MAHARSHI DAYANAND UNIVERSITY ROHTAK

DEPARTMENT OF ZOOLOGY

M. Sc. GENOMICS w.e.f. session 2011-2012

Scheme of Examination

Semester	Course No.	Course Title		Credit	Marks
I	GENOM -101.	Biomolecules	CP	4	80
	GENOM -102.	Techniques in Animal Science	CP	4	80
	GENOM -103	Animal Cell Biology	CP	4	80
	GENOM -104	Computer & Biostatistics	CP	4	80
	GENOM -105	Programme elective (PE) i. System Biology ii. Communication skill in life science	PE	3	80
	GENOM -IA-I	Internal Assessment			20 in each Theory paper
	GENOM –Sem-I	Seminar		2	50
	GENOM -LC-I	Laboratory Course		10	150
	Total Marks (Semester I)				**700**
11	GENOM - 201	Developmental Biology	CP	4	80
	GENOM - 202.	Advanced Physiology	CP	4	80
	GENOM - 203.	Molecular Biology	CP	4	80
	GENOM -204.	Cell function & metabolic regulation	CP	4	80
	GENOM -205.	Programme elective (PE) i. Evolutionary Biology ii. Introduction to Proteomics	PE	3	80
	GENOM -IA-II	Internal Assessment			20 in each Theory paper
	GENOM -SS	Self Study		3	50
	GENOM -Sem-II	Seminar		2	50
	GENOM -LC-II	Laboratory Course		10	150
	Total Marks (Semester I1)				**750**
111	GENOM -301	Bacterial & eukaryotic genomics	CP	4	80
	GENOM -302	Biochemistry and metabolic disorder	CP	4	80
	GENOM -303	Human structural and functional genomics	CP	4	80
	GENOM -304	Human Molecular Genetics	CP	4	80
	GENOM -305	Programme elective i. Immunogenetics ii. Neurogenetics	PE	3	80
	GENOM -IA-III	Internal Assessment			20 in each Theory paper
	GENOM -LC-III	Laboratory Course		10	150
	Total Marks (Semester 111)				**650**
1V	GENOM - 401	Clinical genetics & counseling	CP	4	80
	GENOM -402	Genomic instability & diseases	CP	4	80
	GENOM -403	Bioinformatics	OE	3	80
	GENOM -404	Dissertation		24	300
	GENOM -IA-IV	Internal Assessment			20 in each Theory paper
	GENOM-TT	Tutorial I & II		2	
	Total Marks (Semester IV)				**600**
	Grand total				**2700**

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Semester-I

Course no.: GENOM-101 **MM: 80**
Course Title: Biomolecules **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Biomolecular foundations of biology:
pH, pK, acids, bases, buffers, bonds- Van der Waal's, electrostatic, hydrogen bonding and hydrophobic interaction, free energy, resonance, isomerisation.
Structure of soluble biomolecular pool of cells – aminoacids and peptides; monosaccharides, oligosaccharides and polysaccharides; glycoproteins, peptido-glycans; nucleotides, oligonucleotides, lipids and vitamins.

Unit II

Proteins Structure -primary, secondary, tertiary and quaternary.
Folding, denaturation and function of polypeptides like Ribonuclease A, Myoglobin, Hemoglobin, Chymotrypsin, Lysozyme and Carboxypeptidase.
Conjugated proteins-structure and functions
Analysis of proteins: Western blotting; Reverse turns and Ramachandran plots

Unit III

Nucleic acids: - types, structural organization and helix-coil transition energetics. Physicochemical techniques and macromolecular analysis
Biomolecular interaction: Protein-ligand, protein-protein, nucleic acid-protein and nucleic acid-ligand interactions.

Unit IV

Assembly of macromolecular complexes;- Ribosomes, chromatin, plasma membrane and viruses;
Nanoparticles;
Organisation of animal tissues.

Suggested Reading Material

1. D.Voet and J.G. Voet. Biochemistry, John Wiley & Sons.
2. D. Freifelder. Physical Biochemistry, W.H. Freeman & Company
3. I.H. Segal. Biochemical Calculations, John Wiley & Sons.
4. T.E. Creighton. Proteins-structure and Molecular Properties, W.H. Freeman & Company.
5. D. Freifelder, Essentials of Molecular Biology.
6. K. Wilson and K.H. Goulding. A Biologist's guide to principles and techniques of practical biochemistry.
7. T.G. Cooper. Tools of Biochemistry.
8. Hawk. Practical Physiological Chemistry.
9. R.H. Garrett and CM. Grisham. Biochemistry, Saunders College Publishers.

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Semester-I

Course no.: GENOM -102 **MM: 80**
Course Title: Techniques in Animal Sciences **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Microscopy- Principles of light, phase-contrast, fluorescence, scanning and transmission electron microscopy; X-ray diffraction; pH meter; Fixation and staining of the biological materials.

Units II

Principles and uses of biophysical methods: colorimeter; spectrophotometer; Spectroscopy: Visible, UV, ORD/CD, ESR, NMR, atomic absorption and plasma emission.

Unit III

Principles and applications of tracer techniques in biology; Radiation dosimetry, Radioactive isotopes and half life of isotopes; Effect of radiation on biological system; Autoradiography; Cerenkov radiation; Liquid scintillation spectrometry.

Cryopreservation for cells, tissue, organisms Cryotechniques for microscopy Freeze-drying for physiologically active substances

Unit IV

Separation techniques in biology

Molecular separations by gel-filtration, ion-exchange and affinity chromatography, Thin layer and gas chromatography; High pressure liquid (HPLC) chromatography, Electrophoresis and electrofocussing, Ultracentrifugation (velocity and buoyant density).

Suggested Reading Material

1. Animal Cell Culture - A practical approach, Ed. John R.W. Masters, IRL Press.
2. Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Editions.
3. Shukla and Upadhyaya. Experimental Science
4. Randhir Singh. Practicals in Biochemistry
5. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.H. Goulding, ELBS Edn.

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Semester-I

Course no.: GENOM -103 **MM: 80**
Course Title: Animal Cell Biology **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Introduction-experimental systems in Cell Biology;
Structure of pro-and eukaryotic cells;
Structure and function of cells and intracellular organelles of both prokaryotes and eukaryotes); Significance of intracellular compartments;
Mechanism of cell division including (mitosis and meiosis) and cell differentiation;
Cell-cell interaction.

Unit II

Biomembranes: Molecular composition and arrangement functional consequences; Model membranes; Liposomes.
Transport across cell membrane-
Diffusion, active transport and pumps, uniports, symports and antiports; Membrane potential; Co-transport by symporters or antiporters; Transport across epthelia.
Cytoskeleton:
Microfilaments and microtubulus-structure and dynamics; Microtubules and mitosis; Cell movements-intracellular transport, role and kinesin and dynein; Cilia and Flagella

Unit III

Cell-Cell signaling:
Signal transduction mechanisms;
Cell surface receptors;
Second messenger system;
MDP kinase pathways;
Signalling from plasma membrane to nucleus.
Cell-Cell matrix, adhesion and communication
Ca++ dependent & independent homophilic cell-cell adhesion; Gap junctions and connexins
Cell matrix adhesion: Integrins, Collagen, Non-collagen components & Cellulose fibril synthesis and orientation

Unit IV

Cell cycle: Cyclines and cyclin dependent kinases and Regulation of CDK-cycline activity
Genetic analysis in Cell Biology: Nucleus; Mitochondria and chloroplasts and their genetic organization;
Biology of cancer, Biology of aging and Apoptosis-definition, mechanism and significance

Suggested Reading Material

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B.Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson. Garland Publishing Inc., New York.

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Semester-I

Course no.: GENOM -104 **MM: 80**
Course Title: Computer & Biostatistics **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Computer peripherals and hardware description- computer system design, recognition and structure of different components of a computer system and their respective usage. Input/output and storage devices. Introduction of internet.Office application: MS office 2000 including MS word, MS excel and MS power point Overview of Windows XP. Number system and flow charts in computing language. DOS internal and external commands Generations of programming languages, system and application software; Introduction of programming in BASIC

Unit II

Collection, classification and tabulation of data. Frequency distribution, Diagrammatic and Graphical presentation of statistical data, Sampling techniques. Central tendency, Dispersion, coefficient of variation; Standard error; Confidence limits; Skewness and Kurtosis Measures of Relationship: Correlation ,Regression, Non-parametric tests

UNIT III

Probability: Approaches to measurement of Probability, Random experiments, sample space, events. Mathematical definition of probability of an event.
Probability distributions: - Distribution of Binomial, Poisson and Normal Distributions and their properties; (including problems).

UNIT IV

Testing of Hypothesis, Chi-square test,'t' and 'f' test. Analysis of variance for one-way classified data, and two-way classified data.

Suggested Reading Material

1. Batschelet, E. Introduction to mathematics for life scientists. Springer-Verlag, Berling.
2. Snedecor, G.W. and W.G. Cochran. Statistical methods. Affiliated East-West Press, New Delhi (Indian ed.).
3. Green, R.H. Sampling design and statistical methods for environmental biologists. John Wiley & Sons, New York.
4. Computer fundamentals: concepts, systems and application by PK Sinha. BPB publications
5. Computer fundamentals (Paperback) by Ashok Arora, Shefali Bansai and Shefali Bansal. Excel Books
6. Discovering computers: fundamentals (paperback) by Gary B. Shelly. Pub: Course technology
7. Discovering computers: fundamentals,4th ed. (Shelly Cashman) (paperback) by Grey B Shelly Thomas J Cashman and Misty E Vermaat. Pub: Course technology
8. Computer fundamentals architechture and organization (paper back) by B Ram. Pub: New age publications (academic)

Semester-I

Course no.: GENOM -105 (i) **MM: 80**
Course title : Systems Biology [Programme elective] **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Systems Microbiology - 'The Cell as a Well-stirred Bioreactor'
Introduction Michaelis-Menten Kinetics
Equilibrium Binding Cooperativity: Michaelis-Menten Kinetics
Lambda Phage Multistability: A Genetic Switch in Lamba Phage
Synthetic Genetic Switches

Unit II

Systems Microbiology - 'The Cell as a Well-stirred Bioreactor'
Stability Analysis
Introduction *E. coli* Chemotaxis
Fine-tuned versus Robust Chemotaxis Models; Wrapping up Chemotaxis
Biological Oscillators; Genetic Oscillators; Biological Oscillators
Stochastic Chemical Kinetics: The Origin and Consequences of Noise in Biochemical Systems

Unit III

Cell Systems Biology - 'The Importance of Diffusion and Gradients for Cellular Regulation'
Introduction Cell Systems Biology: Fick's Laws
Local Excitation: Global Inhibition Theory & Model
Rapid Pole-to-pole Oscillations in *E. coli*
Models for Eukaryotic Gradient Sensing
Modeling Cytoskeleton Dynamics

Unit IV

Developmental Systems Biology - 'Building an Organism Starting From a Single Cell'
Quorum Sensing
Drosophila Development

Suggested Readings:

1. Alberts, Bruce, et al. *Molecular Biology of the Cell*. 4th ed. New York: Garland Science, 2002.
2. Multistability Hasty, Jeff, Joel Pradines, Milos Dolnik, and J. J. Collins. "Noise-based Switches and Amplifiers for Gene Expression." *Proc. Natl. Acad. Sci. USA* 97, no. 5 (Feb 29, 2000): 2075-80.
3. Isaacs, Farren J., Jeff Hasty, Charles R. Cantor, and J. J. Collins. "Prediction and Measurement of an Autoregulatory Genetic Module." *PNAS* 100, no. 13 (June 24, 2003): 7714-19.
4. Synthetic Genetic Switches Gardner, Timothy S., Charles R. Cantor, and James J. Collins. "Construction of a Genetic Toggle Switch in *Escherichia coli*." *Nature* 403, no. 6767 (January 20, 2000): 339-42.
5. Modeling Escherichia coli chemotaxis Spiro, Peter A., John S. Parkinson, and Hans G. Othmer. "A Model of Excitation and Adaptation in Bacterial Chemotaxis." *Proc. Natl. Acad. Sci. USA* 94, no. 14 (July, 1997): 7263–68.
6. Oscillators Elowitz, Michael B., and Stanislas Leibler. "A Synthetic Oscillatory Network of Transcriptional Regulators." *Nature* 403, no. 6767 (January 20, 2000): 335-8.
   Atkinson, Mariette R., Michael A. Savageau, Jesse T. Myers, and Alexander J. Ninfa. "Development of Genetic Circuitry Exhibiting Toggle Switch or Oscillatory Behavior in *Escherichia coli*." *Cell* 113, no. 5 (May 30, 2003): 597-607.
8. Howard, Martin, Andrew D. Rutenberg, and Simon de Vet. "Dynamic Compartmentalization of Bacteria: Accurate Division in *E. Coli*." *Physical Review Letters* 87, no. 27 (December 31, 2001).
9. Eukaryotic Gradient Sensing Narang, Atul, K. K. Subramanian, and D. A. Lauffenburger. "A Mathematical Model for Chemoattractant Gradient Sensing based on Receptor-regulated Membrane Phospholipid Signaling Dynamics." *Annals of Biomedical Engineering* 29, no. 8 (2001): 677-91.

10. Postma, Marten, and Peter J. M. Van Haastert. "A Diffusion–Translocation Model for Gradient Sensing by Chemotactic Cells." *Biophysical Journal* 81, no. 3 (September, 2001): 1314-23.
11. Modeling Cytoskeleton Dynamics Dogterom, Marileen, and Stanislas Leibler. "Physical Aspects of the Growth and Regulation of Microtubule Structures." *Physical Review Letters* 70, no. 9 (March 1, 1993).
12. Cytrynbaum, E. N., V. Rodionov, and A. Mogilner. "Computational Model of Dynein-dependent Self-organization of Microtubule Asters." *Journal of Cell Science* 117, no. 8 (March 15, 2004): 1381-

Semester - I

Course no : GENOM -105 (ii) **MM: 80**
Course Title: Communication skills in Science **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Scientific and technical writing: Preparation of scientific report, Thinking and planning, Information, ideas, order of writing, Paragraph writing proper use of verb, Nouns, pronouns, tense, use of MS office, excel, powerpoints for preparing a scientific report.

Unit II

Scientific presentation: Preparation of presentation, Order of material, Use of web information in presentation, Ethical/copyright issues in presentations, Title, objective, methodology and results presentation, Different ways to make impressive presentations.

Unit III

Oral presentations: General gesture for presentations, Speed, loudness, clarity during presentations, use of appropriate vocabulary during presentation, General discussions, scientific presentation, Sharing view and ideas.

Unit IV

Use of web to collect specific informtaion, Scientific paper and review writing, Correspondence with editors and reviewers, appropriate citations, copyright and Ethical issues in paper drafting, Acknowledgment, Keywords, Use of appropriate citations, usage of different softwares for manuscript preparation, usage of line-,bar-graphs, charts to describe the results.

Suggested readings: -

1. Rastogi, B.C., Bioinformatics, Concept, Skills & Applications, CBS Publications.
2. Richard Ellis, Communication Skills: Stepladders to sucess for professional,Gutenberg Press, Malta.
3. John W. Davis, Communication skills: aguide for engineering and applied science students, Prantics Hall, 2001.
4. Gupta S., Communication skills and Functional Grammer, University Science Press, New Delhi 110002.
5. Llyod M., Bor R., Communication skills for medicine, Elsevier press, Churchill Liverstone Elsevier.

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Semester- I

Course no.: GENOM-LC-I **M.M. : 150**
Course Title : Laboratory Course **Time : 6 Hrs.**

List of the proposed experiments

- To separate and identify sugar by TLC
- To prepare casein from milk
- To plot the calibration curve for protein estimation by Lowry method
- To plot standard curve for estimation of carbohydrate by anthrone method
- Estimation of creatinine in blood
- Colorimetric estimation of DNA and RNA
- Separation and identification of amino acids by paper chromatography
- To study the effect of auxochromes on the absorption properties of chromophore using spectrophotometer
- To study the effect of pH on absorption properties of chromophore using spectrophotometer
- To study effect of solvent polarity on the absorption properties of chromophore using spectrophotometer
- Measurement of H_2 ion concentration in given sample with the help of pH meter
- Apply gravimetric methods to estimate the amount of sulphate in a given sample
- To determine standard plate count out of water, air and soil sample
- Ouchterlony double diffusion (antigen-antibody pattern)
- To analyse the given sample by SDS PAGE
- To perform gel chromatography for analysis of given sample
- Separation of molecules using ion exchange chromatography
- Separation and identification of amino acids by radial chromatography
- To study different stages of mitosis in onion root tips
- To perform protein estimation test with the help of Bradford method
- Estimation of DNA by diphenylamine reaction
- Determination of RNA by orcinol method
- Isolation of DNA of tissue
- Study of apoptosis by microscopical analysis
- To prepare food material for *Drosophila* culture and maintenance of its population
- To study the genetic variability in human population
- To dissect out the *Drosophila* larva to prepare the polytene chromosome slide
- To identify male and female *Drosophila melanogaster*
- To solve numerical based problems on Hardy Weinberg law
- To study life cycle of *Drosophila melanogaster*
- To demonstrate reproductive isolation in *Drosophila* species in hybridization experiments
- T_n10 Transposition
- Media preparation and sterilization
- Inoculation and growth monitoring
- Animal tissue culture
- Plasmid isolation
- Restriction digestion
- Ligation
- Genomic DNA extraction
- To determine dissolved O_2, free CO_2, BOD, COD, salinity and hardness content in polluted and control samples
- Wild life project
- To study presence of pollutants specific microbes in samples
- To determine physiochemical characteristics of polluted water and soil
- To study concentration of air pollutant with the help of high volume sampler in the air
- To study concentration of air pollutant with the help of personal sampler around the person
- Spirometric analysis of pollution impact and its implications
- Apply gravimetric method to estimate the amount of sulphate in given sample

Note: Besides these any other additional experiment relevant to the syllabi in all semesters or as feasible depending on resources.

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- **Semester-II**

Course no.: GENOM -201 **MM: 80**
Course Title: Developmental Biology **Time: 3hrs**

Note: There shall be nine questions in total. One question is compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Animal development:
Developmental patterns in metazoans
Development in unicellular eukaryotes
Molecular basis of spermatogenesis
Oogenesis

Unit II

Molecular basis of multicellularity:
Fertilization
Cleavage types and significance
Comparative account of Gastrulation
Fate maps

Unit III

Early vertebrate development:
Neurulation and ectoderm
Mesoderm and endoderm
Cytoplasmic determinants and autonomous cell specification:
Cell commitment and differentiation
Cell specification in nematodes
Germ cell determinants
Germ cell migration
Progressive cell - Cell interaction and cell specification fate

Unit IV

Genetics of pattern formation
Caenorhabditis: Vulva formation
Drosophila:
Maternal genes and formation of body axis
Segmentation genes
Homeotic genes function
Imaginal disc development
Vertebrates
Axes formation and HOX genes
Limb formation in chick
Proximate tissue interactions
Genetics of axis specification in Drosophila
Tetrapod limb and eye development

Suggested Reading Material

1. S.F. Gilbert. Developmental Biology. Sinauer Associates Inc., Massachusetts.
2. Ethan Bier. 'The Coild Spring'. Cold Spring Harbor Laboratory Press, New York.
3. Sastry KV and Shukla V. Text Book of Development Zoology, Rastogi Publication, Meerut

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Semester-II

Course no.: GENOM -202 **MM: 80**
Course Title: Advanced Physiology **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Digestive system:
Feeding mechanisms and regulation
Physiology of mammalian ingestion, digestion, absorption, assimilation and egestion;
Dentition in mammals

Unit II

Respiratory system:
Respiratory organs and respiratory pigments;
Control of respiration;
Structure of heart and blood vessel;
Circulation and composition of body fluids and their regulation;
Blood coagulation.

Unit III

Excretion and osmoregulation:
Patterns of nitrogen excretion among different animal groups;
Physiology of excretion;
Osmoregulation in different mammalian groups;

Unit IV

Muscle and Receptor physiology:
Receptor physiology -
Mechanoreception
Photoreception
Chemoreception
Equilibrium reception
Muscles: structure and function;
Neuromuscular transmission and nerve conduction.

Suggested Reading Material

1. Eckert, R. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman and Company, New York.
2. Hochachka, P.W. and'Somero, G.N.Biochemical Adaptation. Princeton, New Jersey.
3. Hoar, W.S. General and Comparative Animal Physiology, Prentice Hall of India.
4. Schiemdt Nielsen. Animal Physiology: Adaptation and Environment. Cambridge.
5. Strand, F.L. Physiology: A regulatory Systems Approach. Macmillan Publishing Co., New York.
6. Pummer, L. Practical Biochemistry, Tata McGraw-Hill.
7. Prosser, C.L. Environmental and Metabolic Animal Physiology. Wiley-Liss Inc., New York.
8. Willmer, P.G. Stone, and I. Johnston. Environmental Physiology. Blackwell Sci. Oxford, UK, 644pp.
9. Newell, R.C. (ed.) 1976. Adaptation to environment. Essays on the physiology of marine animals. Butterworths, London, UK, 539pp.
10. Townsend, C.R. and P. Calow. Physiological Ecology: An evolutionary approach to resource use. Blackwell Sci. Publ., Oxford, UK.
11. Alexander, R.M.N. Optima for animals. Princeton Univ. Press, Princeton, NJ.
12. Johnston, I.A., & A.F. Bennett (eds.). Animals and Temperature: Phenotypic and evolutionary adaptation. Cambridge Univ. Press, Cambridge, UK.
13. Louw, G.N. Physiological animal ecology. Longman Harloss, UK.
14. Sastry KV and Shukla V. Text Book of Physiology and Biochemistry, Rastogi Publication, Meerut

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Semester-II

Course no.: GENOM -203 **MM: 80**
Course Title: Molecular Biology **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

History and Scope of Molecular Zoology

DNA replication: Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, Enzymes and accessory proteins involved in DNA replication

Unit II

Transcription: Prokaryotic and Eukaryotic transcription; RNA polymerases; General and specific transcription factors; Regulatory elements and mechanisms of transcription regulation

Post-transcriptional modifications in RNA: 5'-Cap formation; Transcription termination; 3'-end processing and polyadenylation; Splicing, Editing; Nuclear export of mRNA; mRNA stability and Transcriptional and post-transcriptional gene silencing.

Unit III

Translation: Prokaryotic and eukaryotic translation; The translational machinery; Mechanisms of initiation, elongation and termination; Regulation of translation; Genetic code and Co- and post-translational modifications of proteins

Unit IV

Recombination and repair: Holiday junction, gene FLP/FRT and Cre/lox recombination; RecA and other recombinases and DNA repair mechanisms.

Biomaterials and their significance

Suggested Reading Material

1. Molecular Biology of the Gene, J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. The Benjamin/Cummings Pub. Co., Inc., California.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Books, Inc., USA.
3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
4. Gene VI, Benjamin Lewin, Oxford University Press, U.K.
5. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.), VCH Publishers, Inc., New York.
6. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
7. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York.
8. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford

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Semester-II

Course no.: GENOM -204 **MM: 80**
Course Title: Cell Function and Metabolic Regulation **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Structure of atoms, molecules and chemical bonds;
Energy metabolism (concept of free energy); Thermodynamic principles in biology; Energy rich bonds; Weak interactions; Coupled reactions and oxidative phosphorylations; Group transfer; Kinetics, dissociation and association constants; Biological energy transducers; Bioenergetics and steady-state conditions of living organisms.
Degradation of palmitic acid, phenylalanine, tryptophan and nucleotides in animals.

Unit II

Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Interconversion of hexoses and pentoses.
Energy metabolism and high energy compounds:
Redox potentials
Mitochondrial electron transport chain
Oxidative phosphorylation

Unit III

Storage and utilization of biological energy
Biosynthesis of triglycerides; Cholesterol; Phospholipids; Prostaglandins; Sterols.
Biosynthesis of urea, proline, aspartic acid, Uridylic acid, adenylic acid, glucose, glutathione.

Unit IV

Classification and nomenclature of enzymes; Regulation of enzymatic activity; Active sites; Coenzymes: Activators and inhibitors, isoenzymes, allosteric enzymes; Ribozyme and abzyme.
Enzyme Kinetics (negative and positive cooperativity);
Metabolic engineering;
Immobilised enzymes and their applications.

Suggested Reading Material

1. D. Voet and J.G. Voet. Biochemistry, J. Wiley & Sons.
2. R.L. Foster, Nature of Enzymology.
3. Lodish et al. Molecular Cell Biology.
4. Annual Reviews of Biochemistry.
5. Garett and Grisham, Biochemistry.

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Semester - II

Course no : GENOM -205(i) **MM: 80**
Course Title: Evolutionary Biology (Programme elective) **Time: 3hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Genetics of speciation and Molecular Evolution:
Phylogenetic and biological concept of species
Patterns and mechanisms of reproductive isolation
Models of speciation (Allopatric, sympatric, parapatric)
Gene Evolution
Evolution of gene families

Unit II

Origin of theories of life
Phylogenetic gradualism and punctuated equilibrium
Major trends in the origin of higher categories
Micro-and Macro-evolution

Unit III

Molecular phylogenetics:
How to construct phylogenetic trees?
Phylogenetic inference- Distance methods, parsimony methods.
Immunological techniques
Amino acid sequences and phylogeny
Nucleic acid phylogeny-DNA-DNA hybridizations, Nucleotide sequence comparisons and homologies
Molecular clocks

Unit IV

Metapopulations
Monitoring natural populations
Why small populations become extinct?
Loss of genetic variations
Conservation of genetic resources

Suggested Reading Material

1. Dobzhansky, Th. Genetics and Origin of Species. Columbia Unvieristy Press.
2. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
3. Futuyama, D.J. Evolutinary Biology, Suinuaer Associates, INC Publishers, Dunderland.
4. Haiti, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.
5. Jha, A.P. Genes and Evolution. John Publication, New Delhi.
6. King, M. Species Evolution-The role of chromosomar change. The Cambridge University Press, Cambridge.
7. Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
8. Smith, J.M. Evolutinary Gentics. Oxford University Press, New York.
9. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston London

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Semester - II

Course no : GENOM -205 (ii) **MM: 80**
Course title : Introduction to Proteomics [Programme elective] **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Outline for Structure genomics
Foot-printing analysis of macromolecules principles of covalent labeling for DNA, RNA, and proteins biophysical analysis (kinetics and thermodynamics) by footprinting, structural analysis of DNA and proteins by mass spectrometry
Outline of structure to function and modeling
Structure to function by fold comparison and functional site comparison
Homology modeling

Unit II

Pfam (protein families) 5000 strategy and targetDB (targetdb.pdb.org).
Protein preparation.
Structure determination by NMR and X-ray crystallography: crystallization, data collection (using synchrotron radiation source), structure solution.
Structure dissemination: structure deposition in PDB and publication.
Outlook: reducing cost and function annotation.
Introduction to Proteomics
Current Proteomics
Tools to study proteome
Protein-protein interaction networks
Topology
Network motifs

Unit III

Fundamentals of Protein/Peptide Separation Technique
Two-dimensional gel electrophoresis (2D-PAGE)
Property of proteins
2D electrophoresis
Protein detection
2D DIGE
High-performance liquid chromatography (HPLC)
Fundamentals of high-performance liquid chromatography
Reverse-phase chromatography
Strong cation exchange chromatography
Multidimensional HPLC

Unit IV

Quantitative Proteomics and Protein Modification Proteomics
2D-PAGE based method
Mass spectrometry based method
Absolute quantification method
Post-translational modification proteomics

Suggested Reading Material

1. Brown Genomes Bios 2002
2. Coleman & Tsongalis Molecular Diagnosis Humana 1997
3. Dale & Schartz From Genes to Genomes Wiley 2003
4. Hawley and Mor The Human Genome Academic 1999

Lewis Human Genetics WCB 1999 Liebler Introduction to Proteomics Humana 2002

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Semester- II

Course no.: GENOM-LC-II **M.M. : 150**
Course Title : Laboratory Course **Time : 6 Hrs.**
List of the proposed experiments

- To dissect out *Drosophila* larvae to prepare the polytene chromosome slide and arm identification
- To prepare the permanent slide of insect larvae and its study
- To dissect out Drosophila larvae and to take out the imaginal discs
- To study the effect of temperature on life cycle of *Drosophila melanogas*
- To study different developmental stages with the help of charts
- To study the effect of varying pH on salivary amylase
- To determine the effects of varying temperatures on the activity of salivary amylase
- To study the rate of respiration by aquatic animals
- To determine the concentration of free CO_2 in variety of given samples
- Determination of dissolved O_2 of given samples by Wrinklers method
- Isolation of monocytes
- To study hematological parameter in blood
- To study the effect of osmolarity of solution on RBC
- To study the knee jerk reflex in man
- To test the urine for urea,proteins,ketones and sugar
- Separation and identification of amino acids by vertical paper chromatography
- Separation and identification of amino acids by radial chromatography
- To separate and identify the sugar by thin layer chromatography
- To perform extraction of nucleic acids
- To perform isolation of DNA
- To separate DNA sample by agarose gel electrophoresis
- To perform western blotting to analyse the given protein sample
- DNA gel extraction
- To determine the protein concentration in the given albumin by Biuret method
- To plot the calibration curve for glucose with the help of spectrophotometer
- Qualitative estimation of salivary amylase
- To investigate the effect of temperature on enzyme catalysed reaction
- To investigate the effect of varying pH on the activity of salivary amylase
- Quantitative estimation of protein ,glucose, DNA and RNA
- Analysis of isozymes/ proteins on SDS page
- Purification of carbohydrates/protein /lipids by column chromatography
- Analysis of biological information by any bioinformatics tool
- Study of nutrition deficiency diseases in human in different areas of Rohtak city

Note: Besides these any other additional experiment relevant to the syllabi in all semesters or as feasible depending on resources.

Semester - III

Course no : GENOM -301 **MM: 80**
Course title : Bacterial & eukaryotic genomics **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Gene mapping in bacteria
Transformation
Conjugation
Transduction

Unit II

Sexduction
Transposons and transposition mechanisms
Types of mutations and nomenclature
Detection and isolation of mutations

Unit III

Mutagenesis & DNA repair
Endogenous and exogenous origins of DNA damage
Types of DNA damage
DNA repair pathways

Unit IV

Error-prone repair and mutagenesis
Damage signaling and checkpoint arrest
Recombination
Homologous recombination: models and molecular mechanisms
Gene conversion: molecular mechanisms
Site specific recombination

Suggested Reading Material

1. Pasternak, An Introduction to Molecular Human Genetics
2. Strachan and Read, Human Molecular Genetics
3. Sudbery, Human Molecular Genetics
4. G. Grandi. 2003, Genomics, proteomics and Vaccines
5. S.B. Primrose, 2004, Genomics : Applications in Human Biology
6. J. Zhou, D.K. Thompson, T. Xu, J.M. Tiedge, 2004, Microbial functional Genomics, Proteomics & Bioinformatics

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Semester - III

Course no : GENOM -302 **MM: 80**
Course title : Biochemistry and metabolic disorder **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Biochemical basis of diseases/disorders, diagnosis and treatment
Molecular deficiency disorders
Enzyme deficiency: inborn errors of metabolism
Alkaptonuria
Phenylketonuria
Lesh-Nyhan syndrome
Protein defects/ deficiency
Cystic fibrosis
Sickel cell anaemia
Thalassemia

Unit II

Transport/storage associated disorders
Hypercholesterolemia and atherosclerosis
A-Beta-lipoproteinemia
Tay-Sachs disease Gout
Apoptosis and its implications in health and disease
Process of apoptosis
Induction and biochemical changes
Execution: cytochrome C release, caspase action
Phagocytosis of apoptotic bodies
Regulation of apoptosis: extra- and intra-cellular
Implications
Programmed cell death and development
Development of immunological tolerance
Neurological disorders

Unit III

Cancer
Biochemical aberrations
Therapeutic srategies: TNF-alfa induced, immunological cytotoxicity, chemotherapy and radiotherapy
Drug action, abuse and catabolism
Mechanisms
Drug addiction, alcohol toxicity
Catabolism of drugs

Unit IV

Recent trends in therapy
Biomolecules as diagnostic markers and therapeutic agents
Gene technology and gene therapy
Drug delivery and targeting
Medical gerontology

Suggested Reading Material

1. Murray et al: Harper's Illustrated Biochemistry (27th ed 2006, McGraw Hill)
2. Ganong: Review of Medical Physiology (21st ed 2003, Lange Medical Publications)
3. Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)
4. Goldsby et al: Immunology (5th ed 2003, Freeman)
5. Bhagvan: Medical Biochemistry (4th ed 2004, Hap)
6. Smith & Marks: Basic Medical Biochemistry (2nd ed 2005, LWW Lippincott's)
7. Chatterjea & Shinde: Medical Biochemistry (6th ed 2005, Jaypee brothers)
8. Bennett & Brown: Clinical Pharmacology (9th ed 2005, Elsevier)

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Semester - III

Course no : GENOM -303 **MM: 80**
Course title : Human Structural and functional Genomics **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

The Genome project: History, organization and goals of human genome project, Mapping strategies, current status of various maps; DNA segment nomenclature, Human genome diversity,
Organization of human genome: Mitochondrial genome, Gross base composition of nuclear genome, Gene density, CpG islands, RNA-encoding genes, Functionally identical/similar genes, Diversity in size and organization of genes, Annotation

Unit II

Gene families: Multigene families – Classical gene families, families with conserved domains, Gene superfamilies, Repetitive DNA and transposable elements, Origin of gene families

Unit III

Comparative Genomics: Overview of prokaryotic and eukaryotic genomes, C-value, number of genes and complexity of genomes, Conservation and diversity of genomes, Comparative genomics as an aid to gene mapping and study of human disease genes

Unit IV

Functional genomics**:** Transcriptome and its analysis**,** gene silencing, Disease and genomics

Suggested Reading Material

1. Brown (2007). Genomes. Bios
2. Dale & Schartz (2003). From Genes to Genomes. Wiley
3. Liebler (2002). Introduction to Proteomics. Humana
4. Pasternak (2000). An Introduction to Molecular Human Genetics. Fritzgerald
5. Primrose & Twyman (2003). Principles of Genome Analysis & Genomics. Blackwell
6. Strachan and Read (2005). Human Molecular Genetics 3. Wiley
7. Sudbery (2002). Human Molecular Genetics. Prentice Hall
8. Alberts et al (2007). Molecular Biology of the Cell. Garland
9. Cowell (2001). Molecular Genetics of Cancer. Bios
10. Ehrlich (2000). DNA Alterations in Cancer. Eaton
11. Gersen & Keagle (1999). Principles of Clinical Cytogenetics. Humana
12. Lewin (2007). GenesI X. Pearson
13. Lodish et al (2004). Molecular Cell Biology. Freeman

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Semester - III

Course no : GENOM -304 **MM: 80**
Course title : Human Molecular Genetics **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Genetic mapping of Mendelian traits
Identifying recombinants and nonrecombinants in pedigrees
Genetic and physical map distances
Genetic markers
Two-point mapping- LOD score analysis
Multipoint mapping
Homozygosity mapping
Genetic mapping of complex traits
Difficulties in mapping complex traits
Allele sharing methods- Affected sib pair analysis
Allelic association, Linkage disequilibrium mapping, Transmission disequilibrium test

Unit II

Physical mapping methods
Low resolution mapping- Cell hybrids, mini- and microcells, synteny of genes,
Radiation hybrid mapping
Assembly of clone contigs
Identifying genes in cloned DNA
Integration of cytogenetic, genetic and physical maps
Identifying human disease genes
Principles and strategies
Position-independent and positional cloning. Candidate gene approaches
Confirming a candidate gene- mutation screening, testing in animal models

Unit III

Molecular pathology
Nomenclature of mutations and their databases
Loss-of-function and gain-of-function mutations in diseases
Instability of the human genome: Pathogenicity associated with repeat sequences

Unit IV

DNA testing
Direct testing
Screening for unknown mutations
Detection of known mutations
Indirect testing – gene tracking
DNA profiling: establishing identity and relationships
Population screening - ethics, organization and advantages

Suggested Reading Material

1 Davies (1993). Human Genetic Disease Analysis. IRL
2 Haines & Pericak (2006). Approaches to Gene Mapping in Complex Human Diseases. Wiley
3 Nussbaum et al (2004). Genetics in Medicine. Saunders
4 Pasternak (2005). An Introduction to Molecular Human Genetics. Fritzgerald
5 Rimoin et al (2002). Principles & Practice of Medical Genetics, Vol I-III. Churchill
6 Strachan & Read (1999). Human Molecular Genetics. Wiley
7 Sudbery (2002). Human Molecular Genetics. Prentice-Hall

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Semester - III

Course no : GENOM -305 (i) **MM: 80**
Course title : Immunogenetics **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

An introduction to immune system
Innate and adaptive immunity
Cells and organs of the immune system
Primary and secondary immune responses
Antigens, antibodies and T cell receptors
Antigens
Structure and function of immunoglobulins
Monoclonal antibodies
B and T cell receptors and coreceptors
Antigen-antibody interactions

Unit II

Immunoglobulin and T-cell receptor genes
Organization of Ig gene loci
Molecular mechanisms of generation of antibody diversity
Expression of Ig genes
Regulation of Ig gene transcription
Antibody engineering
Organization of TCR gene loci
Generation of TCR diversity
The HLA complex
Organization of HLA complex
Structure of class I and II HLA molecules
Expression of HLA genes
HLA polymorphism

Unit III

Generation and regulation of immune responses
Antigen processing and presentation
MHC-restriction
Cytokines
T Cell Maturation, activation and differentiation
B Cell Generation, Activation and differentiation
Clonal selection and immunological memory
Complement system
Leukocyte, Activation and Migration
Cell mediated cytotoxic responses
Regulation of immune responses
Immunological tolerance

Unit IV

Disorders of Human Immune System
Primary and secondary immunodeficiencies
Autoimmune disorders
Hypersensitive reactions
Cytokine-related diseases
Immune system in human health
Immune response to infectious diseases and malignancy
Concept of immunotherapy
Vaccines
Transplantation immunology

Suggested Reading Material

1 Abbas et al (2007). Cellular and Molecular Immunology. Saunders
2 Barrett (1988). Text Book of Immunology. Mosloy
3 Benjamin et al (2003). Immunology – A Short Course. Wiley-Liss

4 Kuby (2006). Immunology. Freeman
5 Roitt (2003). Essential Immunology. Blackwell
6 Roitt et al (2001). Immunology. Mosloy

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Semester - III

Course no : GENOM -305 (ii) **MM: 80**
Course title : Neurogenetics **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Nervous system
Major regions of human brain
Cellular components of nervous tissue
Sub cellular organization of the nervous system
Membrane potential and action potential
Learning and memory
Circadian rhythms

Unit II

Neurogenetic disorders
Spinomuscular atrophy
Syndromes due to triplet nucleotide expansion
Alzheimers disease
Parkinsons disease

Unit III

Nature-nurture and behaviour
Genetic experiments to investigate animal behaviour
Selection studies
Inbred strain studies
Identifying genes for controlling behavior
Induced mutations
Quantitative trait loci
Synteny/orthology
Investigating the genetics of human behaviour
Twin and adoption study designs, interpreting heritability
Linkage and association studies
Environmental influence- shared and non-shared environment

Unit IV

Psychopathology
Schizophrenia
Mood disorders
Disorders of childhood

Suggested Reading Material

1 Kaplan and Sadock (2007). Synopsis of Psychiatry. Williams & Wilkins
2 Plomin et al (2001). Behavioral Genetics. Freeman
3 Zigmond, Bloom et al., (2002). Fundamentals Neuroscience. Academic Press
4 Kandel, Schwartz et al. (2000). Principles of Neuroscience. Prentice Hall
5 Pasternak (2005). An Introduction to Molecular Human Genetics. Fritzgarald
6 Cox and Sinclair (1997). Molecular Biology in Medicine. Blackwell
8 Rasko and Downes (1995). Genes in Medicine. Kluwer
9 Rimoin et al(2002). Principles & Practice of Medical Genetics, vol I-III. Churchill
10 Robinson and Linden (1994). Clinical Genetics Handbook. Blackwell
11 Strachan and Read (2003). Human Molecular Genetics. Wiley
12 Wilson (2000). Clinical Genetics: A Short Course. Wiley-Liss

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Semester - III

Course no.: GENOM -LC-III **M.M. : 150**
Course Title : Laboratory Course **Time : 6 Hrs.**

Tentative list of the proposed experiments

- Plotting of growth curve for the determination of bacterial growth
- Demonstration of bacterial transformation: Preparation of competent cells, transformation, and selection by antibiotics or α-complementation.
- Gene induction in *Drosophila* (heat shock treatment)/Transgenic for hsp70-lacZ gene
- Study of life cycles of some model systems: Yeast, mice/rat, *Dictyostelium, etc.*
- Buffers, pH, preparation of solutions
- Spectrophotometric estimation of glucose, cholesterol and protein
- Sugar estimations in normal and diabetic patients
- Assay and kinetics of Alkaline phosphatase/Estera
- Sugar estimations in normal and diabetic patients
- Assay and kinetics of Alkaline phosphatase/Estera
- Study of chromosomal disorders (Phenotypes & karyotypes) and preparation of Pedigree chart of some common phenotypic characters of human
- Risk assessment in Pedigree
- Facial landmarks and dermatoglyphia
- Study of Sex-chromatin from buccal smear and hair root cells
- C, G and Fluorescence banding
- Extraction of DNA from human lymphocytes & agarose gel
- Calculation of the coefficient of relationship (r) in pedigree
- Construction of Pedigree files in computer
- Culture (lymphocyte, fibroblast, etc.) of human tissues for chromosomal studies
- PCR-based detection of allelic inheritance of a DNA marker
- Micrographs demonstrating examples of molecular methods, etc.
- Study of metaphase chromosomes from rat/mice bone marrow
- Study of mitosis and effect of microtubule inhibitor on mitosis in onion root tip cells
- Study of Meiosis in grasshopper testis
- Study of meiosis from super ovulated oocytes of female and male testis mice/rat
- Preparation of synaptonemal complex from mouse testis
- Study of polytene chromosomes in *Drosophila/Chironomous* larval salivary glands
- Isolation of chromatin, its digestion by micrococcal nuclease and separation by agarose gel electrophoresis.
- Extraction of Histones and analysis by SDS-PAGE
- To analyse the restriction pattern by agarose gel electrophoresis and to map restriction plasmid sites on plasmid DNA
- To prepare ligation lambda/E CORI digest using T_4 DNA ligase and amylase ligated sample by agarose gel electrophoresis
- To study normal human karyotype
- To study chromosomal abnormalities
- To study the various human pedigrees
- Gene mapping by TPT cross
- Study of chromosomes slides (autosomes and sex chromosomes)
- To study primary and secondary sexual characteristics
- Precipitation and agglutination reactions
- Study of cell types of immune system
- Blood grouping & Rh factor determination
- To find the blood group of own blood
- To find the Rh factor of own blood group
- To estimate the amount of Hb present in human blood
- To estimate the TLC present in $1mm^3$ volume
- To estimate the RBC present in $1mm^3$ volume
- Quantitative assay of precipitation
- Rocket immunoelectrophoresis
- Separation of lymphocytes
- Sandwich enzyme linked immunosorbant assay
- Haemagglutination test

Note: Besides these any other additional experiment relevant to the syllabi in all semesters or as feasible depending on resources.

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Semester - IV

Course no : GENOM -401 **MM: 80**
Course title : Clinical Genetics & Genetic Counseling **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

An overview of the genetic basis of syndromes and disorders
Monogenic diseases with well known molecular pathology:
Cystic fibrosis, Tay-Sachs syndrome, Marfan syndrome, Inborn errors of metabolism
Genome imprinting Syndromes: Prader-Willi & Angelman syndromes, Beckwith-Wiedeman Syndrome

Unit II

Neurofibromatosis
Disorders of muscle:
Dystrophies (Duchenne Muscular dytstrophy and Becker Muscular Dystrophy)
Myotonias
Myopathies
Disorders of Haemopoitic systems:
Overview of Blood cell types and haemoglobin
Sickle cell anemia
Thalassemias
Hemophilias

Unit III

Disorders of eye: Retinitis pigmentosa, Cataract, Glaucoma, Colour blindness
Multifactorial diseases: Hyperlipidemia, Atherosclerosis, Diabetes mellitus

Unit IV

Components of genetic counseling:
Indications and purpose
Information gathering and construction of pedigrees
Medical Genetic evaluation:
Basic components of Medical History
Past medical history, social & family history
Physical examination
General and dysmorphology examination
Documentation
Biochemical and molecular genetic tests In children, Presymptomatic testing for late onset diseases (predictive medicine)
Prenatal and pre-implantation diagnosis : Indications for prenatal diagnosis, Indications for chromosomal testing; Noninvasive methods, Invasive methods
Legal and ethical considerations

Suggested Reading Material

1 Cox and Sinclair(1997). Molecular Biology in Medicine. Blackwell
2 DeGrouchy and Turleau (1984). Clinical Atlas on Human Chromosomes. Wiley
3 Jankowski and Polak (1996). Clinical Gene Analysis and Manipulation. Cambridge
4 Korf (1996). Human Genetics – A Problem Based Approach. Blackwell
5 Pasternak (2000). An Introduction to Molecular Human Genetics. Fritzgarald
6 Rasko and Downes (1995). Genes in Medicine. Kluwer
7 Rimoin et al (2002). Principles & Practice of Medical Genetics, vol I-III. Churchill
8 Robinson and Linden (1994). Clinical Genetics Handbook. Blackwell
9 Strachan and Read (1999). Human Molecular Genetics. Wiley
10 Wilson (2000). Clinical Genetics: A Short Course. Wiley-Liss
11 Baker et al (1998). A Guide to Genetic Counseling. Wiley
12 Harper (2001). Practical Genetic Counseling. Arnold
13 Rose & Lucassen(1999). Practical genetics of primary care. Oxford
14 Young (1999). Introduction to Risk Calculation in Genetic Counseling. Oxford

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Semester - IV

Course no : GENOM -402 **MM: 80**
Course title : Genomic instability & diseases **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

DNA repair: Origins and types of DNA damage**,** DNA repair pathways**,** Error-prone repair and mutagenesis**,** Damage signaling and checkpoint arrest

Recombination: Homologous recombination: models and molecular mechanisms, Gene conversion: molecular mechanisms, Site specific recombination, Transposons and transposition mechanisms

Unit II

Cell transformation and tumourigenesis: Cell cycle check point and cancerOncogenes, Tumour suppressor genes, DNA repair genes and genetic instability, Epigenetic modifications, telomerase activity, centrosome malfunction, Genetic heterogeneity and clonal evolution Familial cancers: Retinoblastoma, Wilms' tumour, Li-Fraumeni syndrome, colorectal, cancer, breast cancer Genetic predisposition to sporadic cancer

Unit III

Tumour progression: angiogenesis and metastasis

Tumour specific markers

Cancer and environment: physical, chemical and biological carcinogens Host-pathogen interaction, evolution of pathogenecity and regulation of virulence

Unit IV

Mechanism of drug resistance in pathogens

Molecular biology of following pathogens: HIV, Hepatitis viruses, Mycobacterium tuberculosis, Vibrio cholerae, Plasmodium, Leishmania, Trypanosoma, Entamoeba

Molecular mechanisms for origin of new pathogens

Suggested Reading Material

1. Alberts et al (2008). Molecular Biology of the Cell. Garland
2. Benjamin (2003). Genetics: A Conceptual Approach. Freeman
3. Black (2002). Microbiology: Principles and Explorations. Wiley
4. Cowell (2001). Molecular Genetics of Cancer. Bios
5. Dale & Schartz (2003). From genes to Genome. Wiley & Sons
6. Ehrlich (2000). DNA Alterations in Cancer. Eaton
7. Griffiths et al (2002). Modern Genetic Analysis. Freeman
8. Griffiths et al (2004). An Introduction to Genetic Analysis. Freeman
9. Hartl et al (2002). Essential Genetics. Wiley & Sons
10. Klug & Cummings (2003). Essentials of Genetics. Prentice Hall
11. Lewin (2004). Genes VIII. Pearson
12. Lewin (2007). GenesIX. Pearson
13. Lodish et al (2004). Molecular Cell Biology. Freeman
14. Russell (2002). Genetics. Benjaminncer.
15. Streips & Yasbin (2002). Modern Microbial Genetics. Wiley
16. Trun & Trempy (2004). Fundamentals of Bacterial Genetics. Blackwell
17. Streips & Yasbin (2002). Modern Microbial Genetics. Wiley
18. Trun & Trumpy (2004). Fundamentals of Bacterial Genetics. Blackwell

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Semester - IV

Course no : GENOM -403 **MM: 80**
Course title : Bioinformatics [Open elective] **Time: 3 Hrs**

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Definition and Scope of Computational Biology and Bioinformatics
Major Bioinformatics Databases & Resources: NCBI, EBI, ExPASy

Unit II

Biological Sequence Analysis
Sequence Similarity, Homology and Alignment: Pairwise sequence Alignment, Global & Local Alignment algorithms, Basic concept of Scoring matrices (PAM & BLOSSUM), Dynamic programming Algorithms, Dot Plots for comparing sequences, Statistical significance of alignments score, motifs and pattern analysis
BLAST and FASTA algorithms BLAST theory, other BLAST options, PSI-BLAST and PSSM, Applications of BLAST.

Unit III

Multiple sequence alignment:
Introduction to Multiple sequence alignment and progressive alignment algorithm, MSA based software tools ClustalW. Applications of Multiple Sequence alignment.
Phylogenetic analysis:
Definition and description of phylogenetic trees and various types of trees, A primer on Computational phylogenetic analysis.
Computational Gene Prediction Methods (basic concept)

Unit IV

Lab Exercises
Basics of Computer, Internet and Operating system
Major Sequence and Structure Databases**:** Knowledge of the following databases with respect to: organization of data, contents and formats of database entries, retrieval of data using text-based search tools:
Nucleic acid sequence databases: GenBank, EMBL
Protein sequence databases: SWISS-PROT, TrEMBL, PIR
Genome Databases at NCBI, EBI, TIGR, SANGER
Repositories for high throughput genomic sequences: EST, STS and GSS
Derived Databases: basic concept of derived databases, PROSITE, PRODOM, Pfam, CATH, SCOP, DSSP, FSSP, DALI databases
Protein Structure Visualization: Schematic Representations of proteins using Chimera, and Pymol, Protein Data Bank (PDB) and PDB format.

Suggested Reading Material

1 Attwood & Parry-Smith (2002). Introduction to Bioinformatics. Pearson
2 Barnes & Gray (ed) (2003). Bioinformatics for Geneticists. Wiley
3 Lesk (2003). Introduction to Bioinformatics. Oxford
4 Mount (2003). Bioinformatics: Sequence and Genome Analysis. CBS
5 Rashidi & Buchler (2000). Bioinformatics Basics. CRC Press
6 Rastogi et al (2003). Bioinformatics: Concepts, Skills and Applications. CBS
7 Westhead et al (2003). Bioinformatics Instant Notes. Viva Books

Semester - IV

Course no.: GENOM -LC-IV **M.M. : 150**
Course Title : Laboratory Course **Time : 6 Hrs.**

List of the proposed experiments

- Chromosome banding, karyotyping and making idiogram of the banded chromosomes
- Detection of chromosome anomalies in cancer tissues
- Molecular detection of genetic diseases
- Preparation of pedigree charts for common genetic disorders during visit to hospitals/clinics
- Risk assessment (Binomial probability and Bayesian calculation)
- Applications of BLAST, FASTA, CLUSTALW, GENSCAN, RASMOL, Phylodendron
- Biological Data Base assessment tools
- Analysis of biological information by any bioinformatics tool

Note: Besides these any other additional experiment relevant to the syllabi in all semesters or as feasible depending on resources.