Mutability and Repair of DNA (Ch 9 Watson)

Replication Errors, DNA Damage and their repair.

Paper 12-MBHP 301
MOLECULAR BIOLOGY-I

PRACTICALS Marks: 50

1. Preparation of Polytene chromosome from *Chironomous* larva/*Drosophila* larva
2. Demonstration of mammalian sex chromatin.
3. Preparations of temporary mount and study the different stages of Mitosis (Onion root tip).
4. Perform Southern Blot Hybridization (Restrict DNA for Southern Blot electrophoresis, perform electrophoresis of restricted DNA, perform southern transfer, hybridization and detection of gene of interest)
5. Demonstration of Northern Blotting.
6. Demonstration of Western Blotting.
7. Perform DNA amplification by PCR.
8. Study of semiconservative replication of DNA through micrographs/schematic representations.

SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.