

**PONDICHERY UNIVERSITY
PUDUCHERRY 605 014.**

M.Sc. BIOCHEMISTRY AND MOLECULAR BIOLOGY

CURRICULUM AND SYLLABUS

2009 ONWARDS

**PONDICHERY UNIVERSITY
SCHOOL OF LIFE SCIENCES
DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY**

**SYLLABI FOR M.Sc. BIOCHEMISTRY AND MOLECULAR BIOLOGY
(2009 ONWARDS)**

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BMB 506	PROTEOMICS	3	28
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BMB 401: BIOMOLECULES

3 CREDITS

1. Biomolecules- chemical composition and bonding
- chemical reactivity - ionization of water - weak acids and weak bases - buffers - buffering in biological systems. 4 Lectures
2. Principles of bioenergetics- Laws of thermodynamics and their applications in biological system – entropy and enthalpy - standard free energy changes- standard reduction potentials – thermodynamics of coupled reaction. 5 Lectures
3. Carbohydrates-Monosaccharides- disaccharides- oligosaccharides- sugar derivatives- amino sugar- phosphate esters- deoxysugar- sugar acid- polysaccharides- structure and biological functions of homo- and heteropolysaccharides- biosynthesis and degradation of glucose and glycogen. 5 Lectures
4. Proteins-primary- secondary- tertiary and quaternary structure- Ramachandran plot- super secondary structures- helix loop helix- $\beta\alpha\beta$ - biosynthesis of urea. 6 Lectures
5. Nature of enzymes- classification and nomenclature of enzymes - kinetic analysis of enzyme catalyzed reactions– regulation of enzyme activity by non-genetic mechanisms - ribozymes. 5 Lectures
6. Nucleic acids- types and structural organization- triple helix of DNA- DNA denaturation and renaturation- hypochromicity- T_m . 5 Lectures
7. Lipids- Classification- structure and properties- phospholipids- glycolipids- sphingolipids- cholesterol. Fatty acids- saturated and unsaturated fatty acids- biosynthesis and degradation- Structure and biological role of prostaglandins, thromboxanes and leukotrienes. 5 Lectures

Text Book:

1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. 4th ed. Freeman, 2004
2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper's Biochemistry. 27th ed. McGraw Hill, 2006.

Suggested Reading:

1. Dixon & Webb. Enzymes. 3rd ed. Longmans, 1979.
2. Berg.J.M, Tymoczko.J.L, Stryer, L. Biochemistry. 6th - ed. Freeman, 2006.
3. Adams. R.L, Knowler.J.Leader. D.P. Biochemistry of Nucleic Acids. Cambridge Univ. Press, 1998.

BMB 402: HUMAN PHYSIOLOGY

3 CREDITS

- | | | |
|----|---|------------|
| 1. | Introduction- Internal environment and homeostasis- coordinated body functions. | 2 Lectures |
| 2. | Digestion- digestive processes at various regions of digestive system, regulation of -gastric secretion and motility- intestinal secretion and motility-role of gastrointestinal hormones. | 6 Lectures |
| 3. | Cardiophysiology- functional anatomy of heart- genesis and spread of cardiac impulses- cardiac cycle- heart sound- cardiac output- cardiovascular regulatory mechanisms- basic E.C.G. | 7 Lectures |
| 4. | Respiratory physiology- functional anatomy of air-passages and lung-respiratory muscles- mechanism of respiration- lung volumes and capacities- gas exchange in the lungs- regulation of respiration. | 6 Lectures |
| 5. | Renal physiology- structure of nephron- glomerular filtration- tubular reabsorption and secretion- formations of urine- regulation of water and mineral excretion- counter current multiplier and exchanger- renal role in acid base balance. | 6 Lectures |
| 6. | Muscle physiology- skeletal and smooth muscle- electrical properties and ionic properties- types of muscle contraction- Neuromuscular transmission. | 4 Lectures |
| 7. | Nerve physiology-Structure of neuron and synapse- excitability- action potential- conduction of never impulse-synaptic transmission- neurotransmitter systems. | 4 Lectures |

Text Book:

1. Ganong W. E. Review of Medical Physiology. 21st ed. Mc. Graw Hill, 2003.
2. Guyton. A.C, Hall. J.E. Textbook of Medical Physiology. 11th ed. Saunders Company, 2005

Suggested Reading:

1. Widmaier. E. P, Raff. H, Strang. K. T. Vander's Human Physiology : The mechanism of Body Function, 8th ed. Mc. Graw Hill, 2003.

BMB 403: CELL BIOLOGY

3 CREDITS

1. Dynamics of the eukaryotic cell- Molecules of life- Cellular evolution- assembly of macromolecules and Origin of life- integrated structural organization of prokaryotic and eukaryotic cells- Concept of a composite cell and Molecular composition of cells. 4 Lectures
2. Biomembranes- Structural organization- Models of a plasma membrane, Membrane permeability- Transport across cell membranes- Transmembrane signals- Artificial membranes- liposome. 5 Lectures
3. Micro bodies-Peroxisomes and Glyoxysomes- Mechanism of degradation of fatty acids and cellular toxic compounds- Glyoxalate cycle- Lysosomes - as acidic organelles- Enzymes of Lysosomes- Functions of Lysosomes 5 Lectures
4. Molecular organization and function of mitochondria- components of respiratory chain- Chemiosmotic theory- Kinetics of electron transport, ATP formation- uncouplers of oxidative –phosphorylation- mitochondrial DNA and Semiautonomy. 6 Lectures
5. Chemistry of chloroplasts- supramolecular organization of chloroplast membranes and thylakoids- photosynthetic carbon assimilation- C3, C4 and CAM pathways of photosynthesis. 5 Lectures
6. Endomembrane system- Endoplasmic reticulum- protein segregation- microsomes- functions of endoplasmic reticulum- Golgi complex and cell secretion- Protein glycosylation. 4 Lectures
7. Ribosomes- Structural organization- DNA replication- transcription and translation- Protein synthesis and protein processing. Nucleus- Internal organization- Nuclear pore complex- Nucleosomes, Chromatin- The flow of genetic information. 6 Lectures

Text Book:

1. . P. Molecular Biology of the cell. 4th ed. Garland publishing Inc, 2002.

Suggested Reading:

1. Cooper. G. M. Cell - A molecular approach. 2nd ed. Oxford University Press, 2000
2. De Robertis and De Robertis. Cell and Molecular Biology, Lea and Febiger. 8th ed. 2000.

BMB 404: ANALYTICAL BIOCHEMISTRY & BIOPHYSICS

3 CREDITS

1. Electrochemical techniques- basic principles- The pH electrode- Ion-selective- gas- sensing and oxygen electrodes- Elementary details of biosensors. 3 Lectures
2. Principles and techniques of colorimetry and spectrophotometry-Beer-Lamberts Law -instrumentation - qualitative and quantitative methods of analysis-protein estimation methods-hypo and hyper chromicity- coupled assays - Spectrofluorimetry -Turbidimetry - Flame and Atomic absorption Spectrophotometer 3 Lectures
3. Microscopy- basic principles and applications –Light- Compound- Scanning Electron Microscopy (SEM)- Transmission Electron Microscopy (TEM)- Fluorescence Microscopy- Scanning Tunneling Microscopy (STM)- Automated Fluorescence Microscopy - Confocal Microscopy. 6 Lectures
4. Centrifugation- basic principles-instrumentation-centrifugation units-types of centrifuges-colloidal nature of particles-centrifugation methods and accessories - sedimentation velocity-sedimentation equilibrium-cell fractionation methods. 3 Lectures
5. Chromatography- types- column, thin layer, paper, adsorption, partition, gas liquid ion exchange, affinity, HPLC- principles of each type-instrumentation and accessories- detection methods and systems qualitative and quantitative aspects-applications. Electrophoresis- types- paper and gel-agarose and PAGE-pulsed field-capillary - isoelectric focusing- blotting methods-western- southern and northern- application-methods in life sciences and biotechnology. 10 Lectures
6. Radioactive methods- types of radioisotopes-half life- units of radioactivity- uses of radioisotopes in life sciences and biotechnology-detection and measurement of Radioactivity- liquid scintillation counting-solid state counting- Geiger counter - Radiation hazards. 5 Lectures
7. Principles of analytical instrumentation- techniques and applications of Electron spin resonance- Nuclear magnetic resonance- Circular Dichroism (CD) - Optical Rotary Dispersion (ORD). 5 Lectures

Text Book:

1. Freifelder D. M. Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd ed., W.H. Freeman, 1982.

Suggested Reading:

1. Wilson & Walker. Principles and Techniques in Practical Biochemistry. 5th ed. Cambridge Univ. Press, 2000.
2. West & Todd. Biochemistry. 4th ed. Oxford and IBH.
3. Horst Friebolin. Basic One and Two-dimensional spectroscopy. VCH Publ, 1991.
4. Murphy D. B. Fundamental of Light Microscopy & Electron Imaging. 1st ed. Wiley-Liss, 2001.
5. Pierre Crabbe. ORD and CD in chemistry and biochemistry: An Introduction. Academic Press, 1972.
6. Paddock S. W. Confocal Microscopy methods & protocols. 1st ed. Human Press, 1999.

BMB 405: BIOSTATISTICS & SCIENTIFIC WRITING

3 CREDITS

- | | | |
|----|--|------------|
| 1. | Introduction- definition of statistics-population and universe- the sample and population- statistical inference- parameter and statistics | 3 Lectures |
| 2. | Handling of bulky data- construction a histogram- interpretation of histogram- the normal distribution- the mean-mode-and standard deviation- representing the normal curve as straight line- uncertainties in estimating a mean. | 5 Lectures |
| 3. | Proportion data- Examples of Proportion data- MPM- sterility testing of medicines- animal toxicity- infection and immunization studies e.g., LD50, ED50, PD50 statistical treatment to proportion data- Chi-square test- goodness of fit to normal distribution. | 6 Lectures |
| 4. | Count data- Examples of count data (bacterial cell count, radioactivity count, colony and plaque count, etc.). Statistical treatment to count data- poisson distribution- standard error- confidence limits of counts. | 5 Lectures |
| 5. | Analysis of variance- Introduction –procedure-F and t test. | 4 Lectures |
| 6. | Correlation regression and line fitting through graph points- standard curves- correlation- linear regression (fitting the best straight line through series of points)- standards curves and interpolations of unknown y-values thereon. | 5 Lectures |
| 7. | Methodology for writing science report and oral presentation- compilation of experimental record- program of writing- use of vocabulary- use of good english-art of illustration- report writing- editing and correcting- technique of oral presentation. | 7 Lectures |

Text Book:

1. Green. R. H. Sampling Design and Statistical Methods for Environmental Biologists .John Wiley & Sons, 1979.

Suggested Reading:

1. Snedecor G. W. & Cochran W. G. Statistical methods. 8th ed. Iowa State Press, 1989.
2. Thomas Glover, Kevin Mitchell. Introduction to Biostatistics. 1st ed. McGraw –Hill Science, 2001.
3. Matthews. Successful Scientific writing: A step-by- step Guide for Biomedical Scientists. 2nd ed. Cambridge University Press, 2001.
4. Jerrold H. Zar. Biostatistical Analysis. 4th ed. Pearson Education, 2006

BMB 451 BIOMOLECULES LAB

CREDITS 4

1. Laboratory safety
2. Determination of Absorption Maximum
3. Verification of Beer-Lambert's Law
4. Preparation of Standard curve
5. Estimation of protein by Biuret method.
6. Estimation of protein by Lowry's method.
7. Extraction of biochemical constituents from various tissues.
8. Purification & Estimation of DNA from plant, animal and bacteria
9. Purification & Estimation of RNA from plant, animal and bacteria
10. Estimation of Enzyme activity (e.g. Urease)
11. Effect of pH and temperature on enzyme activity- Amylase.
12. Effect of substrate concentration on enzyme activity.
13. Purification & Estimation of Casein in milk.
14. Estimation of cholesterol.

BMB 452 HUMAN PHYSIOLOGY LAB

1. Microscopy
2. RBC count & WBC count
3. Differential leucocyte count by Leishman's staining
4. Estimation of Haemoglobin by Sahli's acid haematin method
5. Determination of Packed cell volume (PCV)
6. Determination of Erythrocyte sedimentation rate (ESR)
7. Determination of Coagulation time & Bleeding time
8. Determination of blood group
9. Nerve muscle preparation
10. Simple muscle curve
11. Determination of Blood Pressure by Sphygmomanometry

BMB 453 CELL BIOLOGY LAB

1. Paper Chromatography of Chlorophyll pigments
2. Arrest and observation of chromosomes after colchicine treatment in onion roots.
3. Cell fractionation
4. Estimation of Chlorophyll
5. Ascorbic acid estimation in different tissues of plants and animals.
6. Catalase assay
7. Growth curve of bacteria.
8. Estimation of cell mass of bacteria.

BMB 454 ANALYTICAL BIOCHEMISTRY & BIOPHYSICS LAB

1. Buffer preparation
2. pH titration
3. Protein purification by ammonium sulfate precipitation.
4. Molecular modeling using modeling kit.
5. Absorption spectra- UV-Visible.
6. Paper Chromatography of amino acids, carbohydrates, nucleic acid.
7. Ion exchange chromatography.
8. SDS Gel electrophoresis.

BMB 406: METABOLISM & REGULATION

3 CREDITS

1. General introduction- Anabolism- Catabolism- Vitamins- coenzymes- interrelations - regulation- antimetabolites. 2 Lectures
2. Carbohydrates metabolism- Pentose phosphate pathway- Glyoxylate pathway-Xenobiotic metabolism. 4 Lectures
3. Metabolism of lipids- Biosynthesis and catabolism in general-oxidation of fatty acids – Biosynthesis of Mono and PUFA-Biosynthesis and degradation of triacylglycerol- phospholipids- sphingolipids - Cholesterol synthesis - Arachidonic acid metabolism – Prostaglandins- Leukotrienes - Thromboxanes. 6 Lectures
4. Metabolism of Proteins and Non-essential amino acids-interrelations between metabolism of carbohydrates, lipids and amino acids. 6 Lectures
5. Biosynthesis and Catabolism of Porphyrins- heme-bile pigments-transport and excretion- Biosynthesis of Purines and Pyrimidines - catabolism and regulation. 7 Lectures
6. Genetic errors of metabolism- Representative examples - phenylketonuria, alkaptonuria- sickle cell anemia- galactosemia – cystinuria- Thalasemia. 5 Lectures
7. Signal Transduction- intracellular receptor and cell surface receptors- signalling via G-protein linked receptor-PKA- PKC- CaM kinase- enzyme linked receptor signalling – JAK-STAT pathway- cross talk between different signal mechanisms. 5 Lectures

Text Book:

1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. 4th ed. Freeman, 2004
2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper's Biochemistry. 27th ed. McGraw Hill, 2006.

Suggested Reading:

1. Berg.J.M, Tymoczko.J.L, Stryer, L. Biochemistry. 6th – ed. Freeman, 2006.
2. Zubay. Biochemistry. 4th ed. William C. Brown Publication, 1998
3. Voet and Voet. Biochemistry. 3rd ed. John Wiley, 1995.

BMB 407: ENZYMOLOGY

3 CREDITS

1. Enzymes- historical perspective- nomenclature- methods of isolation and purification- enzyme units- substrate specificity. 3 Lectures
2. Enzyme kinetics- Factors affecting enzyme activity- Michaelis-Menten equation- analyses of kinetic data- Lineweaver-burk plot- catalytic efficiency- Haldane relationship- Hill's plot- Bisubstrate reactions- sequential - ping-pong reactions- rate equations and examples. 6 Lectures
3. Enzyme inhibition- Irreversible- reversible- competitive- non-competitive - uncompetitive inhibition- Graphical analysis. 4 Lectures
4. Enzymatic catalysis- acid-base catalysis- covalent catalysis- metal ion catalysis- electrostatic catalysis- catalysis through proximity and orientation effects- catalysis by transition state binding. 4 Lectures
5. Carboxypeptidase- Lysozyme- enzyme structure- catalytic mechanism- Phillips mechanism. 4 Lectures
6. Regulation of enzyme activity- allosteric control- reversible covalent modification- proteolytic activation- sequential- concerted and cumulative feed back control- importance of compartmentation- Allosteric enzymes- Jacob and Monod model of allosteric enzymes- Koshland model- subunit interaction and regulation of enzyme activity – ATCase. 7 Lectures
7. Co-enzymes- A, B-complex, C, D, E and K- structure and function- Isoenzymes-LD- CK- Applied Enzymology-Immobilized enzymes- methods and applications in industry- medicine- enzyme electrodes - biosensors. 7 Lectures

Text Book:

1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. 4th ed. Freeman, 2004
2. Berg.J.M, Tymoczko.J.L, Stryer, L. Biochemistry. 6th – ed. Freeman, 2006.

Suggested Reading:

1. Dixon & Webb. Enzymes. 3rd ed. Longmans, 1979.
2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper's Biochemistry. 27th ed. McGraw Hill, 2006.

BMB 409: BIOINFORMATICS

3 CREDITS

1. Introduction- scope- Historical account. 1 Lecture
2. Database Management Systems- Database System Versus File Systems- View of Data- Data Models- Database Languages- Database Users and Administrators- Database System Structure- RDBMS- SQL commands 5 Lectures
3. Biological Databases and Data Retrieval: Nucleotide (Genbank-EMBL- DDBJ)- Sequence submission Methods and tools (Sequin, Sakura, Bankit)- Sequence retrieval systems (Entrez & SRS)- Sequence File Formats and Conversion tools- Protein (Swiss-prot, PIR, Expasy)- Structural Databanks (PDB and NDB)- Protein Structure Classification (SCOP, CATH and FSSP)- Metabolic Pathway db (KEGG)- Specialized db (IMGT, Rebase, COG) 5 Lectures
4. Molecular Sequence Alignment- Pair wise Alignment- Global Alignment- Local Alignment- Visual Alignment- Dynamic Programming- Heuristic approach- Scoring Matrices and Affine Gap costs- Database Search methods- Multiple Sequence Alignment methods. 7 Lectures
5. Gene Prediction and Phylogenetic Analysis: Gene structure in Prokaryotes and Eukaryotes- Gene Prediction methods- Construction of Phylogenetic trees - Distance Methods- Maximum Parsimony Method- Maximum likelihood method. 5 Lectures
6. Molecular Modeling and Drug Designing: Introduction to Protein Structure Prediction- Rational drug discovery- Recent advances in drug design methodologies- Structure-based drug design- Drug-receptor interactions- Structure-Activity Relationships. 6 Lectures
7. Introduction to Networks and Linux: Introduction to Network-Intranet- Internet- DNS- TCP/IP- Web Designing- HTML tags- tables-frames- forms- XML- UML- SOAP- Files and Directories- Bash commands- Users and Groups- Permissions- Software installation-communicating with other computers using Telnet- FTP- SCP- SSH- Shell scripting- STDI/O- Pipes and control. 6 Lectures

Text Book:

1. Claverie. J. M, Notredame. C. Bioinformatics For, Wiley Publishing, Inc. 2003
2. Dan.E.Krane, Michael L. Raymer – 1st ed. Fundamental concepts in Bioinformatics. Pearson Education. 2006.

Suggested Reading:

1. David Mount. Bioinformatics: Sequence and Genome Analysis. CSHL 2001.
2. Andreas D. Baxevanis & B.F. Francis Ouellette. Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins, John Wiley & Sons, UK, 1998.
3. Des Higgins. Bioinformatics Sequence, Structure databanks. Willie Taylor.
4. Abraham Silberschatz, Henry F. Korth, Sudarshan S., “Database System Concepts” – (3rd Edition), McGraw-Hill.

Unit I**-6 hrs**

History and Scope of Microbiology; Classification of Microorganisms-Bacteria, Fungi, Virus, Alga, Protozoa ; sterilization techniques, disinfectant and antiseptic agents. Microscopy - types of microscopes and their applications-simple and compound, bright field, dark field, fluorescence, phase-contrast and electron microscopes.

Unit II**-6 hrs**

Major groups of bacteria- Archaeobacteria, Actinomycetes, Chemoautotrophs, Eubacteria, Pseudomonads, cyanobacteria, Rickettsias, chlamydias and spirochetes; Bacterial cell- structure and functions of cellular components-cell wall composition of Gram positive and Gram negative bacteria, sub-cellular organizations, flagella, capsule and spores; Bacterial Staining; antimicrobial agents-antibiotics, chemotherapeutic drugs-antibacterial agents-mode of action; antibiotic resistance.

Unit III**-8hrs**

Classification, morphology and characteristics of Virus, Fungi & Protozoa- structure of DNA -and RNA viruses, Viral replication, Bacteriophages- Lysogeny and Lytic cycle; Virus like agents-satellites, viroids and prions, antiviral and antifungal drugs; Classification of Helminthic parasites; Life cycle of malarial and filarial parasites.

Unit IV**-6 hrs**

Microbial culture –continuous culture and synchronous culture; composition of culture media -solid and liquid media, chemically defined media, complex and differential media; Effect of pH, temperature and radiation on microbial growth.

Unit V**-10 hrs**

Microbes and Diseases-major human diseases caused by bacterial, viral and fungal pathogens Diseases of the respiratory tract-diphtheria, tuberculosis, pneumonia, influenza, mumps; Diseases of the skin-systemic mycoses, candidiasis; herpes viral infections, chicken pox, zoster and small pox; Genito-urinary infections-Gonorrhoea, syphilis, leptospirosis, and AIDS; trichomoniasis; Diseases of GIT-Cholera, ETEC and EIEC infections; shigellosis; Typhoid; Hepatitis, gastroenteritis. Major human protozoan diseases-Malaria, Amebiasis, Toxoplasmosis.

Text Books:

1. Prescott, Harley and Klein- Microbiology-5th edition; Publisher: McGraw Hill science 2002
2. Gerard J. Tortora, Berdell, R. Funke, Christine L. Case, , Microbiology: An Introduction. 8th edition Hardcover: 944 pages, Publisher: Benjamin Cummings. 2004.

Suggested Reading:

Kenneth J. Ryan,C. George Ray, John C. Sherris, Sherris Medical Microbiology : An Introduction to Infectious Diseases , Hardcover: 992 pages, Publisher: McGraw-Hill Professional, 2003.

Clinical Biochemistry

BMB 412

CREDIT: 3

Unit –I

5 h

Automation in the clinical biochemistry: Precision, reliability, reproducibility and other factors in quality control. Normal values in health and diseases, radio isotopes in diagnosis. Specimen collection and processing (blood, urine and faeces), storage of specimens.

Unit –II

7 h

Kidney, liver and gastric function tests: Renal function tests, osmolarity and free water clearances, acute and chronic renal failure. Liver function tests: clinical features and test based on bile pigments level, plasma changes, prothrombin time. Gastric function tests: collection of gastric contents, examination of gastric residium, FTM, stimulation tests, tubeless gastric analysis.

Unit –III

8 h

Disorders of carbohydrate metabolism: Diabetes mellitus, insulin receptors and c- peptide, assay of insulin, proinsulin and insulin antibodies. Hemoglobin A1c; fructosamines, insulin tolerance test. Glycogen storage diseases, galactosemia, fructosuria, pentosuria. **Plasma lipids and lipoprotein abnormalities:** hypercholesterolemia- lipidosis and hypolipoproteinemias, Taysach's and Niemann picks diseases. **Disorders of nucleic acid metabolism-** hypo and hyperuricemia, gout. **Disorders of erythrocyte metabolism-** hemoglobinopathies, thalassemias and anemias.

Unit –IV

7 h

Inherited disorders of metabolism: Newborn screening: PKU, hypothyroidism, tyrosinemia, homozygotes vs. heterozygotes e.g. cystic fibrosis and sweat tests, aminoacidurias, organic acidurias, porphyrias. Biochemical monitoring of therapy.

Prenatal diagnosis of inborn errors of metabolism, amniotic fluid and fetal blood examination. Acetylcholinesterase and other tests on amniotic fluid. Chromosomal abnormalities by cytogenetics.

Unit –V

8 h

Molecular diagnosis of genetic defects: Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis, Hemachromatosis, thalassemias, sickle cell diseases) DNA probes; restriction fragment length polymorphism (RFLP); polymerase chain reaction (PCR); amplification of mRNA. AIDS: Clinical diagnosis. Oncogenic enzymology: acid phosphatase, alkaline phosphatase, lactate dehydrogenase. Body fluid constituents of use in oncology. Tests for mutagenicity – the Ames test

Text Book:

3. Tietz Fundamentals of Clinical Chemistry. Burtis, Ashwood. 5th ed. Saunders, 2002.
4. Clinical Chemistry: Theory, Analysis and Correlation. Kaplan, L.A. and Pesce, A.J., 4th ed. Mosby, 2003.
5. Handbook Of Clinical Biochemistry, Swaminathan, R. Oxford University Press; 2004
6. Textbook of Medical. Biochemistry, Chatterjee, M.N. and Rana Shinde, 5 th ed. Jaypee Medical Publishers, 2002
7. Practical Clinical Biochemistry, Harold Varley, Interscience Publishers Inc, 2002

Recommended Reading:

1. Lecture Notes on Clinical Chemistry. Whitby, L.G., Percy-Robb, I.W., and Smith, A.F., 6th ed. Blackwell, 1998.
2. Advances in Clinical Chemistry. Latner, A.L. and Schwartz, M.K. (Eds.). Academic Annual volumes. 1998.
3. Biochemical Basis of Pediatric Disease. Soldin, S.J., Rifai, N., Hicks, J.M.B., 3rd ed, American Association for Clinical Chemistry, 1998.

UNIT -1

Introduction to Endocrinology: Historical aspects and anatomical aspects of mammalian endocrine system. Definition of a hormone. Chemical nature of mammalian hormones. Developmental biology of mammalian endocrine system. Feed back regulation of endocrine system. 7 h

UNIT -2

The endocrine hypothalamus-hypophysiotropic hormones- Chemistry & biochemical functions; Pituitary gland- hormones of the pituitary gland- Chemistry & biochemical functions - neurovascular hypothesis; pineal gland- hormones of the pineal gland- Chemistry & biochemical functions. 9 h

UNIT -3

Thyroid gland- thyroid hormones- chemistry and biochemical functions; Pancreas- Insulin/glucagon: somatostatin –chemistry and biochemical functions- 8hrs hormones involving-calcium metabolism. 8 h

UNIT -4

Adrenal gland- hormones of adrenal gland-chemistry and biochemical functions; Gastrointestinal hormones-cholecystokinin, substance P, summary of the neuroendocrine control of GI; Neurohormones- the brain-renin-angiotensin, and urotensin. 8 h

UNIT -5

Hormones of female reproductive system: ovarian steroid hormones- Chemistry & biochemical functions.
Hormones of Male reproductive system: Source, synthesis, chemistry and metabolism of Androgens. 8 h
Endocrine dysfunction-Hypophysial Thyroid, parathyroid adrenal, & pancreas.
Clinical evaluation of endocrine functions-over view.

Text Book:

1. The Physiology of reproduction. E. Knobil & J.D. Neil. 2nd. Lippincott Williams & Wilkins, 2004
2. Textbook of Endocrinology: Williams. R. H, Foster. D.W, Kronenberg. H.M, Larsen. P. R, Wilson. J. M. Williams, 10th ed. W. B. Saunders Company, 2002

Recommended Reading:

1. Lehninger's Principle of Biochemistry.: Nelson Cox. 3rd ed. MacMillian Worth Publ. 2000.
Endocrinology: Mac E. Hadely. 5th ed. Pearson Education, 2000.
2. Endocrinology: Mac E. Hadely. 5th ed. Pearson Education, 2000.

3 CREDITS

BMB 414: MOLECULAR BIOLOGY

CREDIT:3

History and scope of molecular biology- Discovery of DNA- evidence for DNA as the genetic material.	2 Lectures
The genomes of bacteria, viruses, plasmids, mitochondria and chloroplast- Gene transfer in microorganisms- conjugation- transformation, transduction - protoplasmic fusion.	7 Lectures
Organisation of eukaryotic genome- components of eukaryotic chromatin- chromatin and chromosome structure- DNA-supercoiling -linking number- satellite DNA-possible functions- Cot curve- C- value paradox.	5 Lectures
DNA replication- Prokaryotic and eukaryotic DNA replication, mechanism of replication. Enzymes and necessary proteins in DNA replication. Telomeres, telomerase and end replication. Role of telomerase in aging and cancer.	6 Lectures
Transcription- Prokaryotic and eukaryotic Transcription- RNA polymerases- general and specific transcription factors- regulatory elements- mechanism of transcription regulation- Transcription termination	6 Lectures
Post transcriptional modification- 5' cap formation-3' end processing and polyadenylation- splicing- editing- nuclear export of mRNA- mRNA stability.	5 Lectures
Translation- Genetic code- Prokaryotic and eukaryotic translation- translational machinery- Mechanism of initiation- elongation and termination- Regulation of translation.	4 Lectures

Text Book:

1. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R. Molecular Biology of Gene. 5th The Benjamin / Cummings Pub. Co. Inc, 2003
2. Weave.R.F. Molecular Biology.3rd ed. Mc.Graw Hill Publication, 2005.

Suggested Reading:

1. Darnell, Lodish and Baltimore. Molecular Cell Biology, Scientific American Publishing Inc, 2000
2. Weaver. R. F. Molecular Biology. 3rd ed. Mc Graw Hill publication , 2005
3. Benjamin Lewin. Gene VII. Oxford University Press, 2000
4. Nelson Cox. Lehninger's Principle of Biochemistry. 3rd ed. MacMillian Worth Publ, 2000

BMB 455 METABOLISM & REGULATION LAB

CREDITS 1

1. Preparation of Lactalbumin from milk.
2. Folin-Wu method of blood glucose estimation.
3. Estimation of Calcium by Clarke & Collip method.
4. Estimation of urea by Diacetyl monoxime method.
5. Preparation of hemoglobin from blood.
6. Paper electrophoresis of serum proteins.
7. Estimation of glucose by Benedict's method.
8. Estimation of Creatinine in urine.

BMB 456 ENZYMOLOGY LAB

CREDITS 1

1. Colorimetric enzyme assay.
2. Coupled enzyme assay.
3. Determination of K_m & V_{max} of the enzymes
4. Column Chromatography
5. Partial purification of enzyme & enzyme kinetics
6. Enzyme Kinetics – determination of rate constant

BMB 458 BIOINFORMATICS LAB

1. Plasmid Construction
2. Restriction Mapping
3. PCR Primer Designing
4. Sequence Retrieval and Format Conversion
5. ORF Finding
6. Homology Search
7. Multiple Sequence Alignment
8. Gene Prediction in prokaryotes
9. Motif finding in DNA and Protein Sequences
10. Structure Visualization
11. Protein Secondary Structure Prediction
12. Phylogenetic Analysis

BMB 459

MICROBIOLOGY LAB

CREDIT: 1

1. Introduction to good laboratory practice in Microbiology-sterilization techniques
2. Preparation of liquid and solid media
3. Isolation and maintenance of Bacteria
4. Pure culture techniques-streak, pour plate and spread plate techniques
5. Bacterial growth curve, measurement of bacterial population by turbidimetry and serial dilution and colony counting methods
6. Bacterial Staining-differential staining-spore staining, Grams staining
7. In vitro antibiotic sensitivity tests
8. Preservation of cultures: slant, water stock, glycerol stock and lyophilization.

Clinical Biochemistry Lab

Course No. BMB 460

Total Credit: 1

1. Estimation of blood glucose
2. Estimation of cholesterol – HDL, LDL
3. Estimation Triglycerides and free fatty acids.
4. Determination of A/G ratio.
5. Clinical enzymology and determination of transaminases (AST, ALT) phosphatases (ALP, ACP), lactate dehydrogenase.
6. Estimation of Haemoglobin by Drabkin's method
7. Estimation of uric acid, urea and creatinine.
8. Electrophoretic separation of hemoglobins, serum proteins, lipoproteins using agarose, cellulose acetate and polyacrylamide
9. Assay of insulin and C-peptide
10. PAGE: Band detection for enzyme variants
11. Urinalysis - qualitative - characteristics of normal urine - appearance- specific gravity – reaction – microscope examination.
12. Analysis of normal and abnormal constituents in urine

BMB 461 MOLECULAR BIOLOGY LAB

1. Isolation & Purification of genomic DNA from bacteria
2. Isolation & Purification of plasmid DNA
3. Agarose gel electrophoresis of chromosomal & plasmid DNA
4. Restriction Digestion of chromosomal & plasmid DNA
5. Isolation of DNA fragment from agarose gel

BMB 501: MOLECULAR BASIS OF CELLULAR DISORDERS

3 CREDITS

1. **Inflammation and Repair/Wound healing:** Acute inflammation-Vascular changes-cellular events-chemical mediators of inflammation-chronic inflammation-morphologic patterns in acute and chronic inflammation-systemic effects of inflammation-wound healing-mechanism of wound healing-pathologic aspects of inflammation and response. 6 Lectures
2. **Hemodynamic disorders, Thrombosis & Shock:** Edema-hyperemia and congestion-hemorrhage-hemostasis and thrombosis-endothelium-platelets-coagulation system-genesis of thrombosis-fate of thrombus-embolism-pulmonary, systemic, amniotic fluid, air and fat-infarction-septic shock. 5 Lectures
3. **Red & White cell diseases:** Normal development of blood cells-anemias-hemolytic-G6PD deficiency-sickle cell-thalassemias-paroxysmal nocturnal hemoglobinuria-megaloblastic-iron deficiency – chronic disease -aplastic-marrow failure-polycythemia-bleeding disorders-leukopenia-reactive proliferation of white cells –neoplastic proliferation of white cells-leukemias & myeloproliferative disorders - plasma cell dyscrasias. 7 Lectures
4. **Neoplasia & Transformation:** Benign & malignant neoplasm-differentiation and Anaplasia-Invasion and metastasis-epidemiology of cancer incidence- molecular basis of cancer-biology of tumor growth-carcinogenic agents & their cellular interactions- host defense against tumors-tumor antigens-antitumor effector mechanisms-immunosurveillance-immunotherapy-gene therapy of tumors. Environmental and Nutritional diseases: Magnitude of environmental problem-air pollution-chemical and drug injury-adverse drug reactions-exogenous oestrogens and oral contraceptives-carcinogens-street drugs-physical injuries-mechanical force-temperature related-hyperthermic injuries-pressure related-electrical and radiation injuries- protein calories malnutrition-nutritional excesses and imbalances-obesity-diet and systemic diseases. 15 Lectures
5. **Hepatic disorders:** Hepatic injury-Hepatitis a through E-Alcohol liver disease-Drug and toxin induced liver disease- cirrhosis- pregnancy associated-transplantation associated-adenomas and primary carcinoma.

Text Book:

1. Cotran, Kumar, Robbins. Pathological Basis of Disease. 7th ed. Prism, India. 2004.

Suggested Reading:

1. Goodman & Gilman. Pharmaological Basis of therapeutics. 11th ed, McGraw Hill 2006.
2. Zilva & Pannell. Clinical Biochemistry in Diagnosis & Treatment, Lloyd Luke Publications USA.

7 Lectures

BMB 502: MOLECULAR IMMUNOLOGY

3 CREDITS

1. Introduction & overview – The origin of immunology - Principles of Immunity: Innate vs. Acquired - inherent immunity; humoral and cell mediated immunity; Immunity at Body Surfaces. Cells of the immune system - Organs of the immune system – primary and secondary lymphoid organ; B cell, T cell and macrophages; Mononuclear Phagocytic System 7 Lectures
2. Antigens - Antibodies: Antigenicity - Structure, Biological function - synthesis of antibody and secretion – antigen-antibody reaction - Polyclonal and monoclonal antibodies - Antibody genes molecular basis of antibody diversity - Mechanisms of Heavy Class Switching Antigen-antibody reactions - Major histocompatibility complex - Antigen processing and presentation 7 Lectures
3. B-cell diversity, generation, activation, differentiation - Response of B-Cells to Antigens - Genetic Basis of Ag Recognition – T-cell receptor - T-cell maturation, activation, differentiation - Effector T-Cell Functions. 7 Lectures
4. Lymphokines and Cytokines - The complement system - Cell-mediated effector responses (CTL, NK, DH) - Immune responses to infection - Vaccines 6 Lectures
5. Leukocyte recirculation and inflammation - Hypersensitive reactions (immunopathologies) allergies - AIDS and other immunodeficiencies – Autoimmunity: Breakdown in Self-Tolerance. Transplantation: tissue and organ grafting - Cancer and the immune system - Cancer Immunotherapy. 13 Lectures

Text Book:

1. I. Roitt. Essential Immunology. 10th ed. Blackwell Science, 2005

Suggested Reading:

1. Richard A. Goldsby, Thomas J. Kindt and Barbara A. Osborne. Kuby Immunology. 4th ed. W. H. Freeman & Company, 2000.
2. Eli Benjamini, Richard Coico, G. Sunshine. Immunology- A Short Course. 4th Ed. Wiley's Publication, 2000.

BMB 503: PLANT PHYSIOLOGY

3 CREDITS

1. **Introduction to Plant Physiology:** Historical perspectives. 10 Lectures
Photosynthesis: Photosynthetic pigments and light harvesting complexes, Photoinhibition of photosynthesis, Photosynthetic carbon reduction (PCR) cycle, C4 syndrome and Crassulacean acid metabolism.
2. **Cellular Respiration:** Glycolysis, Oxidative respiration, Oxidative pentose phosphate pathway, Glyoxalate cycle, alternate electron pathways and Respiration rate. 6 Lectures
3. **Nitrogen metabolism:** Physical and biological nitrogen fixation, Ammonification, Nitrification, Denitrification, Biochemistry and Genetics of nitrogen fixation and Ammonium assimilation. 12 Lectures
Lipid metabolism: Classification of lipids, Biosynthesis of fatty acids, Enzymatic degradation of fats and Physiological effects.
4. **Plant Hormones:** Biosynthesis, Physiological effects and mechanism of action of Auxins, Gibberellic acids, Cytokinins, Abscisic acid, Ethylene, Brassinosteroids and Polyamines. 6 Lectures
5. **Plant Stress physiology:** Plant stress, Plant responses to abiotic and biotic stresses, Water deficit and drought resistance, Flooding, Temperature stress, Salt stress, Ion toxicity, Pollution stress and potential biotic stress (insects and diseases). 6 Lectures

Text Book:

Salisbury, F. B. and Ross, C.W. Plant Physiology. 4th ed. Wadsworth Pub. Co. California, USA, 1992.

Suggested Reading:

1. Hopkins, W. G and Huner, N. P. A. Introduction to Plant Physiology. 3rd ed. John Wiley & Sons Inc. New York, 2004.
2. Mukherji, S and Gosh A. K. Plant Physiology. 2nd ed. New Central Book Agency, Kolkata, 2005.
3. Wilkins, M. B. Advanced Plant Physiology, English Language Book Agency, Longman, London, 1987.
4. Taiz, L. & Zeiger, E. Plant Physiology. 3rd ed. Sinamer Associates Inc. Publishers, Sunderland, USA, 2000.

UNIT -1	7h
An introduction to genetic engineering-Enzymes used in genetic engineering- Restriction endonucleases, DNA polymerases, Reverse transcriptase, Ligases, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Klenow fragment, Terminal deoxynucleotidyl transferase, RNase. Vectors for cloning- Plasmids, Bacteriophage λ , Filamentous phage vectors, Cosmids, Phagemids, YACs. Ligation of DNA fragments with vectors - Homopolymer tailing, Ligation of cohesive termini, Blunt-end ligation, Linker molecules.	
UNIT -2	7h
Introducing genes into prokaryotes- Natural gene transfer methods-Transformation, transduction, calcium chloride mediated transformation, Transfection with phage vectors. Introducing genes into eukaryotes- Gene transfer by viral transduction, Calcium phosphate mediated transformation; Liposome mediated transformation, Microinjection, Electroporation.	
UNIT -3	7h
Cloning strategies: Producing genomic libraries in λ cloning vectors, Genomic libraries in high-capacity vectors, cDNA cloning, Shotgun cloning, Cloning in <i>E.coli</i> , Identifying the recombinant DNA and its products- Immunochemical screening, Hybrid arrested translation, Nucleic acid probes.	
UNIT -4	7h
Prokaryotic expression systems –Gene expression based on bacteriophage T7 RNA polymerase, Eukaryotic expression systems- Fused genes, Unfused genes, Secreted proteins, Gene expression by transcription factors- Nfkb, PPAR, Antisense RNA technology- SiRNA, miRNA.	
UNIT -5	8h
Techniques in genetic engineering- Hybridization technique, Southern, Northern-Western blotting techniques, Site directed mutagenesis, Restriction mapping, DNA profiling in forensic science, Chromosome walking, Chromosome jumping, DNA sequencing, PCR. Basic concepts of Intellectual property rights.	

Text Books:

1. Primrose's. B., Twyman, R.M., and Old, R.W. Principles of gene manipulation. Sixth edition. Blackwell Publishers.2001.
2. Sandhya Mitra, Genetic Engineering. Macmillan India Limited. 2005.

Recommended Reading:

1. Primrose, Principles of Genome analysis. Blackwell Sciences.2003.
2. Watson. Recombinant DNA. Second edition. American Publishers.1992.
3. Sambrook, J., Fritsch, E. F., and T. Maniatis, Molecular Cloning, A Laboratory Manual, Second edition. Cold Spring Harbor Laboratory Press, New York, 1989.
4. Joseph M. Fernandez and James P. Hoeffler. Gene expression systems.Academic Press, 1999.

UNIT - 1

Introduction – Growth characteristics of cancers cells; Morphological and ultrastructural properties of cancer cells. Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. 5 h
Differences between benign and malignant tumors. Epidemiology of cancer.

UNIT -2

Cancer biology and biochemistry- Aberrant metabolism during cancer development; Paraneoplastic syndromes; Tumor markers; 8 h
cellular protooncogenes- oncogene activation.
Growth factors-EGF, TNF- α and TGF- β and growth factor receptors– Signal transduction in cancer – Role of transcription factors.

UNIT -3

Carcinogenesis- radiation and chemical carcinogenesis- stages in chemical carcinogenesis- Initiation, promotion and progression. 8 h
Free radicals, antioxidants in cancer; Viral carcinogenesis -DNA and RNA Viruses and human cancer; Cancer endocrinology.

UNIT – 4

Cell Cycle Regulation-Tumor suppressor genes p53, p21, Rb, BRACA1 and BRACA2. Telomeres, Telomerase, and Immortality; cell-cell interactions, cell adhesion-invasion and metastasis - VEGF 10 h
signaling, angiogenesis; Epigenetics-Role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes;
Apoptosis in cancer-Cell death by apoptosis–role of caspases;
Death signaling pathways-mitochondrial and death receptor pathways.

UNIT -5

Strategies of anticancer drug therapy – chemotherapy - gene therapy. 8 h
Immunotherapy and Radiotherapy; Stem Cells and Cancer.

Text Book:

1. The Biological Basis of Cancer: R. G. McKinnell, R. E. Parchment, A. O. Perantoni, G. Barry Pierce, I. Damjanov. 2nd Edition, Cambridge University Press, 2006.
2. The Biology of Cancer: R. A. Weinberg. Garland Science. 2006.

Recommended Reading:

1. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication. 2002
2. The Cancer Hand Book: Malcolm R. Alison. Nature Publishing Group. 2003

BMB 551: MOLECULAR IMMUNOLOGY LAB

CREDIT: 1

1. Analyses of Antigens: Immunodiffusion (Ouchterlony) method.
2. Immuno-electrophoresis (IEP).
3. SPE: Serum Protein Electrophoresis
4. Preparation of mouse spleen cells
5. Isolation of lymphocytes.
6. Cell counting.
7. Immunoaffinity chromatography.
8. Generation and purification of polyclonal antibodies.
9. ELISA.

BMB 552: PLANT PHYSIOLOGY LAB

CREDIT: 1

1. Estimation of total chlorophyll, chlorophyll a and b, xanthophylls and carotenoid pigments from the leaves.
2. Isolation of chloroplasts and estimation of photochemical activity.
3. Determination of Chlorophyll a, Chlorophyll b in C3 and C4 plants.
4. Estimation of starch content by Anthrone reagent.
5. Spectrophotometric estimation of Indoleacetic acid in plant tissues.
6. Determination of nitrate reductase activity in crop plants under low water regimes.
7. Determination of Gibberellic acid by half seed method.
8. Determination of succinic dehydrogenase activity with and without inhibitors.
9. Determination of peroxidase activity.
10. Determination of protein under abiotic stress.

BMB-554

GENETIC ENGINEERING LAB

CREDIT - 1

Culture of *E.coli* cells & plasmid isolation
Preparation of competent cells
Calcium chloride mediated transformation
Ligation of DNA
Polymerase chain reaction
Restriction fragment length polymorphism
Random amplified polymorphic DNA
Cloning of GFP protein

BMB 506: PROTEOMICS

CREDIT : 3

Protein Profiling

Introduction: Human genome, From Genomes to Proteomes- Proteomics. Branches of proteomics: Protein separation, Protein identification, Protein quantification, Protein sequence analysis, Structural proteomics, Interaction proteomics, Protein modification, and Cellular proteomics.

Sample handling and storage: Preparation of Sample, Subcellular fractionation, Density gradients, Affinity, Protein fractionation, Ultrafiltration.

Purification: Removal of interfering compounds, Salts, DNA, lipids, Protein solubilisation, Disulfide bonds, chaotropes, detergents, etc.

Detection and quantitation: Chemical tagging, fluorescence, negative staining, Radio-labelling.

Protein expression and interaction

Protein Expression system: transfection, transformation, transduction, induction, detection and purification of expressed transgenes.

Protein/peptide chemical Synthesis: Biotinylated product, Antibody Production & Engineering

Protein Interactome: Methodology for detection, protein-protein interactions. Protein Arrays: protein-polynucleotide, interactions with other Biomolecules, Signalling Complex, Liposome, reconstitution of membrane protein in lipid vesicles.

Protein Identification/ Protein Post-Separation Analysis

X-ray crystallography and nuclear magnetic resonance - Tandem mass spectrometry combined with reverse phase chromatography or 2-D electrophoresis - Affinity chromatography - fluorescence resonance energy transfer (FRET), Surface Plasmon Resonance (SPR) - X-ray Tomography.

Proteome analysis – Algorithms for proteomics – Protein expression profiling – protein arrays – Protein microarrays. Advantages and disadvantages of DNA and protein microarrays.

Analysis of profile in normal and disease condition: Body Fluids, Lipid & Kidney, Blood diseases, Diabetes, Infectious Diseases, Stroke & Myocardial infarction, Nervous System, Alzheimer, Low abundance and hydrophobic proteins. High through put technique to identify the protein molecules in the sample.

Text Book:

1. Twyman, R. M. Principles of proteomics. BIOS Scientific Publishers, New York. 2004.
2. Liebler, D. C. Introduction to Proteomics: Tools for the New Biology. Humana Press, Totowa, NJ. 2002.

Suggested Reading:

1. Westermeier, R. and T. Naven. Proteomics in Practice: A Laboratory Manual of Proteome Analysis. Weinheim: Wiley-VCH, 2002.

BMB 507: MOLECULAR ENDOCRINOLOGY

3 CREDITS

1. Definition and scope of molecular endocrinology. Steroid hormones: structure, biosynthesis and transport - dynamics of steroid hormone production and metabolism - mechanism of action of sex steroid hormones. 8 Lectures
2. Peptide hormones: gonadotropins - cell surface receptors - signal transduction - second messengers - protein kinases - regulation of gene expression. 8 Lectures
3. Applications of molecular biology to reproduction: peptide hormone receptor genes - sexual differentiation - testicular and ovarian determining genes - mullerian inhibiting substance genes. 7 Lectures
4. Molecular basis of endocrinopathies- Hormones, receptors, transduction and transcription. Molecular targets of male and female contraception. 12 Lectures
5. Principles of radioimmunoassay and enzyme linked immunoassays – basic principles and measurement of steroid hormone receptors. 5 Lectures

Text Book:

1. Bolander, F. F. Molecular Endocrinology, III ed. Academic Press, 2004.
2. R. A Lobo, D.R. Mishell (Jr.), R.J. Paulson, D. Shoupe. Text Book of Infertility, Contraception, and Reproductive Endocrinology, 4th ed. Blackwell Science, Malden, M. A, U.S.A, 1997.

Suggested Reading:

1. Knobil & Neill's Physiology of Reproduction – III Edition, J.D. Neill (Ed in chief), Elsevier Academic Press, 2006.
2. L. Hermo, Y. Clermont, Ed. B. Robeira, J.L. Pryor, J. M. Transler, Handbook of Andrology. American Society of Andrology, San Francisco, 1995.
3. T.D. Pollard, W. C. Earnshaw. Cell Biology. Saunders, New York, 2002
4. L.D. Russell, M.D. Griswold. The Sertoli Cell. Clearwater Cache River Press,

BMB 508: PLANT BIOTECHNOLOGY

3 CREDITS

Introduction to cell and tissue culture-Medica composition and preparation
Culture types callus culture cell suspension culture, protoplast culture and etc., Somatic embryogenesis, organogenesis, Embryo culture and embryo rescue. 07 Lectures

Protoplast isolation, Protoplast culture and fusion, selection of hybrid cells,cybrids, somaclonal variation. Anther culture, pollen culture and ovary culture for production of haploid plants. Germplasm storage and cryo-preservation. 8 Lectures

Basic features of vectors for plant transformation-promoter and terminator, selectable markers- Antibiotic resistance marker, Antimetabolite resistance marker and reporter genes GUS gene, Lux gene and GFP protein. 8 Lectures
Co-integrate and binary vectors, Agrobacterium mediated gene transfer Ti plasmid, the process of T DNA transfer and integration, direct gene transfer methods – particle bombardment, PEG transformation, Electroporation.

Application of transgenesis in crop improvement – Insect resistance, disease resistance, virus resistance herbicide resistance, and resistance to abiotic stress. 9 Lectures
Transgenesis for production of carbohydrates, lipids, protein and vaccines
Transgenesis for male sterility and terminator seed. Transgenic plant-Bt cotton, Plant genome-Rice

Molecular markers and their uses in plant biotechnology-Molecular markers – Restriction fragment length, polymorphism, **Randomly** amplified polymorphic DNA, DNA amplication fingerprinting (DAF)Amplified fragement length polymorphism (AFLP), Single sequence repeats (SSR) arbitrarily printed PCR (AP PCR) 8 Lectures

Text Book:

1. Slater A, NW Scott, MR Fowler. Plant bio technology, Oxfor University Press, 2003
2. Hans Walter Heldt. Plant Biochemistry & Molecular Biology Oxford University Press 1997

Suggested Reading:

5. Lea and Leagood. Plant Biochemistry and Molecular Biology, John Wiley & Sons.2nd ed 1993.
6. Ramawat KG & JM Merillon. Biotechnology of Secondary Metabolites Oxford & IBH Pub.1999

UNIT - 1

Developmental Neurobiology: Organogenesis and neuronal multiplication, axonal and dendritic growth, glial multiplication and myelination, growth in size, 5 h regeneration and repair mechanisms, plasticity.

UNIT -2

Neuromorphology and neurocellular anatomy: Central nervous system – General features of neurons, cellular organization of neurons, Dendrites and Axons, neurotubules, neurofilaments, synapse neuralgia, astrocytes, oligodendrocyte, ependymal cells, Schwann cells.

Peripheral nervous system (PNS): Muscle, nerve endings, sensory receptor and effector endings; peripheral nerves, spinal and cranial nerves: Plexuses ganglia, afferent pathways and sense organs. 10 h

Spinal cord: Topographical anatomy, spinal nerves, spinal meninges, joint reflexes, gray and white matter of spinal cord.

UNIT - 3

Neurotransmitters: Acetylcholine, Dopamine, Norepinephrine, Serotonin, Histamine, Epinephrine, Gamma-aminobutyric acid, Glycine, Glutamate, Aspartate, NO₂, and CO - Chemistry, synthesis, storage and release of neurotransmitters, transmitter action, synaptic modulation and mechanism of neuronal integration. Secondary Messengers: Importance of cyclic nucleotides and protein phosphorylations in nervous system. Involvement of protein kinases and calcium in neuronal metabolism. 12 h

Neuropeptides: Classes of neuropeptides, mode of action, role of neuropeptides in obesity and pain neuropeptide receptors.

UNIT - 4

Learning and Memory: Correlation of behavioral and biochemical events, measurement of learning and memory, agents affecting learning and memory, biochemical correlates of excitation, learning and behavior. 5 h

UNIT - 5

Neurodegenerative diseases: Parkinson's, Alzheimer's disease, amyotrophic lateral sclerosis, senile dementia. Psychopharmacology and Biochemical theories of Mental Disorder: Chemistry of neuroleptics and anxiolytics, antidepressants, hallucinogenic agents, biochemical theories of mental disorders. 10 h

Text Books:

1. Basic Biochemistry: Siegel A.R, 3rd ed. 2004
2. Elements of Molecular Neurotoxicology : Smith C. U. M, 7th ed. 2003.

Recommended readings.

1. Text Book of Medical Physiology: Guyton A. G, and Harcourt Hali. J. E, 10th ed. 2001
Review of Medical Physiology: Lange Ganong W. F, 12th ed, 1985 Medical pub.
2. Neuro anatomy: Grossman S. R, and Neavy O, 11th ed, 2002.

UNIT -1	8h
The stages of animal development, Human spermatogenesis and oogenesis, Structure of the human sperm and the egg, Molecular events during mammalian fertilization: Action at a distance, Induction of the mammalian acrosomal reaction, Translocation and capacitation, Hyperactivation and chemotaxis, Fusion of genetic material in mammals, Prevention of Polyspermy.	
UNIT -2	8h
An introduction to early developmental processes in mammals: The unique nature of mammalian cleavage, Mammalian gastrulation, Formation of extra embryonic membranes, Mammalian anterior-posterior axis formation, Mammalian dorsal-ventral and left-right axes formation.	
UNIT -3	8h
Chromosomal sex determination in mammals: Primary and secondary sex determination, Temperature-dependent sex determination in reptiles, Induction and competence. Postembryonic development- Metamorphosis of frog: Morphological changes associated with metamorphosis, Biochemical changes associated with metamorphosis, Epimorphic regeneration of Salamander limbs.	
UNIT -4	6h
Embryological origins of the gene theory, Mechanism of X chromosome inactivation, Theories of ageing: Evolutionary theories of ageing, Integrated theory of ageing in the nematode <i>Caenorhabditis elegans</i> .	
UNIT -5	6h
Properties of stem cells, Pluripotency of human embryonic stem cells, Embryonic stem cell lines, Hematopoietic stem cells, Markers commonly used to identify stem cells, Embryonic stem cells and their applications.	

Text Books

1. Balinsky, B.I. An Introduction to Embryology. W. B. Saunders Publishing Company. 2004.
2. Scott F. Gilbert. Developmental Biology. Sinauer Associates, INC Publishers, Sunderland. 2000.

Recommended reading

1. Jonathan, M.W. Essential Developmental Biology. Wiley Blackwell Publishers, 1991.
2. Longo, F.J. Fertilization. Chapman and Hall publishers, New York. 1997.

