

PONDICHERRY UNIVERSITY



Biochemistry & Molecular Biology

CURRICULUM / SYLLABUS

2011-2012 ONWARDS

Puducherry - 605014, India.

PONDICHERRY UNIVERSITY
SCHOOL OF LIFE SCIENCES
DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY

Admission Process

Selection of students to M. Sc. Programs is based on National Level Entrance Examination conducted by Pondicherry University at 40 different centers in the country. The test consists of objective type questions in Biochemistry, Molecular Biology, Zoology, Botany, Chemistry, Biophysics, Microbiology, Genetics, Physiology and allied areas. In addition, UGC/CSIR- NET qualified students are admitted directly to the Ph.D. program. Students joining the Ph.D. Program also have to take the National level Entrance exam and based on their merit in the rank list, are entitled to receive the University Research Fellowship. Project Fellows desirous of registering for the Ph.D. program need to appear for the Entrance Examination.

Curriculum goals/Objectives: The curriculum of this Department incorporates classical to recent concepts within different areas of each subject offered, and updates syllabus with periodic revision exercises, ensured by the Board of Studies and ratified through the School Board. The curriculum is made with a view to impart fundamental knowledge in the field of Biochemistry and Molecular Biology to students admitted from diverse academic backgrounds. The theory and practical sessions augment their ability to understand the implications of the scientific and technical approaches involved in this domain of knowledge, enabling to mold them into prospective skillful scientific workforce for the future.

EVALUATION

The student assessment followed in this department is as per the regulations notified by the Office of the Controller of Exams, Pondicherry University.

All subjects in the PG program carry an Internal assessment component. Students are expected to secure 40 % in the internal evaluation and 60% in end Semester external evaluation modes. Each teacher is expected to organize continuous assessment modes for each course assigned to him/her. The internal assessment is categorized into 30 marks for internal assessment tests/Term papers/Quizzes and 10 marks for Seminars/Assignment/Presentation/Write ups/Viva, etc. There is double evaluation of answer scripts for the end semester exams. Where the difference in evaluation is more than 15% of marks, the answer

paper shall be revalued by an Examination Committee. A failed student who fulfils the required attendance shall have a minimum 40% in internal assessment for being permitted to register for the end semester exam. Students who have failed due to insufficient attendance and / or less than 40% in internal assessment marks should repeat the course as when it is offered. Performance of students in each paper is expressed in terms of marks as well as in letter grades. A student is not permitted to repeat any course only for the purpose of improving the grade. The grades are arrived at by dividing the difference between the highest mark secured and the minimum pass mark by 6 (as there are six passing grades). The formula is as given below:

$$K = (X-50)/6 \text{ where, } K = \text{class interval, } X = \text{the highest mark in the subject.}$$

GRADING

TABLE I

Range of Marks in %	Letter Grade	Points for Calculation of GPA/CGPA
X to (X-K)+1	A+	10
(X-K) to (X-2K)+1	A	9
(X-2K) to (X-3K)+1	A-	8
(X-3K) to (X-4K)+1	B+	7
(X-4K) to (X-5K)+1	B	6
(X-5K) to 50	C	5
Below 50	F	0
Failure due to lack of attendance	FA	0

K should not be rounded off to less than two decimal places. The numbers given in range of Marks column, (X-K), (X-2K), (X-3K), etc., can be rounded off to the nearest whole number.

In courses where the number of students who have secured 50 marks and above is less than 10 then grading may be given based on Table II.

TABLE II

Range of Marks in %	Letter Grade	Points for Calculation of GPA/CGPA
81-100	A+	10
71-80	A	9
66-70	A-	8
61-65	B+	7
56-60	B	6
50-55	C	5
Below 50	F	0

The GPA and CGPA will be calculated as weighted average of points secured by the student in all papers registered. The weights are number of credits for each paper. For example, a student getting an A grade in 4 credit course, A- grade in 2 credit course, A+ grade in a 3 credit course and F grade in a 3 credit course will have a GPA as $(9 \times 4 + 8 \times 2 + 10 \times 3 + 0 \times 3) / (4 + 2 + 3 + 3) = (36 + 16 + 30 + 0) / 12 = 82 / 12 = 6.83$ out of 10.0; GPA = 6.83. The CGPA shall also be calculated in similar lines including all the subjects taken by a student in all semesters. Students with CGPA of 9.0 and above, without fail in any of the courses taken shall be awarded distinction. A CGPA of 6.0 and above shall be placed in first class. Students who secure less than 50% marks in any paper gets F grade and is treated as failed in the particular paper.

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SYLLABI FOR M.Sc. BIOCHEMISTRY AND MOLECULAR BIOLOGY
(2011-2012 ONWARDS)

SL.NO.	NAME OF THE COURSE	CREDIT	PAGE NO
FIRST SEMESTER			
BMB 401	BIOMOLECULES	3	1
BMB 402	HUMAN PHYSIOLOGY	3	2
BMB 404	ANALYTICAL BIOCHEMISTRY & BIOPHYSICS	3	3
BMB 405	BIostatISTICS & SCIENTIFIC WRITING (Soft Core)	3	4
BMB 418	CELL BIOLOGY	3	5
BMB 451	BIOMOLECULES LAB	1	6
BMB 452	HUMAN PHYSIOLOGY LAB	1	7
BMB 454	ANALYTICAL BIOCHEMISTRY & BIOPHYSICS LAB	1	7
BMB 463	CELL BIOLOGY LAB	1	8
SECOND SEMESTER			
BMB 407	ENZYMOLoGY	3	9
BMB 413	ENDOCRINOLOGY	3	10
BMB 414	MOLECULAR BIOLOGY	3	11
BMB 415	PLANT BIOCHEMISTRY & BIOTECHNOLOGY	3	12
BMB 416	METABOLISM & REGULATION	3	13
BMB 417	GENERAL MICROBIOLOGY	3	14
BMB 456	ENZYMOLoGY LAB	1	15
BMB 461	MOLECULAR BIOLOGY LAB	1	15
BMB 462	PLANT BIOCHEMISTRY & BIOTECHNOLOGY LAB	1	16
BMB 464	METABOLISM & REGULATION LAB	1	16
BMB 465	MICRO BIOLOGY LAB	1	17

SL.NO.	NAME OF THE COURSE	CREDIT	PAGE NO
THIRD SEMESTER			
BMB 501	MOLECULAR BASIS OF CELLULAR DISORDERS	3	18
BMB 510	CANCER BIOLOGY	3	19
BMB 513	MOLECULAR IMMUNOLOGY	3	20
BMB 514	CLINICAL BIOCHEMISTRY (Soft core)	3	21
BMB 515	GENETIC ENGINEERING	3	22
BMB 554	GENETIC ENGINEERING LAB	1	23
BMB 555	MOLECULAR IMMUNOLOGY LAB	1	24
BMB 570	SEMINAR	1	
FOURTH SEMESTER			
BMB 511	NEUROBIOLOGY (Soft Core)	3	25
BMB 512	DEVELOPMENTAL BIOLOGY (Soft Core)	3	26
BMB 516	PROTEOMICS	3	27
BMB 517	MOLECULAR ENDOCRINOLOGY	3	28
BMB 575	PROJECT (Soft Core)	4	

Ph.D., SYLLABI

BMB 701	RESEARCH METHODOLOGY	6	29
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BMB 401**BIOMOLECULES****3 CREDITS****UNIT- I**

Biomolecules- chemical composition and bonding - chemical reactivity - ionization of water - weak acids and weak bases - buffers - buffering in biological systems.

4 Lectures

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

UNIT- II

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

UNIT- III

Proteins-primary- secondary- tertiary and quaternary structure- Ramachandran plot- super secondary structures- helix loop helix- $\beta\alpha\beta$ - biosynthesis of urea.

6 Lectures

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

UNIT- IV

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

UNIT- V

Nucleic acids- types and structural organization- triple helix of DNA- DNA denaturation and renaturation- hypochromicity- T_m .

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****UNIT I**

Introduction- Internal environment and homeostasis- coordinated body functions. 3 Lectures

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

Nerve physiology-Structure of neuron and synapse- excitability- action potential- conduction of never impulse-synaptic transmission- neurotransmitter systems. 4 Lectures

Muscle physiology- skeletal and smooth muscle- electrical properties and ionic properties- types of muscle contraction- Neuromuscular transmission. 4 Lectures

Text Book:

1. Pal, G.K. Textbook of Medical Physiology, Ahuja Publishing House, Delhi, 2007
2. Hall. J.E. Guyton and Hall Textbook of Medical Physiology. 12th ed. Saunders, Elsevier Inc., , 2011.

Suggested Reading:

1. Barrett KE, Brooks HL, Boitano S and Barman SM, Ganong's Review of Medical Physiology, 23rd Ed., McGraw-Hill Medical, 2009.

BMB 404 ANALYTICAL BIOCHEMISTRY & BIOPHYSICS 3 CREDITS

UNIT- I

Electrochemical techniques- basic principles- The pH electrode- Ion-selective-gas- sensing and oxygen electrodes- Elementary details of biosensors. 3 Lectures

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

UNIT- II

Principles of analytical instrumentation- techniques and applications of Electron spin resonance- Nuclear magnetic resonance- Circular Dichroism (CD) - Optical Rotary Dispersion (ORD). 5 Lectures

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. 3 Lectures

UNIT- III

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

UNIT- IV

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

UNIT- V

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

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.

BMB 405 BIostatistics & Scientific Writing 3 CREDITS

UNIT- I

Introduction- definition of statistics-population and universe- the sample and population- statistical inference- parameter and statistics 3 Lectures

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

UNIT- II

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

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

UNIT- III

Analysis of variance- Introduction –procedure-F and t test. 4 Lectures

UNIT- IV

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

UNIT- V

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 418**CELL BIOLOGY****3 CREDITS****UNIT- I**

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.

9 Lectures

Biomembranes- Structural organization- Models of a plasma membrane, Membrane permeability- Transport across cell membranes- Transmembrane signals- Artificial membranes- liposome.

UNIT- II

Micro bodies-Peroxisomes, Glyoxysomes and Lysosomes and their functions. The Cytoskeleton-microtubules and microfilaments.

6 Lectures

The extracellular matrix-collagen, elastin, fibrillin, fibronectin, laminin and proteoglycans.

UNIT- III

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

UNIT- IV

Endomembrane system- Endoplasmic reticulum- protein segregation- microsomes- functions of endoplasmic reticulum- Golgi complex and cell secretion- Protein glycosylation.

8 Lectures

Ribosomes- Structural organization.

Nucleus- Internal organization- Nuclear pore complex- Nucleosomes, Chromatin.

UNIT- V

Cell cycle - Different stages of mitosis – significance of meiosis - Cohesins and condensins in chromosome segregation, Microtubules in spindle assembly, Structure of kinetoshore, centrosomes and its functions,

7 Lectures

Components in cell cycle control - Cyclin, CDKs, Check points in cell cycle, phase dependent cyclic CDK complexes.

Text Book:

1. Essential Cell Biology, 3rd edition, by Alberts *et al.*, Garland. Publishing Co., 2009.
2. Raven, P.H *et al*, Biology, 7th edition Tata McGrawHill publications, New Delhi, 2006.

Suggested Reading:

- 1.Campbell NA and Reece JB. Biology, 8th edition, Pearson Benjamin Cummings, San Francisco. 2008.

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.

REFERENCE

1. Nigam. 2007. Lab Manual Of Biochemistry. By. Tata McGraw-Hill Education, USA.

BMB 452**HUMAN PHYSIOLOGY LAB****1 CREDIT**

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. Determination of Blood Pressure by Sphygmomanometry

REFERENCE

G.K.Pal & P. Pal. 2006. Textbook of Practical Physiology. 2nd Edn. Orient Blackswan.

ANALYTICAL BIOCHEMISTRY & BIOPHYSICS LAB**BMB 454****1 CREDIT**

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.

REFERENCE:

T S Work and E Work, 2009. Laboratory techniques in biochemistry and molecular biology. by Amsterdam, North-Holland Pub. Co.,

1. Observation of prokaryotic and eukaryotic cells with the help of light micrographs
2. Arrest and observation of chromosomes after colchicine treatment in onion roots.
3. Different stages of Meiosis.
4. Cell fractionation
5. Isolation of Goat RBC membrane and estimation of Na^+/K^+ ATPase.
6. Determination of osmotic fragility of RBC (Goat).
7. Isolation of peroxisomes and determination of catalase assay
8. Isolation of mitochondria and Determination of succinate dehydrogenase activity.

REFERENCE

Becker WM Kleinsmit, LJ, Hardin J, and Bertoni GP, 2009. The World of the Cell, seventh edition. Pearson/Benjamin-Cummings, Boston, MA.

UNIT- I

Enzymes- historical perspective- nomenclature- methods of isolation and purification- enzyme units- substrate specificity. 3 Lectures

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

UNIT- II

Enzyme inhibition- Irreversible- reversible- competitive- non-competitive - uncompetitive inhibition- Graphical analysis. 4 Lectures

UNIT- III

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

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

UNIT- IV

Carboxypeptidase- Lysozyme- enzyme structure- catalytic mechanism- Phillips mechanism. 4 Lectures

UNIT- V

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

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.

UNIT -I

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. 7 lectures
Feed back regulation of endocrine system.

UNIT -II

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

UNIT -III

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

UNIT -IV

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

UNIT -V

Hormones of female reproductive system: ovarian steroid hormones- Chemistry & biochemical functions.
Hormones of Male reproductive system: Source, synthesis, chemistry and 8 lectures
metabolism of Androgens.
Endocrine dysfunction-Hypophysical 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

Suggested 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.

UNIT I

History and scope of molecular biology- Discovery of DNA- evidence for DNA as the genetic material. The genomes of bacteria, viruses, plasmids, mitochondria and chloroplast- Gene transfer in microorganisms- conjugation- transformation, transduction - protoplasmic fusion. 9 Lectures

UNIT II

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

UNIT III

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. 9 Lectures
DNA Repair- Mismatch, Base-excision, Nucleotide-excision and direct repair
DNA recombination- Homologous, site-specific and DNA transposition

UNIT IV

Transcription- Prokaryotic and eukaryotic Transcription- RNA polymerases- general and specific transcription factors- regulatory elements- mechanism of transcription regulation- Transcription termination. Post transcriptional modification- 5' cap formation-3' end processing and polyadenylation- splicing- editing- nuclear export of mRNA- mRNA stability. 8 Lectures

UNIT V

Translation- Genetic code- Prokaryotic and eukaryotic translation- translational machinery- Mechanism of initiation- elongation and termination- Regulation of translation. 5 Lectures

Text Book:

1. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R. Molecular Biology of Gene. 6th The Benjamin / Cummings Pub. Co. Inc, 2008
2. Lehninger's Principles of Biochemistry, sixth Edition, 2009
Publisher: W. H. Freeman; 6th edition | ISBN: 071677108X

Suggested Reading:

1. Darnell, Lodish and Baltimore. Molecular Cell Biology, Scientific American Publishing Inc, 2000
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular biology of the Cell. 4th ed. Garland publishing Inc, 2002
3. Benjamin Lewin. Gene VII. Oxford University Press, Nelson Cox.

BMB 415 PLANT BIOCHEMISTRY AND BIOTECHNOLOGY**UNIT- I**

Introduction to Plant cells

Photosynthesis: Chloroplast- structure and function; Photosynthetic pigments and light harvesting complexes, Photo inhibition of photosynthesis, Photosynthetic carbon reduction (PCR) cycle, C4 syndrome and Crassulacean acid metabolism. Oxidative respiration, Alternate electron pathways and Respiration rate.

8 Lectures

UNIT- II

Nitrogen metabolism: Physical and biological nitrogen fixation, Ammonification, Nitrification, Denitrification, Biochemistry and Genetics of nitrogen fixation and Ammonium assimilation.

10 Lectures

Plant Hormones: Biosynthesis, Physiological effects and mechanism of action of Auxins, Gibberellic acids, Cytokinins, Abscisic acid, Ethylene, Brassinosteroids and Polyamines.

UNIT- III

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

UNIT- IV

Introduction to tissue culture-Media composition and preparation.

Culture types callus culture cell suspension culture, protoplast culture and etc., Somatic embryogenesis, organogenesis, Embryo culture and embryo rescue. Micropropagation.

6 Lectures

Protoplast isolation, Protoplast culture and fusion, selection of hybrid cells, cybrids, somaclonal variation. Germplasm storage and cryo- preservation.

UNIT- V

Application of transgenesis in crop improvement – Insect resistance, disease resistance, virus resistance herbicide resistance, and resistance to abiotic stress.

Transgenesis for male sterility and terminator seed. Transgenic plant-Bt cotton, Bt brinjal, Plant genome-Rice

6 Lectures

Text Book:

1. Mukherji, S and Gosh A. K. Plant Physiology. 2nd ed. New Central Book Agency, Kolkata, 2005.
2. Slater A, NW Scott, MR Fowler. Plant bio technology, 2nd ed. Oxford University Press, 2008.

Suggested Reading:

1. Hopkins, W. G and Huner, N. P. A. Introduction to Plant Physiology. 3rd ed. John Wiley & Sons Inc. New York, 2004.

BMB 416 METABOLISM AND REGULATION 3 CREDITS

UNIT-I

General introduction- Metabolism- Anabolism- Catabolism- Vitamins- Coenzymes–Antimetabolites. 2 Lectures

UNIT-II

Carbohydrates metabolism- Pentose phosphate pathway- Glyoxylate pathway- Xenobiotic metabolism. 4 Lectures

Metabolism of Lipids- Oxidation of fatty acids - Beta oxidation, alpha oxidation and omega oxidation, Oxidation of fatty acids with odd number of carbon atoms. Ketogenesis, Biosynthesis of saturated fatty acids and unsaturated fatty acids. Biosynthesis and degradation of triacylglycerol and phospholipids. Biosynthesis and degradation of cholesterol. Arachidonate metabolism- Prostaglandin biosynthesis. 6 Lectures

UNIT-III

Metabolism of Proteins- Synthesis of Non-essential amino acids, Urea cycle reactions - interrelations between metabolism of carbohydrates, lipids and amino acids. 6 Lectures

Biosynthesis and Catabolism of Porphyrins- Heme- Bile pigments-transport and excretion- Biosynthesis and Catabolism of Purines and Pyrimidines. 7 Lectures

UNIT-IV

Genetic errors of metabolism- Representative examples - phenylketonuria, alkaptonuria, sickle cell anemia- galactosemia, cystinuria, Thalasemia. 5 Lectures

UNIT-V

Metabolic regulation-Regulation of carbohydrate metabolism- Glycogen metabolism- TCA cycle regulation, Regulation of lipid metabolism-Regulation of fatty acid biosynthesis- Regulation of cholesterol biosynthesis-Regulation of fatty acid oxidation, Regulation of purine and pyrimidine biosynthesis. 6 Lectures

Text Book:

1. Nelson.D.L, Cox. M. M. Lehninger s Principle of Biochemistry. 5th ed. Freeman, 2008
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.4th edition, John Wiley, 2010.

UNIT I

History and Scope of Microbiology; Classification of Microorganisms-Bacteria, Fungi, Virus, Alga, Protozoa ; sterilization techniques, disinfectant and antiseptic agents.

6 Lectures

Microscopy - types of microscopes and their applications-simple and compound, bright field, dark field, fluorescence, phase-contrast and electron microscopes.

UNIT II

Major groups of bacteria- Archaeobacteria, Actinomycetes, Chemoautotrophs, Eubacteria, Pseudomonads, cyanobacteria, Rickettsias, chlamydias and spirochetes; B: 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, and antibacterial agents and their mode of action; antibiotic resistance.

6 Lectures

UNIT III

Classification, morphology and characteristics of Virus, and Fungi - structure of DNA, RNA viruses, replication of animal viruses, bacteriophages- Lysogeny and Lytic cycle; virus like agents- satellites, viroids and prions; mode of action of antiviral and antifungal drugs ; Classification of Protozoa and Helminthic parasites; L cycle of malarial and filarial parasites; Antihelminthic and antiprotozoan drugs.

8 Lectures

UNIT IV

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.

6 Lectures

UNIT V

Microbes and Diseases-major human diseases caused by bacterial, viral and fungal pat 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, and HIV; Diseases of GIT- Cholera, shigellosis, salmonellosis, amebiasis, Escherichia gastroenteritis- ETEC, EIEC; Typhoid; Hepatitis; Major human protozoan diseases- Malaria, Trypanosomiasis, meningoencephalitis, Toxoplasmosis.

10 Lectures

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:

1. Jacquelyn G. Black Microbiology-Principles and explorations 6th edition: Publisher John Wiley & Sons 2004
2. Robert W. Bauman Microbiology Brief edition : Pearson Benjamin Cummings 2004

BMB 456**ENZYMولوجY LAB****1 CREDIT**

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
7. Enzyme inhibition studies

REFERENCE

1. Hans Bisswanger. Practical enzymology. 2nd ed. John Wiley & Sons, 2011.

BMB 461**MOLECULAR BIOLOGY LAB****1 CREDIT**

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

REFERENCE

- J Sambrook & D. W. Russell (2001). Molecular cloning: a laboratory manual Vol 1,2 & 3, CSHL Press.

BMB 462

1 CREDIT

PLANT BIOCHEMISTRY AND BIOTECHNOLOGY LAB

1. Estimation of total chlorophyll, chlorophyll a and chlorophyll b pigments from the leaves.
2. Estimation of starch content by Anthrone reagent.
3. Spectrophotometric estimation of Indole acetic acid in plant tissues.
4. Determination of Gibberlic acid by half seed method.
5. Determination of peroxidase activity.
6. Determination of protein under abiotic stress.
7. Isolation of plant genomic DNA
8. Isolation of chloroplast DNA

REFERENCE:

Sadasivam, S, and Manickam, A., (2001), Biochemical Methods, 3rd edition, New Age International Publishers, New Delhi

BMB 464

METABOLISM AND REGULATION LAB

1 CREDIT

1. Preparation of lactalbumin from milk
2. Estimation of reducing sugar by DNSA (dinitrosalicylic acid) method
3. Estimation of glucose by Benedict's method
4. Estimation of urea by Diacetyl monoxime method
5. Estimation of uric acid
6. Estimation of creatinine in urine
7. Estimation of cholesterol by ZAK's method
8. Estimation of calcium by Clarke and Collip method
9. Estimation of pyruvate by DPNH (2,4-dinitrophenylhydrazine) method

Reference:

Harold Varley, 1988, Practical Clinical Biochemistry, 6th edition, edited by H.Gowenlock with the assistance of Janet R. McMurray and Donald M..McLauchlan, Heinemann Medical in London

BMB 465

GENERAL MICROBIOLOGY LAB

1 CREDIT

1. Introduction to sterilization techniques
2. Preparation of liquid and solid media
3. Isolation of Bacteria from soil –serial dilution technique
4. Bacterial Staining-differential staining-spore staining, Grams staining
5. Biochemical tests for bacteria
6. Measurement of bacterial population by turbidimetry and colony counting methods
7. Pure culture techniques-streak plate, spread plate techniques and pour plate
8. Bacterial growth curve
9. In vitro antibiotic sensitivity tests
10. Preservation of cultures: slant, water stock, glycerol stock and lyophilization.

REFERENCE:

Cappuccino Sherman. Microbiology A Laboratory Manual, Sixth Edition. Pearson education, 2004.

BMB 501 MOLECULAR BASIS OF CELLULAR DISORDERS 3 CREDITS

UNIT- I

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

UNIT- II

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

UNIT- III

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

UNIT- IV

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- hot 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

UNIT- V

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. 7 Lectures

Text Book:

1. Cotran, Kumar, Robbins. Pathological Basis of Disease. 7th ed. Prism, India. 2004.
2. Harold Varley. Clinical Practical Biochemistry. Arnold Heinman Publisher

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.

UNIT – I

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 lectures

Differences between benign and malignant tumors. Epidemiology of cancer.

UNIT- II

Cancer biology and biochemistry- Aberrant metabolism during cancer development; Paraneoplastic syndromes; Tumor markers; cellular protooncogenes- oncogene activation.

8 lectures

Growth factors-EGF, TNF- α and TGF- β and growth factor receptors–Signal transduction in cancer – Role of transcription factors.

UNIT- III

Carcinogenesis- radiation and chemical carcinogenesis- stages in chemical carcinogenesis- Initiation, promotion and progression.

8 lectures

Free radicals, antioxidants in cancer; Viral carcinogenesis -DNA and RNA Viruses and human cancer; Cancer endocrinology.

UNIT- IV

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 signaling, angiogenesis; Epigenetics-Role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes;

10 lectures

Apoptosis in cancer-Cell death by apoptosis–role of caspases;

Death signaling pathways-mitochondrial and death receptor pathways.

UNIT- V

Strategies of anticancer drug therapy – chemotherapy - gene therapy.

8 lectures

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

UNIT I

Types of Immunity - Innate and acquired immunity; Innate basic immunity -physical, physiological defenses, acute phase proteins and interferons; Acquired Immunity-natural, artificial, active and passive immunity; Humoral and Cell mediated immunity; cells of the immune system – myeloid lineage and lymphoid lineage; Inflammatory response and Phagocytic system- Role of mononuclear phagocytes, macrophages, neutrophils; Toll like receptors, Role of B cells and T cells in innate immunity; Role of complement system in immunity

5 Lectures

UNIT II

Organs, and tissues of Immune system- Primary and Secondary Lymphoid organs Thymus, Bone marrow; Lymph node, spleen and tonsils, MALT, GALT; cells of the adaptive Immunity - T lymphocytes B lymphocytes. Role of MHC molecules- Antigen Presenting Cells-Macrophages, dendritic cells, mechanism of antigen processing and presentation in CMI; Development of T cells and B cells in the Primary and Secondary Lymphoid organs-Positive and Negative selection, Central tolerance;

5 Lectures

UNIT III

Humoral Immunity- Antigens – nature of antigens, Immunogenicity, antigenicity, Nature of antigens; Factors that influence immunogenicity ; Antibodies - Structure, types and biological function - Polyclonal response; primary and secondary immune response; T cell B-cell interaction; B-cell diversity- Antibody genes- molecular basis of antibody diversity– gene recombination, somatic hypermutation, N- and P-nucleotide insertion, Class Switching; Tests based on Ag-Ab reactions –principle and applications of tests based on precipitation, agglutination, complement fixation, Immunoelectrophoresis, ELISA, Western Blotting, and Immunofluorescence techniques; -Development of murine monoclonal antibodies - Hybridoma technique and their applications; genetically engineered antibodies- humanized antibodies and their therapeutic applications

10 Lectures

UNIT IV

Cell mediated Immunity -MHC restriction - T-cell receptors –T-cell activation & differentiation into effector T cells; Lymphocyte recirculation; Functions of Effector T cells- Mode of recognition of target cells by CTL and NK cells and mechanism of killing; Role of Lymphokines and Cytokines in immune regulation; Antiviral and antitumor immunity; Development of Vaccines- conventional vaccines- attenuated, killed organisms and subunit vaccines; modern vaccines-recombinant vaccines and DNA vaccines

8 Lectures

UNIT V

Immunopathology -Hypersensitivity reactions- Immediate and delayed type reactions, their causes and treatment; Immunodeficiency diseases –types, causes and treatment; Tolerance mechanisms, Breakdown of Self-tolerance and Autoimmunity; Types of autoimmune diseases- Organ specific and Systemic autoimmune diseases - causes and treatment; Transplantation immunity- mechanism of graft rejection; prevention of graft rejection – Immuno suppressors-Physical, chemical and biological immuno suppressants; cancer immunity and cancer immunotherapy

8 Lectures

Text Book:

1. Janeway's Immunobiology 7th ed. Garland Science, Taylor & Francis Group, 2008
2. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby. Kuby Immunology. 6th ed. W. H. Freeman & Company, 2006.

Suggested Reading:

1. David Male, Jonathan Brostoff, David B. Roth, Ivan Roitt. Essential Immunology. 11th ed. Elsevier, 2006

UNIT – I

Automation in the clinical biochemistry: Precision, reliability, reproducibility and other factors in quality control. Normal values in health and diseases. 6 Lectures

UNIT- II

Kidney & Liver function tests: Renal function tests, osmolarity and free water clearances, acute and chronic renal failure. 7 Lectures

Liver function tests: clinical features and test based on bile pigments level, plasma changes, prothrombin time.

UNIT- III

Gastric function tests: Gastric function tests: collection of gastric contents, examination of gastric residium, FTM, stimulation tests, tubeless gastric analysis. 6 Lectures

UNIT- IV

Prenatal Diagnosis: Newborn screening: PKU, cystic fibrosis and sweat tests. 8 Lectures

Prenatal diagnosis of diseases, amniotic fluid and fetal blood examination.

Acetylcholinesterase and other tests on amniotic fluid.

Chromosomal abnormalities by cytogenetics.

UNIT – V

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. 8 Lectures

Text Books

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

Suggested Reading

1. Lecture Notes Clinical Biochemistry (8th Edition). Simon Walker, S., Ashby, P. , Rae, P., and Beckett, G., Blackwell, 2010.
2. Textbook of Biochemistry With Clinical Correlations. Devlin, D.M., (Ed). Wiley-Liss, 2010.

UNIT I

An introduction to genetic engineering, Enzymes used in genetic engineering- Restriction endonucleases, DNA polymerase, Reverse transcriptase, Polynucleotide kinase, DNA ligase, Terminal deoxynucleotidyl transferase, Alkaline phosphatase. Characteristics of *E. coli* as host for cloning, Vectors for cloning - Plasmids, Bacteriophage λ , Filamentous phage vectors, cosmids, BAC and YAC vectors, Shuttle vectors, Expression vectors. Ligation of DNA fragments with vectors- Homopolymer tailing, Linkers, Adaptors

8 Lectures

UNIT-II

Properties of yeast as host for cloning, Types of vectors designed for cloning in yeast, Vectors for cloning in animal cells- SV 40, Adenovirus, Baculovirus, Retrovirus vectors. DNA viruses that infect plants – Caulimoviruses vectors, Geminiviruses vectors, Types of vectors used in higher plants- Tumour-inducing (Ti) plasmids, binary and cointegrate vectors, Methods of introduction of foreign DNA in animal system- DNA/calcium phosphate coprecipitate method, Phospholipids as gene-delivery vehicles, Electroporation, Microinjection.

7 Lectures

UNIT-III

Introducing genes into prokaryotes - Natural gene transfer methods, Calcium chloride mediated transformation, Transfection with phage vectors, Cloning strategies- Construction of genomic and cDNA libraries, Shot gun cloning, Selection and screening of recombinant clones, Methods based on nucleic acid hybridization, Finding specific clones by functional complementation, Chromosome walking, Reporter genes

7 Lectures

UNIT-IV

Prokaryotic expression systems- Gene expression based in bacteriophage T7 RNA polymerase, Studying of gene function through protein interactions-Two hybrid screening, Phage display libraries, RNA interference- siRNA, miRNA, Concept of gene knock out technique.

6 Lectures

UNIT-V

Principles and methods for DNA sequencing, Advantages of automatic gene sequencers, Blotting techniques –Southern, Northern, Western, Polymerase chain reaction, Site directed mutagenesis, Transposon mutagenesis, Fluorescence *in-situ* hybridization, Electrophoretic mobility shift assay, DNA foot printing, Restriction mapping, DNA fingerprinting, Patenting and basic concepts of IPR.

8 Lectures

Text Books:

1. Sandy Primrose. 2006. Principles of Gene Manipulation and Genomics. 7th Edition, By Black Well Publishers.
2. Brown T.A. 2004. Gene Cloning and DNA analysis. 2nd edition. By ASM press.

Suggested Reading:

1. Desmond S. T. Nicholl. 2002. An introduction to genetic engineering. 2nd edition. Cambridge University Press.
2. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten. 2010. Molecular biotechnology: Principles and applications of recombinant DNA, 4th edition, By ASM press.
3. Joseph Sambrook, David William Russell. 2001. Molecular cloning: a laboratory manual, Volume 3, 3rd edition, By CSHL Press, New York.

BMB-554

GENETIC ENGINEERING LAB

1 CREDIT

1. Culture of *E.coli* cells & plasmid isolation
2. Preparation of competent cells
3. Calcium chloride mediated transformation
4. Ligation of DNA
5. Polymerase chain reaction
6. Restriction fragment length polymorphism
7. Random amplified polymorphic DNA
8. Cloning of GFP protein

REFERENCE

Joseph Sambrook, David William Russell. (2001). Volume 3, Third edition, By CSHL Press, New York.

1. Preparation of antigens from microbes
2. Analyses of Antigens: Double Immunodiffusion,
3. SRID
4. Immunoelectrophoresis (IEP).
5. Generation of polyclonal antibodies and determination of antibody titer
6. Purification of IgG from hyper immune serum
7. ELISA.
8. Separation of antigens by SDS PAGE
9. Identification of specific antigens by Western blotting
10. Isolation of lymphocytes from Blood (PBMC)

REFERENCE:

Gordon JR. A Practical Guide to cellular and Molecular Research Methods in Immunology, Fifth edition, Saskatchewan 2004.

UNIT - I

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

UNIT – II

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. 10 lectures

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.

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

UNIT- III

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 lectures

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

UNIT- IV

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 lectures

UNIT- V

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 lectures

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- I

The stages of animal development, Human spermatogenesis and oogenesis, 8 lectures
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- II

An introduction to early developmental processes in mammals: The unique nature of 8 lectures
mammalian cleavage, Mammalian gastrulation, Formation of extra embryonic membranes,
Mammalian anterior-posterior axis formation, Mammalian dorsal-ventral and
left-right axes formation.

UNIT- III

Chromosomal sex determination in mammals: Primary and secondary sex determination, 8 lectures
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- IV

Embryological origins of the gene theory, Mechanism of X chromosome inactivation, 6 lectures
Theories of ageing: Evolutionary theories of ageing, Integrated theory of ageing in the
nematode *Caenorhabditis elegans*.

UNIT- V

Properties of stem cells, Pluripotency of human embryonic stem cells, Embryonic stem cell 6 lectures
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.

UNIT-I

Proteomics Introduction: Human genome - Genomes to Proteomes - HUPO – Branches of proteomics - Protein extraction Methods: Subcellular fractionation, Density gradients, Ultrafiltration, - Protein fractionation - Affinity purification – Combined Fractional Diagonal Chromatography (COFRADIC) - Removal of interfering compounds, salts, DNA, lipids, Protein solubilization methods, chaotropes, detergents, etc - Preparation of Sample - Sample handling and storage - Protein detection and quantification methods – Stable Isotope Labeling with Aminoacids in Culture (SILAC) - Chemical tagging, fluorescence, negative staining, radio-labeling – Chemical modifications.. 8 Lectures

UNIT II

Structural Proteomics: Protein structure-function relationship – Disulfide bonds, Post translational modifications, Glycosylation, Phosphorylation, other modifications, Applications - methods for detection of protein-protein interactions - Yeast 1, 2 and 3 hybrid systems – Phage display – Surface Plasmon Resonance (SPR) - Fluorescence Resonance Energy Transfer (FRET) - Algorithms for proteomics –OMSSA - SEQUEST - MASCOT. 6 Lectures

UNIT-III

Protein expression: Conjugation, Transformation, Transduction, Transfection - Expression Systems – Plasmids, E.Coli, Yeast, *Pichia pastoris*, Baculovirus - introduction, detection and purification of expressed transgenes - .antibody capture – antibody generation and Engineering – Protein/peptide chemical synthesis –Reconstitution of proteins in lipid vesicles, - Liposomes - Protein-polynucleotide interactions – Biotinylated reactions - Signaling complex. 8 Lectures

UNIT-IV

Proteomic Techniques for Analysis: 2-D gel electrophoresis – Mass Spectrometry – Principles - MALDITOF - RP chromatography /Tandem mass spectrometry - Protein sequence analysis - N-terminal determination methods- Protein modification – Protein microarrays – Tissue microarray – Infra red Protein array with Quantitative Readout (IPAQ)- X-ray crystallography - Nuclear Magnetic Resonance - X-ray Tomography - Data Analysis algorithms - Sequence Analysis algorithms. 8 Lectures

UNIT-V

Proteomic approach for Clinical studies: Protein Biomarker Discovery and Validation - Body fluid profiles, blood disease profiles, diabetes profiles, infectious diseases, stroke and myocardial infarction, nervous system, Alzheimer, low abundance and hydrophobic proteins. High through put techniques to identify protein molecules in sample - Emerging technologies: Proteomics in Biotechnology - Microfluidics. 6 Lectures

Text Book

1. Twyman, R.M. Principles of Proteomics. BIOS Scientific Publisher, New York. 2004.
2. Liebler, D.C. Introduction to Proteomics: Tools for the New Biology. Human 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 517

MOLECULAR ENDOCRINOLOGY

3 CREDITS

UNIT-I

8 lectures

Definition and scope of molecular endocrinology- steroid hormones- structure, biosynthesis and transport - dynamics of steroid hormone production and metabolism - mechanisms of action of sex steroid hormones.

UNIT-II

6 lectures

Peptide hormones- genetic control of peptide hormone formation- gonadotropins - cell surface receptors - mechanisms of action of peptide hormones.

UNIT-III

8 lectures

Applications of molecular biology to reproduction: testicular and ovarian determining genes - Mullerian inhibiting substance genes- molecular basis of male and female contraception.

UNIT-IV

8 lectures

Molecular basis of endocrinopathies- Disorders of pituitary hormone axis- thyrotoxicosis- hypothyroidism- Hashimoto's thyroiditis- metabolic bone diseases- Cushing syndrome- Addison's diseases, androgen deficiency syndromes- testicular neoplasm- Klinefelter's syndrome and Turner's syndrome.

UNIT-V

6 lectures

Laboratory techniques in molecular endocrinology- principles of radioimmunoassay and enzyme linked immunoassays- basic principles and measurement of steroid hormone receptors- analytic validation- quality assurance.

Text Books:

1. Henry M. Kronenberg, Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen. Williams Textbook of Endocrinology, 11th ed. Saunders Elsevier 2008
2. Bolander, F. F. Molecular Endocrinology, III ed. Academic Press, 2004.

Suggested Reading:

1. Knobil & Neill's Physiology of Reproduction III Edition, J.D. Neill (Ed in chief), Elsevier Academic Press, 2006.