MICROBIOLOGY

Molecular Cell Biology

Description of the Course

Course Title: Molecular Cell Biology
Course No: MB 301 (Major)
Nature of the Course: Theory

Full Marks: 100
Pass Marks: 35
Year: III
Total Lecture Hours: 150

Course Objectives

After completion of the course, the students will be able to:

a) understand how cell evolved and different organelles of the cell
b) understand role and importance of inter and intra cellular transport in cell
c) understand the concept of cell communication, its significance and importance
d) know the importance of cytoskeleton for the integrity of cell and its dynamic nature

Course Contents

An overview of cells **5hrs**

Origin of life on Earth: import of life through meteorites, theory of chemical evolution, primitive earth conditions: anoxic reductive atmosphere, evolution of biomolecules to cell, evolution of prokaryotic cell, evolution of cellular organelles and eukaryotic cells

Cell structure and function **25hrs**

Introduction to cytoplasmic organelles and cytoskeleton: protoplasm, mitochondria, chloroplast, endoplasmic reticulum, golgi complex, lysosome, endosome, ribosome, centriole, microbodies: peroxisomes and glyoxisomes, flagella, cilia, cell wall, extracellular matrix

Nucleus **15 hrs**

Chromosomes, chromatin and nucleosome, chromosome structure in bacteria and eukaryotes, centromere, telomere, hetero and euchromatin, nucleosome model and radial-loop scaffold model

Membrane structure and transport **20hrs**

Models of membrane structure, membrane lipids, proteins and carbohydrates and their functions, fluidity of membrane, lipid raft, membrane electric potential, transport across cell membranes: diffusion of small molecules across phospholipid bilayers, uniporter catalyzed transport, cotransport by symporters and antiporters, active transport by ATP powered pumps

Structure and organization of actin filaments **12hrs**

Actin cytoskeleton, dynamics of actin assembly, myosin: the actin motor protein, actin and myosin in nonmuscle cells, cell locomotion

The microtubule cytoskeleton **18hrs**

Microtubule structures, components of microtubules and dynamics of microtubule assembly, associated proteins, kinesin, dynein, and intracellular transport, cilia and flagella movement, motor proteins during mitosis, microfilaments, intermediate filaments

Intracellular transport **15hrs**

Transport of molecules between nucleus, mitochondria, chloroplast and other cell organelles, vesicular transport: transport from ER to cell organelles; transport across plasma membrane: endocytosis (phagocytosis, pinocytosis, receptor mediated endocytosis) and exocytosis

Cell signaling **25hrs**

Signaling molecules and their receptors (extracellular and intercellular signaling molecules, ligands and receptors), local and long distance signaling, pathways of intracellular signal transduction, types of extracellular signaling processes, Intracellular second messengers with examples (cyclic nucleotides, phospholipids, calcium and protein kinases as elements of signal transduction), third messengers (DNA binding proteins) and role of signaling molecules in gene activation, interaction and regulation of signaling pathways as related to G-Protein coupled receptor signaling mechanisms, receptor tyrosine kinase based signaling mechanisms, receptor guanylyl cyclase based signaling mechanisms, Gated ion channel based signaling mechanisms, Adhesion receptor based signaling mechanisms

The cell cycle **15hrs**

Regulating eukaryotic cell cycle, cyclin dependant kinase regulation during mitosis, check points in cell cycle regulation, components of cell cycle control system: intracellular and extra-cellular control of cell division, mitosis and meiosis, programmed cell death (apoptosis), intrinsic and extrinsic pathways of cell death, apoptosis in relation with cancer and viral disease (AIDS), stem cells, embryonic stem cells and therapeutic cloning

Recommended Readings

Text books

1. Lodish H, Berk A, Matsudaira P, Kaiser C, Krieger M, Scott M, Zipursky L and Darnell J (2003). Molecular Cell Biology, 5th Edition. W.H Freeman and Company.
2. Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P (2002). Molecular Biology of the Cell, 4thEdition. New York: Garland Science.

Molecular Cell Biology Practical

Description of the Course

Course Title: Molecular Cell Biology Practical
Course No: MB 302 (Major)
Nature of the Course: Practical

Full Marks: 50
Pass Marks: 20
Year: III
Total Lecture Hours: 180

Course Objectives

After completion of the course, the students will be able to:

a) develop skills in cell counting, be able to isolate cell organelles and analyze basic cellular activity

Course Contents

To perform differential centrifugation for separation of different cell organelles

To isolate mitochondria from different samples

To perform cell counting using haemocytometer

To perform lysis of cell using different techniques

Selective permeability of membrane (artificial membrane: cellophane)

Analysis of sub-cellular fraction: Mitochondria by measuring succinate dehydrogenase activity, lysosomal fraction by protease activity

Isolation of chloroplast from leafy vegetables (e.g. spinach, mustard, lettuce)

Extraction of brain lipid

Quantitative analysis of lipid classes by TLC

DNA extraction from eukaryotic and prokaryotic cells

Pharmaceutical Microbiology and Quality Management

Description of the Course

Course Title: Pharmaceutical Microbiology and Quality Management
Course No: MB 303 (Elective I)
Nature of the Course: Theory

Full Marks: 50
Pass Marks: 17.5
Year: III
Total Lecture Hours: 75

Course Objectives

After completion of the course, the students will be able to:

a) understand applications of microbiology and quality control systems in pharmaceutical and food industries

Course Contents

Introduction of pharmaceutical microbiology **5 hrs**

Definition, scope, objectives, application of microorganisms in pharmaceutical science

Antimicrobial agents **15 hrs**

Definition, sources, types, target and mode of action of antibiotics, antiviral, antiparasitic and antifungal drugs, drugs in combination

Quality evaluation of pharmaceutical products **15 hrs**

Bioassays, chemical assays, immunoassay of antibiotics, quality evaluation of disinfectants, antiseptics and preservatives

Microbial spoilage and preservation of pharmaceutical products **15 hrs**

Types of spoilage, factors affecting microbial spoilage, preservation of pharmaceutical products, physical, chemical and biological indicators of sterilization, principles and methods of sterility testing

Quality assurance and quality management **20 hrs**

Principles of quality risk management, quality risk management process, risk assessment, risk control and communication, risk management methodology and tools, hazard analysis and critical control points (HACCP), quality risk management for facilities, equipment and utilities, good hygiene practices (GHP), good manufacturing practices (GMP), good laboratory practices (GLP), quality management systems - ISO9001, ISO 22000, safety and quality auditing of the food and pharmaceutical products, quality assurance

Food safety and consumer protection **5 hrs**

Microbiological hazards, chemical hazards, food adulteration, genetically modified organisms and novel foods, sanitary and phytosanitary measures

Recommended Readings

Text books

1. Denyer SP, Hodges NA and Gorman SP (Eds) (2004). Hugo and Russell's Pharmaceutical Microbiology, 7th Edition, Blackwell Science Ltd.
2. WHO (2007). Quality Assurance of Pharmaceuticals, Volume 2, 2nd Edition.

Reference books

1. Tripathi KD (2009). Essentials of Medical Pharmacology, 6th Edition, Jaypee Brothers, New-Delhi
2. Laurence DR, Bennette PN and Brown MJ (1997). Clinical Pharmacology, 8th Edition, Churchill Livingstone
3. US Pharmacopia
4. British Pharmacopia

Bioinformatics

Description of the Course

Course Title: Bioinformatics
Course No: MB 304 (Elective II)
Nature of the Course: Theory

Full Marks: 50
Pass Marks: 17.5
Year: III
Total Lecture Hours: 75

Course Objectives

After completion of the course, the students will be able to:

a) understand the principles and applications of bioinformatics in microbiological research

Course Contents

History, scope and importance of bioinformatics **5 hrs**

Definition, contribution in bioinformatics, aims and tasks of bioinformatics, applications of bioinformatics, challenges and opportunities in bioinformatics

Internet, World Wide Web and NCBI in bioinformatics **5 hrs**

Computer programs and operating systems for bioinformatics, world wide web pages and websites, browsers, EMBnet and SRS, Sequence retrieval system, NCBI, Entrez, Data model, basic sites of bioinformatics

DNA and protein sequencing and analysis **15 hrs**

Genomics and proteomics, approaches to genome sequencing, genome mapping, DNA sequencing, ORF, CDS, determining sequence of a clone, expressed sequence tags, protein sequencing, determination of protein structure, gene and protein expression analysis, gene finding databases and accession sites, capturing expression profile, human genome project, benefits of genome research

Databases, tools and their uses **15 hrs**

Definition, importance of databases, types of databases, classification, database entries, sequence formats, database record, database management system, relational database management system, structured query language, data mining and knowledge discovery, nucleic acid sequence databases (EMBL, DDBJ, genebank, GSDB, Ensembl, specialized genomic resources, protein sequence databases, PIR databases, SWISS-PROT, TrEMBL, NRL-3D, Structure classification database (SCOP, CATH, DALI, CE, NDB, CSD, BMRB, 3Dee, FSSP, MMDB, CDD, Rasmol database), secondary databases (PROSITE, PRINTS, BLOCKS, HMMs, IDENTIFY, KEGG, MEDLINE databases), Specialized analysis packages (GCG package, EGCG package, staden package, lasergene package, sequencher package, vector NTI package, Macvector package), DALI program, uses of databases

Sequence alignment **15 hrs**

Algorithm, genetic algorithm, goals and types of alignment, study of similarities, high and low scoring matches, scoring mutations, deletions and substitutions, sequence alignment methods (dot matrix, dynamic programming, k-tuple, FASTA, BLAST, multiple sequence alignment, automatic alignment-CLUSTAL, CINEMA), algorithms for identifying domains within a protein structure, algorithms for structural comparisons, sequence search

Predictive methods using DNA and protein sequences **10 hrs**

Gene prediction strategies, prediction of RNA secondary structures, gene prediction programs, protein prediction strategies and methods, prediction of secondary structure of protein, comparative modeling, threading, protein function prediction, protein prediction programs, molecular visualization

Homology, phylogeny, evolutionary trees and pharmainformatics **10 hrs**

Definition of homology and similarity, orthologs, paralogs, xenologs, study of orthologous and paralogous proteins, modular proteins, phylogeny and relationships, evolutionary tree, approaches used in phylogenetic analysis, steps in phylogenetic analysis, phylogenetic trees, tree building methods, molecular approaches to phylogeny, phylogenetic analysis databases, definition of pharmainformatics, chemical libraries, search programs, docking algorithms, active site analysis, QSAR

Recommended Readings

Text books

1. Ignacimuthu S. Basic Bioinformatics. Alpha Science International Ltd, UK.

2. Campbell AM and Heyer LJ (2007). Discovering Genomics, Proteomics and Bioinformatics (2nd Edition). Benjamin Cummings; CSH Press, Newyork.

Reference books

1. Pevsner J (2009). Bioinformatics and Functional Genomics (2nd Edition). Wiley Blackwell.
2. Mount DW (2004). Bioinformatics- Sequence and Genome Analysis (2nd Revised Edition). Cold Spring Harbor Laboratory Press, USA.