



# **BANGALORE UNIVERSITY**

## **CENTRE FOR APPLIED GENETICS SYLLABUS**

**(REVISED SEMETER SYLLABUS)**

**For**

**M.Sc. APPLIED GENETICS**

**From 2009-10**

**PROCEEDINGS OF THE MEETING OF**

## **THE BOARD OF STUDIES IN APPLIED GENETICS (PG)**

A meeting of the Board of Studies in Applied Genetics for Post Graduate studies was held on Friday, the 25<sup>th</sup> September 2009 at 10.30 AM in the Chamber of the Co-Ordinator, Centre for Applied Genetics, Bangalore University, Bangalore.

The Meeting was attended by the following Members:

**Signature**

- |    |   |                 |            |
|----|---|-----------------|------------|
| 1. | Dr. JAYAPRAKASH<br>Professor & Co-Ordinator<br>Centre for Applied Genetics<br>Bangalore University<br>Bangalore-560 056               | Chairman        | <i>Sd/</i> |
| 2. | Dr. N.B. RAMACHANDRA<br>Professor of Zoology<br>University of Mysore<br>Mysore-570 006  | External Member | <i>Sd/</i> |
| 3. | Dr. K.R. MANJUNATHA<br>Professor of Human Genetics<br>NIMHANS, Hosur Road<br>Bangalore-560 029  | External Member | <i>Sd/</i> |
| 4. | Dr. S. K. SARANGI<br>Professor & Chairman<br>Department of Microbiology/Biotechnology<br>Bangalore University<br>Bangalore-560 056    | External Member | <i>Sd/</i> |
| 5. | Dr. M.V.V. SUBRAMANYAM<br>Professor & Chairman<br>Department of Sericulture/Life Science<br>Bangalore University<br>Bangalore-560 056 | External Member | <i>Sd/</i> |

**Members Absent:**

1. Dr. M.C. GAYATRI Internal Member  
Professor & Co-Ordinator  
Molecular Biology Unit  
Bangalore University, Bangalore – 560 056
2. DR. R.M. RANGANATH Internal Member  
Professor & Chairman  
Department of Botany  
Bangalore University, Bangalore – 560 056

The Chairman welcomed the Members for the meeting and initiated discussion for the Agenda.

1. **Approval of Panel of Examiners** : The Panel of Examiners (both Internal and External) for M.Sc. in Applied Genetics for the year 2010-11 was approved.
2. **Approval of Ph.D. Panel of Examiners** : The Panel of Examiners submitted by Dr. N.J. Shetty in respect of the Ph.D. candidate Mr. T.P.N Hari Prasad was approved.
3. **Revision of B.Sc. Syllabus** : Keeping in view the requirement of the revision of the syllabus once in 3 years as per the UGC guidelines and University orders, the Members discussed, deliberated and unanimously approved the proposed revision of the 2006-07 syllabus of M.Sc. in Applied Genetics (for all the 4 semesters) and authorized the Chairman for necessary forwardal to the University.

The Chairman concluded the meeting expressing his thanks to the members of the Board attending the Meeting.

*Sd/-*  
**JAYAPRAKASH**  
Chairman  
BOS in Applied Genetics

**M.Sc. APPLIED GENETICS**

## Semester syllabus contents

### **I Semester**

#### **Theory**

- Paper 101 - Fundamentals of Cell Biology
- Paper 102 - Basic Genetics
- Paper 103 - Essentials of Cytogenetics
- Paper 104 - Biological Chemistry

#### **Practical**

- Paper 105 - Cell Biology and Genetics
- Paper 106 - Cytogenetics and Biochemistry

### **II Semester**

#### **Theory**

- Paper 201 - Cellular Physiology
- Paper 202 - Genetics of Development
- Paper 203 - Genes and Genomes
- Paper 204 - Population and Evolutionary Genetics

#### **Practical**

- Paper 205 - Cell Physiology and Developmental Genetics
- Paper 206 - Genomics and Population Genetics

### **III Semester**

#### **Theory**

- Paper 301 - Human Cytogenetics
- Paper 302 - Recombinant DNA Technology
- Paper 303 - Immunogenetics and Haematology
- Paper 304 - Bioinformatics and Biostatistics

#### **Practical**

- Paper 305 - Clinical Cytogenetics and R D T
- Paper 306 - Immunogenetics and Bioinformatics

### **IV Semester**

#### **Theory**

- Paper 401 - Medical Genetics
- Paper 402 - Mutation and Cancer Biology
- Paper 403 - Molecular Medicine
- Paper 404 - Applied Biotechnology

#### **Practical**

- Paper 405 - Medical Genetics and Cancer Biology
- Paper 406 - Molecular Medicine and Biotechnology

**M.Sc. APPLIED GENETICS** (Semester Syllabus Scheme)

### I Semester

Paper No.	Title of the Paper	Total Hrs	Hrs/Wk	Marks	Int. Ass.*	Total Marks
101	Fundamentals of Cell Biology	52	4	80	20	100
102	Basic Genetics	52	4	80	20	100
103	Essentials of Cytogenetics	52	4	80	20	100
104	Biological Chemistry	52	4	80	20	100
105	Cell Biology and Genetics	120	4	40	10	50
106	Cytogenetics and Biochemistry	120	4	40	10	50

### II Semester

Paper No.	Title of the Paper	Total Hrs	Hrs/Wk	Marks	Int. Ass.*	Total Marks
201	Cellular Physiology	52	4	80	20	100
202	Genetics of Development	52	4	80	20	100
203	Genes and Genomes	52	4	80	20	100
204	Population and Evolutionary Genetics	52	4	80	20	100
205	Cell Physiology & Developmental Genetics	120	4	40	10	50
206	Genomics and Population Genetics	120	4	40	10	50

### III Semester

Paper No.	Title of the Paper	Total Hrs	Hrs/Wk	Marks	Int. Ass.*	Total Marks
301	Human Cytogenetics	52	4	80	20	100
302	Recombinant DNA Technology	52	4	80	20	100
303	Immunogenetics and Haematology	52	4	80	20	100
304	Bioinformatics and Biostatistics	52	4	80	20	100
305	Clinical Cytogenetics and R D T	120	4	40	10	50
306	Immunogenetics and Bioinformatics	120	4	40	10	50

### IV Semester

Paper No.	Title of the Paper	Total Hrs	Hrs/Wk	Marks	Int. Ass.*	Total Marks
401	Medical Genetics	52	4	80	20	100
402	Mutation and Cancer Biology	52	4	80	20	100
403	Molecular Medicine	52	4	80	20	100
404	Applied Biotechnology	52	4	80	20	100
405	Medical Genetics and Cancer Biology	120	4	40	10	50
406	Molecular Medicine and Biotechnology	120	4	40	10	50

**\*Internal Assessment:**

**Theory:**

- a) Seminar/Assignment - 5 marks
- b) Test - 5 marks
- c) Mid-session - 5 marks
- d) Attendance - 5 marks

**Total - 20 marks**

- Practical:**
- a) Attendance - 5 marks
  - b) Test - 5 marks

**Total - 10 marks**

### THEORY SYLLABUS

## I SEMESTER

<b>PAPER-101: FUNDAMENTALS OF CELL BIOLOGY</b>		<b>52hrs</b>
<b>1</b>	<b>Overview of cells:</b> Structure, types and kinds of cells, Differences between prokaryotic and eukaryotic cells.	3hrs
<b>2</b>	<b>Membrane systems:</b> <b>a) Plasma membrane:</b> Structure and chemical composition: Fluid-mosaic model, Membrane lipids, carbohydrates and proteins, Transport across membranes: Diffusion, active transport, co-transport and bulk transport, Membrane potentials – resting potential and types of propagation of action potentials, liposomes. <b>b) Organelle membrane:</b> <b>Endoplasmic reticulum:</b> The smooth and rough endoplasmic reticulum and their functions. <b>Golgi complex:</b> Types and mechanisms of vesicular transport within the Golgi complex and their functions. <b>Lysosomes:</b> Lysosomal membranes and their functions. <b>Mitochondria:</b> Ultrastructure, oxidative metabolism, proton gradients, ATP synthesis, importing of mitochondrial proteins. <b>Chloroplasts:</b> Ultrastructure, overview of photosynthesis, photophosphorylation, fixation of carbon dioxide and the synthesis of carbohydrates, importing of chloroplast proteins. <b>Nucleus:</b> Structural organization and functions of nuclear membrane.	15hrs
<b>3</b>	<b>Cellular interactions and their environment:</b> <b>a) Interaction of cells with non cellular substrates</b> The extra cellular space, the extracellular matrix, collagens, proteoglycans, fibronectin, laminin and other proteins, Integrins, focal adhesions and hemidesmosomes. <b>b) Interactions of cells with other cells</b> Selectin, immunoglobulin super family and integrin super family, cadherins, Junctions: tight junctions, gap junctions and desmosomes, Plasmodesmata.	8hrs
<b>4</b>	<b>Cytoskeleton and cell motility:</b> Microtubules-structure and function, dynamic property; Molecular motors, Cilia and flagella- structure and function, Intermediate filaments, microfilaments, muscle contractility, non-	8hrs

muscle motility.

- 5 Cell signaling:** Communication between cells and their environment, basic characteristics, second messengers and G protein-complex-coupled receptors, role of calcium as a second messenger, receptor tyrosine kinases, MAP kinase cascade, other signaling pathways- NO, IP3 pathways in plants. 8hrs
- 6 Techniques in cell and molecular biology:** Microscopy: Bright-field, phase-contrast, polarization, fluorescence, confocal, microphotography, video processing and image processing, cell culturing, Ultracentrifugation, Isolation, purification and fractionation of proteins and nucleic acids, Autoradiography, Flow cytometry. 10hrs

#### REFERENCES

- 1 Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. & Watson, J.D., 1996. Molecular Biology of Cell, II Ed., Garland Pub. Inc. N.Y.
- 2 Lodish, H., Berk, A., Zipuosky, L.S., Matsudaira, P., Baltimore, D. & Darnell, J., 2004. Molecular Cell Biology – IV Ed., W.H. Freeman & Company.
- 3 Gilbert, S.F., 1997. Developmental Biology, Sinauer Associates Inc.
- 4 Wilson, E.B. Cell in Development and Inheritance, Mac Millan, N.Y.
- 5 Celis, J.E (Ed.), 1998. Cell Biology: A Laboratory Hand Book – Vol. I & II, Academic Press.
- 6 Darnell, J. H. Lodish & D. Baltimore 2003. Molecular Cell Biology, Scientific American Books, Inc., USA.
- 7 Cooper, G.M., 1997. The Cell: A Molecular Approach, Sinauer Associates Inc.
- 8 Lewin B., 1997. Genes VIII, Oxford University Press, Oxford, N.Y. & Tokyo.
- 9 Garrett & Grisha., 1994. Molecular Aspects of Cell Biology, Saunders, N.Y.
- 10 Karp G., 1999. Cell and Molecular Biology, II Ed., John Wiley & Sons, N.Y.

- 1 **Introduction to Science of Inheritance:** Model genetic organisms. Life history and inheritance pattern in bacteriophage (T4), Fungi (*Neurospora*), Algae (*Chlamydomonas*), Bacteria (*E. coli*), Plant (*Arabidopsis*), *Caenorhabditis*, *Drosophila*, Zebra fish, Mouse 4 hrs
- 2 **Mendel's principles:** Mendel and his laws, Applications of laws and probability tests. Chi-square test and its application in the analysis of genetic data. Pattern of inheritance in haploid and diploid organisms. Extension of Mendelism- alleles, allelic variation and genetic factor dominant relationship, basis of dominant and recessive inheritance. Multiple alleles and allelic series, lethal alleles, penetrance and expressivity. Inheritance of genes. Pleiotropy. 6 hrs
3. **Chromosomal basis of inheritance:** Concepts and evidences, Sex linked inheritance in *Drosophila* and man. Sex chromosomes, Sex determination. Multiple sex chromosomes, Sex linked and sex- limited traits. 8 hrs
4. **Linkage and crossing over:** Concept, Genetic recombination and construction of genetic map. Genetic and linkage map in *Drosophila*, *Neurospora*, algae and plants. Interference and coincidence. Mitotic recombination. 10 hrs
5. **Non-Mendelian inheritance / Extranuclear genes:** Maternal inheritance, Extra nuclear inheritance in *Neurospora*, *Chlamydomonas*, *Paramecium*, Yeast, *Drosophila* and Man, Mitochondrial genomes, Chloroplast genomes, Transposable genetic elements. 10 hrs
6. **Somatic cell genetics:** Cell-cell hybridization, cell hybrids, mapping of genes by cell hybridization methods, Mapping by *in-situ* hybridization. 8 hrs
7. **Behavioral Genetics:** Methodology, Type and examples, Genetic basis of behavioral traits in *Drosophila*, Mice and Humans. 6 hrs

## REFERENCES

1. Atherly A. G., Girton, J. R. & McDonald, J. F., 1999. The Science of Genetics, Saunders College Publishing, Harcourt Brace College Publishers.
2. Brookers R. J., Benjamin / Cummings, 1999. Genetics: Analysis and Principles, Longman Inc.
3. Garner E.J, Simmons, M.J. & Snustad, D.P.1991. Principles of Genetics, John Wiley & Sons Inc, N.Y
4. Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. & Gelbart, 1996. An



Introduction to Genetic Analysis, W H. Freeman and Company, N.Y.

5. Monroe W. Strickberger. 1996. Genetics, 3<sup>rd</sup> Ed., M. W. Mac Millan Publishing Co., N.Y.
6. Watson, J.D., Hopkins, N. H., Roberts, J. W. Steitz & Weiner, A. M., 1987. Molecular Biology of the Genes, The Benjamin/Cummings Publishing Company Inc., Tokyo.
7. William S. Klug & Michael R. Cummings 1996. Essentials of Genetics, 2<sup>nd</sup> Ed, Prentice Hall Internationals
8. Daniel L. Hartl & Elizabeth W. Jones, 1999. Essential Genetics, 2<sup>nd</sup> Ed., Jones & Bartlett Publishers
9. Tom Strachan & Andrew P. Read, 2004. Human Molecular Genetics 3, 3<sup>rd</sup> Ed., Garland Science, N.Y.
10. Robert H. Tamarin, 2002. Principles of Genetics, 7<sup>th</sup>Ed, TaTa McGraw-Hill Edition, New Delhi, India.
11. Griffiths, A.J.G., Willian M. Gelbart, Richard C. Lewontin & Jeffrey H. Miller, 2003. Modern Genetic Analysis: Integrating Genes and Genomes, 2<sup>nd</sup> Ed., W. H. Freeman and Company, N.Y.

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|----------|--|-------|
| <b>1</b> | <b>Chromosome structure:</b> Chromosomal theory of inheritance, Interphase nucleus, Nuclear matrix and other structures, Molecular organization of prokaryotic and eukaryotic chromosomes, Nucleosome structure, Chromosomal protein, Higher order of eukaryotic chromosomes, DNA scaffolds and loops, Molecular organization of chromosomes, Chromomere, Kinetochores, Cenromeres & Telomeres, Heterochromatin & Euchromatin. | 10hrs |
| <b>2</b> | <b>Cell division:</b> Mitotic and meiotic transmission of chromosomes, Specialized chromosomes; Lampbrush chromosomes: Types, occurrence, organization and biological significance. Polytene chromosomes: Occurrence, structural organization and their functional role. Supernumerary chromosomes: Occurrence, role during meiosis and mitosis and their evolutionary significance.   | 8hrs  |
| <b>3</b> | <b>Chromosome mutations:</b> Changes in chromosome structure, Origins of changes in chromosome structure. Deletions, duplications, inversions and translocations. Genetic significance of non-Robertsonian chromosome changes.   | 6hrs  |
| <b>4</b> | <b>Changes in chromosome number: Anueploidy:</b> Causes and consequences. Polyploidy: Occurrence, types and genetic significance, Overview of chromosome dynamics during cell division. Mechanisms of chromosome inheritance. Chromosome mechanisms in plant breeding.   | 8hrs  |
| <b>5</b> | <b>Role of chromosomes during evolution:</b> Chromosomes in karyotype changes and species differentiation, Chromosomal mechanics in speciation processes (Rodents, Insects), Polytene chromosome polymorphism in Dipteran examples. Role of heterochromatin in species evolution and karyotypic differentiation.   | 10hrs |
| <b>6</b> | <b>Chromosomal basis of sex determination:</b> Evolution of chromosomal heteromorphism, Evolution of sex chromosomes, Sex chromosome type, simple and multiple sex chromosomes, mechanism and systems of sex determination in <i>C. elegans</i> , <i>Drosophila</i> and Humans. Chromosome imprinting phenomena.   | 10hrs |

## REFERENCES

- 1 Goodenough Ursula, 1984. Genetics. 3<sup>rd</sup> Ed., CBS College Publishing.
- 2 Hamerton, J. L., 1984. Human Cytogenetics. Vols. I & II. Academic Press, N.Y.
- 3 White, M.J.D., 1973. Animal Cytology and Evolution, Cambridge University Press.
- 4 White, M.J.D. Modes of Speciation, W.H. Freeman & Co.
- 5 Gardner, Simmons, & Snustad, 1997. Principles of Genetics 8<sup>th</sup> Ed., John Wiley and Sons.
- 6 Lewin, B., 1996. Genes VI, John Wiley and Sons.
- 7 Mark H. F. L., 2000. Medical Cytogenetics, Marcel Dekker Inc, N.Y.
- 8 Sambamurthy, A.V.S., 1999. Genetics, Narosa Publishing House, New Delhi.
- 9 Sumner, A.T. 2003. Chromosomes : Organization and Function, Blockwell Publishing, USA

**PAPER-104: BIOLOGICAL CHEMISTRY**

**52hrs**

- 1 **Cell Environment:** Properties of water, acids and bases. Water in cell environment, salts, electrolytes, pH, Henderson–Hasselbach equation, buffers, buffering capacity and Zwitter-ions, Physiological buffering systems. 3hrs
- 2 **Biomolecules:** 14hrs
- a) **Carbohydrates** - Classification, structure and properties of different classes, chemical reactions, derived sugars.
  - b) **Amino acids and Proteins** – Structure, classification and properties of amino acids and proteins, non-protein amino acids, essential amino acids, amphoteric properties of amino acids, dissociation, chemical reactions. Classes and properties of proteins. Structural organization of proteins (Primary, Secondary Tertiary and Quaternary structure).
  - c) **Lipids** – Classification, structure of lipids, fatty acids, phospholipids, spingolipids, glycolipids and steroids, chemical reactions.
  - d) **Nucleic acids** – Structure and properties of different types of RNA, Structure of DNA. Watson – Crick model of DNA, Polymorphism in DNA Structure.
- 3 **Enzymes:** History, classification and nomenclature, specificity of enzyme; Kinetics of enzyme catalyzed reaction - Chemical kinetics, Michaelis – Menten equation, Transformation of M-M equation, L-B Plot, quantitative assay of enzyme activity, factors affecting enzyme activity. Mechanism of enzyme action – Hypothesis, catalytic mechanism, acid base and covalent catalysis – activation and inhibition of enzymes, allosteric modulation, coenzymes and isoenzymes. 8hrs
- 4 **Biological oxidation:** Oxidation–reduction reactions, biological redox potential, mitochondrial electron transport chain, oxidative phosphorylation, chemical and chemiosmotic hypothesis. 5hrs
- 5 **Bioenergetics:** Laws of thermodynamics and their application to biological process, basic concepts of metabolic energy, capture and transfer, biochemical energetics-free energy concept, high energy phosphate compounds (ATP & others) 5hrs
- 6 **Metabolism:** 10hrs
- a) **Carbohydrates:** Glycogenolysis, glycogenesis, regulation of glycogen metabolism, glycolysis, TCA cycle, fermentation reactions, glyoxylate cycle, pentose phosphate pathway.
  - b) **Proteins and amino acid metabolism:** Enzymatic and chemical

hydrolysis of protein, general metabolism of amino acids – transamination, deamination, decarboxylation, urea cycle and uric acid biosynthesis.

c) **Lipids:** Biosynthesis of fatty acids – Regulation of fatty acid synthesis. Oxidation of fatty acids – scheme of  $\beta$ -oxidation, energetics of  $\beta$ -oxidation, other pathways.

d) **Nucleic acids** - Biosynthesis of purines and pyrimidines.

7 **Vitamins:** Chemistry, lipid and water soluble vitamins.

3hrs

#### **REFERENCES**

- 1 Basic Concepts of Biochemistry, Gilbert, H.F., McGraw Hill professional, New York, 2002
- 2 Biochemistry. Down, M.B., Lipincott Willam & Wilkins, London, 1999
- 3 Biochemistry. Campbell, M., AND Farrell, D., 4<sup>th</sup> ed. Thomson Brooks/Cole, 2005
- 4 Biochemistry. Stryer, L., 4<sup>th</sup> ed, W.H. Freeman and Company, New York 1999
- 5 An Introduction to Practical Biochemistry, 3<sup>rd</sup> ed., Tata McGraw Hill, New Delhi, 2001
- 6 Biochemistry. Power & Chatwal, Himalaya publishing House, New Delhi, 2000
- 7 Biochemistry. Mathew, Sand Van Holde., 2<sup>nd</sup>. Benjamin/Cumming publishing Comp. London, 1995
- 8 Principles of Biochemistry 1995, Zutrav et al. W C B Puls.
- 9 Voet & Voet. John Wily & Sons.

#### **I SEMESTER – PRACTICAL SYLLABUS**

**PAPER-105:**

**CELL BIOLOGY AND GENETICS**

**Total : 120 hrs**

1. Vital staining of Mitochondria
2. Meiosis: Study of meiotic stages of a grasshopper testis (*Poecilocera/Oxya* sps).
3. Special Chromosomes: Preparation of Dipteran (*Drosophila* / *Chironomus* sps.) larval salivary gland chromosomes and study of naturally occurring inversion polymorphism.
4. Demonstration and identification of sperms: Insect, Amphibian, Annelid and Mammalian.
5. Study of *Drosophila* life cycle and its external morphology.
6. Study of phenotypic mutations of *Drosophila*.
7. Study of abnormal sperms of mouse.

**PAPER-106 :**

**CYTOGENETICS AND BIOCHEMISTRY**

**Total : 120 hrs**

1. Study of meiosis in *Laccotrephis* and *Sphaerodema*.
2. Studies of inversion polymorphism in *Chironomous*/mosquito polytene chromosomes.
3. Study of chromosomal aberrations induced by means of chemicals and X-rays (Rat).
4. Feulgen staining of DNA in Protozoa (*Paramecium*)
5. Study of sodium-potassium ATPase activity in two tissues (Frog/Rat).
6. Estimation of acetylcholine esterase activity by Hestrin's method (Frog/Rat).
7. Preparation of phosphatides from egg yolk.
8. Estimation of proteins in liver/mouse by Lowry's/Bradford's method.
9. Estimation of amino acids by Sorenson's method.
10. Determination of blood glucose and serum cholesterol in clinical samples.

**PAPER – 201: CELLULAR PHYSIOLOGY**

**52hrs**

<b>1</b>	<b>Cell Membrane:</b> Lipids, proteins, channels, pumps, transporters, membrane receptors, transport across cell membrane, transport across epithelial cells.	8hrs
<b>2</b>	<b>Cell water and electrolyte homeostasis:</b> Volume and distribution, normal balance of water and electrolytes. Cell volume regulations.	6hrs
<b>3</b>	<b>Channel and control of membrane potential:</b> Measuring membrane potential, separation of charge, generation of resting potential, factors controlling ion movements, Nerst equilibrium potential, Goldman-Hodgkin equation. Changes in membrane potentials. Passive properties of cells.	8hrs
<b>4</b>	Action potential, role of voltage – sensitive sodium channels, voltage clamping, threshold, refractory periods. Action of drugs and toxins on ion channels. Extra cellular recordings – compound action potential, cardiac action potential.	8hrs
<b>5</b>	<b>Synapsis:</b> Presynaptic process, amino acids, catecholamines, Postsynaptic process. Integrated synaptic currents, Presynaptic inhibition.	6hrs
<b>6</b>	<b>Muscle and other contractile systems:</b> Force generation and shortening. Control of intracellular calcium, mechanical output.	6hrs
<b>7</b>	Plant cell, Photosynthesis and bioluminescence.	4hrs
<b>8</b>	<b>Cell in Stress:</b> Various stressors, Stress responses, modulation of metabolic pathways due to stress. Cell responses to promote cell survival. Disorders due to chronic stresses.	6hrs

## REFERENCES

- 1 Irwin H. Segel, 1976. Biochemical Calculations, John Wiley and Sons Inc.
- 2 Voet D., Voet J.G. & Pratt, C.W., 1999. Fundamentals of Biochemistry, John Wiley and Sons.
- 3 Nelson, D.L., Cox, M. M., 2002. Lehninger Principles of Biochemistry, 3<sup>rd</sup> Ed. Macmillan Worth Publishers.
- 4 **Zubay, G., 1993. Biochemistry 3<sup>rd</sup> Ed., WCB Publishers.**
- 5 Bezkorovainy A. & Rafelson, Jr., M.E, 1996. Concise Biochemistry, Marcel Dekker, Inc. N.Y
- 6 Mckee, Trudy & Mckee James R. 1999. Biochemistry: An Introduction, WCB McGraw Hill.
- 7 Mathews C.K., van Holde, K.E. & Ahern K.G., 2003. Biochemistry, 3<sup>rd</sup>Ed, Pearson Education
- 8 Freifielder, D., 1998. Physical Biochemistry, W.H. Freeman and Company.
- 9 Berg, J.M, Tymoczko J.L., Stryer, L., 2001. Biochemistry, W.H. Freeman and Company, N.Y.

**PAPER – 202: GENETICS OF DEVELOPMENT**

**52hrs**

- 1 **Gametogenesis and differentiation:** Oogenesis and spermatogenesis, Hormonal regulations. 2hrs
- 2 **Fertilization and development:** Molecular events of fertilization, activation of sperm motility, gamete fusion, Role of calcium during egg activation, Genetics of multicellularity cleavage, Molecular events. 6hrs
- 3 **Pattern formation:** Cell fate and pattern formation, mutational and molecular analysis of basic body plan, Communication between and among cells, Genetics of axis specification in *Drosophila*, *C. elegans*, Amphibians and Mammals. 6hrs
- 4 **Metamorphosis:** Molecular mechanisms of: (a) Ecdysone action (b) Signalling during larval organ differentiation (c) Hormone response during metamorphosis (d) Genetics of eversion and differentiation of imaginal disc cells; Regeneration: (a) Cellular processes (b) Formation of blastomeres (c) Neuronal innervation (d) Transdifferentiation. 8hrs
- 5 **Cellular aging and death:** Concepts of aging, Cellular change during aging, theories, Caspases, Cellular death receptors, Signaling cell survival, Apoptotic genes. 6hrs
- 6 **Control of gene expression in bacteriophages and eukaryotic viruses:** Regulation of gene expression by lytic bacteriophages and during phage  $\lambda$  infection, Gene regulation by SV40 infection. 6hrs
- 7 **Control of gene expression in bacteria:** Regulation of lactose utilization and control of tryptophan biosynthesis, Translational control. 8hrs

## REFERENCES

- 1 Balinsky. 1975. Text Book of Embryology, Holt Saunders Company Ltd.
- 2 Berryl & Karp. 1980. Text Book of Developmental Biology, Tata Mac Graw Hill.
- 3 Browder, Erison, Jeffery, 1991. Developmental Biology, 3<sup>rd</sup> Edition, Saunders College Publishing Co., Inc. USA.
- 4 De Robertis, E.D.P., 1986. Essentials of Cell and Molecular Biology, Academic Press.
- 5 Gerald Karp, 1996. Cell and Molecular Biology, John Wiley and Sons, Inc. Canada.
- 6 Gilbert, S.F., 2000. Developmental Biology-VI Ed, Sinauer Associates Inc. Publishers, Massachusetts.
- 7 Knobil, E. & Neil, J.D. (Eds.), 1994. The Physiology of Reproduction-II ED, Vol-I&II, Raven Press Ltd.
- 8 Meyerowitz, E., 1998. Principles of Development, Oxford University Press.
- 9 Wolpert, Et al., 2002. Principles of Development, 2<sup>nd</sup> edition, Oxford University Press.
- 10 Davis. J.M., 2002. Basic Cell Culture, 2<sup>nd</sup> edition.

**PAPER – 203: GENES AND GENOMES**

**52hrs**

- |    |  |        |
|----|--|--------|
| 1  | <b>Conceptual definition of a gene:</b> Clinical features, 'DNA' 'RNA' as a genetic material. Biochemistry of a gene. Experimental set up of Griffiths, Avery et al, Hershey and Chase. Prokaryotic and eukaryotic version.  | 6 hrs  |
| 2  | <b>Gene Expression:</b> (a) Transcription, types of RNA prokaryotic and eukaryotic transcriptional processes, Post transcriptional modifications. (b) Translation: Genetic code, Universality and evolution of code. Translational enzymes. Translational machinery Ribosomes and its biogenesis. (c) Recombination Mechanisms. Enzymes involved in recombination. Various modes and models. | 16 hrs |
| 3  | <b>Viral genomes:</b> Viral infecting cycle, Viral genome analysis, Complementation. Gene mapping strategies in Bacteriophages. Recombination frequency mapping. Deletion mapping. Mapping without recombination.  | 4 hrs  |
| 4  | <b>Bacterial genomes and plasmidology:</b> Molecular overview of bacterial transformation, Conjugation and transduction. Mapping of bacterial genomes, Plasmids-Replication, Control and transfer, Properties of transposons.  | 6 hrs  |
| 5  | <b>Recombination in Fungi:</b> Tetrad analysis in Fungi, <i>Neurospora</i> and <i>Aspergillus</i> genomes and mapping of their genomes.  | 6 hrs  |
| 6  | <b>Mapping of algal Genome:</b> Fine structure, of algal genome. Gene expression and control in <i>Acetabularia</i> . Plastid inheritance.   | 4 hrs  |
| 7  | <b>Mapping of eukaryotic chromosomes:</b> Classical studies on linkage and recombination. Mapping in <i>Drosophila</i> in sexual crosses. Cytological mapping. Linkage groups and chromosomes.   | 4 hrs  |
| 8. | <b>Proteomics:</b> Tools and applications of proteomics.   | 6 hrs  |

## REFERENCES

- 1 Benjamin Lewin. Genes V (1994), VI (1997), VIII (2004), Oxford University Press.
- 2 Maxine Singer & Paul Berg, 1991. Genes & Genomes: A Changing Perspective, University Science Books.
- 3 Watson, J.D., Hopkins, N.H., Roberts, J. W., Steitz, J.A. & Weiner, A. M., 1987. Molecular Biology of the Gene, 4<sup>th</sup> Ed., The Benjamin/Cummings Publishing Co. Inc.
- 4 Leland H. Hartwell, Lelroy Hood, Michael L. Goldberg, Ann E. Reynolds, Lee M. Silver & Ruth C. Veres., 2004. Genetics: From Genes to Genomes, McGraw –Hill.
- 5 T.A.Brown, 1999. Genomes, John Wiley & Sons (Asia) Pte Ltd.
- 6 Lodish, Berk, Zipursky, Matsudaira, Baltimore & Darnell, 2001. Molecular Cell Biology.
- 7 Gunther S. Stent & Richard Calendar, 1986. Molecular Genetics, CBS Publishers & Distributers
- 8 Nicholas W.Gillham, 1994. Organelle Genes & Genomes, Oxford University Press.

**PAPER - 204: POPULATION AND EVOLUTIONARY GENETICS      52hrs**



- |          |   |       |
|----------|---|-------|
| <b>1</b> | <b>Quantitative genotype and phenotype distribution:</b> Determining norms of reactions, Heritability of traits and quantification.   | 8hrs  |
| <b>2</b> | <b>Population genetics I:</b> General principles and Mendelian populations: Allele and genetic variations in populations; Mendelian populations. Sources of variations: Hardy-Weinberg principles and its applications.<br><br><b>Population genetics II:</b> Evolutionary agents: Fitness, Selection, Migration, random drift in Small population, Polymorphism, Neutral theory.<br><br><b>Population genetics III:</b> Speciation and molecular evolution, Speciation concept, modes of speciation, Pattern of changes in nucleotide and amino acid sequences. Molecular clock and evolution. | 12hrs |
| <b>3</b> | <b>Molecular phylogenetics:</b> Construction of phylogenetic tree, Phylogenetic inferences: Distance method, Parsimony, maximum - likelihood method, Molecular phylogenetics of <i>Homo sapiens</i> and related issues, Hominid evolution   | 10hrs |
| <b>4</b> | <b>Human population genetics and evolution:</b> Basic attributes and polymorphic structures in human protein coding genes. Mitochondrial DNA polymorphism. Y-chromosome polymorphism and Single nucleotide polymorphism (SNP), Human society.   | 12hrs |
| <b>5</b> | <b>Genetics in forensic science:</b> Protein comparisons, DNA comparisons, RFLPs, genetic finger-printing, VNTRs, Genetic profiles. Unique correlation, Sociobiology, Altruism, Kin selection and inclusive fitness, Haplodiploidy, Imprinting phenomena.   | 10hrs |

## REFERENCES

- 1 T. A. Brown, 1999. Genomes, John Wiley & Sons (Asia) PTE Ltd.
- 2 Scott Freeman & Jon C. Herron, 2001. Evolutionary Analysis (2<sup>nd</sup> Edition), Prentice Hall.
- 3 Falconer & Mackay, 1996. Introduction to Quantitative Genetics (IV Edition), Longman.
- 4 David P. Mindell, 1997. Avian Molecular Evolution & Systematics, Academic Press.
- 5 Derek A. Roff, 1997. Evolutionary Quantitative Genetics, Chapman & Hall.
- 6 R.S.Singh & C. Krimbas, 2000. Evolutionary Genetics- From Molecules to Morphology, Cambridge University Press.
- 7 Peter Donnelly & Simon Tavaré, 1997. Progress in Population Genetics & Human Evolution (Vol. 87), Springer.
- 8 William S. Klug & Michael R. Cummings, 2000. Concepts of Genetics (Sixth Edition), Prentice Hall.
9. Monre W. Strickberger, 1985. Genetics (Third Edition), Prentice Hall of India.

## II SEMESTER – PRACTICAL SYLLABUS

### PAPER-205:

**CELL PHYSIOLOGY AND DEVELOPMENTAL GENETICS** **Total : 120 hrs**

1. Paper chromatography of aminoacids.
2. Thin layer chromatography of eye pigments (*Drosophila*).
3. Estimation of RNA and DNA by orcinol and diphenyl amine method (Burton's method).
4. Study of the early development of frog/chick.
5. Mounting of chick embryos during development.
6. Morphogenetic movements in chick *in vivo* experiment.
7. Study of imaginal discs in *Drosophila*.
8. Studies of absorption spectra of nucleic acids and proteins.
9. Frog: induction, spawning and early embryogenesis.

**PAPER-206 :**

**GENOMICS AND POPULATION GENETICS** **Total : 120 hrs**

1. Isolation of cellular DNA by rapid method.
2. Estimation of cellular DNA by standard method (Burtons).
3. Estimation of concentration of DNA by agarose gel electrophoresis.
4. Analysis of genomic DNA by agarose gel electrophoresis.
5. Study of isozymes by (PAGE) electrophoresis.
6. Quantitative characters in *Drosophila*: Sternoplurals and Acrostichals, Mean and standard error.
7. Calculation of change in gene frequencies.
8. Applications of Hardy-Weinberg principles and genetic problems.
9. Experiments on Genetic Drift: a) Population size b) Sampling Error
10. Studies on Homology Analogy

**PAPER - 301: HUMAN CYTOGENETICS**

**52hrs**

1. **Organization of Human Genome:** General features of human chromosome complement, Reiterated sequences occupy one-third of the total genome, Most structural genes occur in small families of closely knit sequences, Most protein genes are complex internal organization, Pseudogenes are common, The structure & variations of functional genes. 8hrs
2. **Human genome mapping:** Historical account. 10hrs
  - I. Physical mapping by means of somatic cell hybrids at chromosomal and subchromosomal level, Gene mapping by in-situ hybridization, Isolation of individual chromosomes, The top-to-down approach to molecular mapping, Restriction maps and contig construction-the bottom up (reverse genetics) approach.
  - II. Linkage analysis and genetic maps, RFLP and linkage analysis to assess dominance and recessive disease, Linkage analysis to set up with genetic heterogeneity, Linkage equilibrium and disequilibrium.
3. **Cellular and molecular cytogenetic technologies:** Cell lines, Cell and tissue culture practices, Harvesting of cells for chromosomal analysis, Conventional and specialized staining protocols, FISH and spectral karyotyping, Imaging in cytogenetic practices, Chromosome jumping and walking, Evolving molecular cytogenetic technologies, Chromosome instability and fragile sites. 8 hrs
4. **Clinical cytogenetics:** Heritable chromosomal abnormalities, Incidence of chromosome aberrations, Disorders of autosomes, Disorders of sex chromosomes, Disorders of sexual differentiation, Chromosome breakage syndromes. 8 hrs
5. **Prenatal diagnosis:** Amniocentesis, Chorionic villi biopsy, Cytogenetics of prenatal chromosomal abnormalities with clinical citations, Genetic counseling, Transplantation changes in bone marrow, peripheral stem cells and umbilical cord cells with chromosomal features. 8 hrs
6. **Chromosomal diagnostics in heamatopoietic disorders:** Myeloid disorders, AML, CML and lymphoid leukemia, lymphoblastic lymphoma and their chromosomal changes, Chromosome changes in benign and malignant tumors, Cytogenetics of breast cancer. 10hrs

## REFERENCES

- 1 Peter Sudbery 2002. Human Molecular Genetics (Second Edition), Prentice Hall.

- 2 Tom Strachan & Andrew P.Read 1999. Human Molecular Genetics (2nd Edition), John Wiley & Sons
- 3 M.A. Jobling, M.E. Hurles & C. Tyler-Smith, 2004. Human Evolutionary Genetics-Origins, Peoples & Disease, Garland Science.
- 4 Jorge J.Yunis, 1977. Molecular Structure of Human Chromosomes, Academic Press.
- 5 Elaine Johansen Mange & Arthur P. Mange, 1995. Basic Human Genetics (Second Edition), Sinauer Associates, Inc.
- 6 Ricki Lewis, 1998. Human Genetics-Concepts & Applications (3<sup>rd</sup> Edition), McGraw-Hill.
- 7 Margarlet J.Barch, Turid Knutsen & Jack L.Spurbeck, 1997. The AGT Cytogenetics Laboratory Manual (3<sup>rd</sup> Edition), Lippincott-Raven.
- 8 K.C. Sawant 2003. Concise Encyclopedia of Human Genetics, Dominant Pub. & Distributors
- 9 Amita Sarkar, 2001. Human Genetics, Dominant publishers and Distributors.
- 10 Michael Baraitser & Robin Winter, 1983. A Colour Atlas of Clinical Genetics, Wolfe Medical Publications Ltd.

**PAPER - 302: RECOMBINANT DNA TECHNOLOGY**

**52hrs**

1. **Making of recombinant DNA:** Cloning of a specific gene using a cloned 4hrs

DNA.

2. **Applications:** In-vitro mutagenesis, RFLP mapping, Reverse genetics, 10hrs  
Expressing eukaryotic gene in bacteria, Recombinant DNA technology in eukaryotes, transgenic eukaryotes and Genetic engineering in baker's yeast, Genetic engineering in plants and animals, Gene therapy, Human gene therapy
3. **Genomics:** Genome projects, structural genomics, Assigning loci to specific 8 hrs  
chromosomes, High resolution chromosome maps, physical mapping of genomes, Genome sequencing.
4. **Functional genomics:** Gene disruption knockouts, The study of developmental 6 hrs  
regulation by using DNA chips, Benefits of genome sequencing.
5. **Comparative genomics:** Orthologous, paralogous and Gene displacement, 8 hrs  
Comparative genomes of prokaryotes, Organelles eukaryotes. Phylogenetic finger printing.
6. **Protein structural genomics:** Classification, High throughput determination 8hrs  
of protein structure, using protein structure to predict function, other routes to functional the annotation Rosetta Coevolution.
7. **Global expression profiling:** Traditional approaches to expression profiling, 8hrs  
the proteosome Application of genome analysis and genomics, Developmental genomics.

## REFERENCES

- 1 Maxine Singer & Paul Berg, 1991. Genes and Genomics: A Changing Perspective, University Science Books, California.
- 2 T. A. Brown, 1999. Genomes, John Wiley & sons (Asia), Pte Ltd.
- 3 Benjamin Lewin. Genes V1994, VI 1997, VII 1999 & VIII 2004 Oxford University Press, USA
- 4 S.B. Primrose & R.M. Twyman. Principles of Genome Analysis and Genomics, III Ed., Blackwell Publishing.
- 5 Anthony J.F. Griffiths, Jeffrey H. Miller, David T. Suzuki, Richard C. Lewontin, William M. Gelbart 2003, An introduction to Genetic Analysis, 7th Ed., W.H. Freeman and Company, N.Y, USA

**PAPER – 303: IMMUNOGENETICS AND HAEMATOLOGY**

**52hrs**

### Part A – Immunogenetics

- 1 B cell and Antibody response:** Antibody proteins and their genes, Cells and organs of immune systems, Characteristics of antigens, Molecular characteristics of immunoglobulins, Construction and expression of light and heavy chain genes, Overview of the genetic basis of antibody diversity, Monoclonal antibodies. 12hrs
- 2 The T cell response:** Cell mediated immunity, Molecular architecture of TCR, BCR and MHC, Antigen processing and presentation. 6hrs
- 3 Immunodisorders and diseases:** Autoimmunity – Organ and non-organ specificity (Systemic), Tolerance and autoimmunity, Autoimmune diseases, Deficiency-disorders of the immune systems. 10hrs

### Part B – Haematology

- 1 Blood and blood group antigens:** General characteristics of ABO, Lewis, Rh, Mn and Xg antigens, Leucocyte and platelet and isoantigens, Blood transfusion, Erythroblastosis fetalis. 10hrs
- 2 Molecular structure of hemoglobins:** Genetic Significance of Hemoglobin, Structural variation, Chemical and biochemical characteristics of Hemoglobin biosynthesis 6hrs
- 3 Genetic basis of globin gene variation:** Gene duplication and evolution of globin genes, Genetic disorders of hemoglobin, Haemoglobinopathies, Tropical Vector borne diseases. 8hrs

### REFERENCES

- 1 H.Harris & K.Hirschhorn, 1983. Advances in Human Genetics. (Vol. 10-13), Plenum Press, N.Y. & London.
- 2 Muin J. Khoury, Julian Little & Wyle Burke, 2004. Human Genome Epidemiology, Oxford University Press.
- 3 Lai poh San & Eric P H Yap, 2001. Frontiers in Human Genetics - Diseases & Technologies, World Scientific.
- 4 Frank A. Barile, 2004. Clinical Toxicology- Principles & Mechanisms, CRC Press.
- 5 Jeffrey C. Hall & Jay C. Dunlap, 1995. Advances in Genetics–Incorporating Molecular Genetic Medicine (Vol. 32), Academic Press.
- 6 J. Fernandes, J.M. Saudubray & G.Van den Berghe, 1996. Inborn Metabolic Diseases – Diagnosis and Treatment (Second Edition), Springer.

- 7 Sally A. Moody, 1999. Cell Lineage and Fate determination, Academic Press.
- 8 James C. Thomas & David J. Weber (Ed.), 2001. Epidemiological Methods for the Study of Infectious Diseases, Oxford University Press.
- 9 Max Levitan, 1977. Text Book of Human Genetics (2<sup>nd</sup> Ed), Oxford University Press.
- 10 Vogel Motulsky 1982. Human Genetics: Problems & Approaches, Springer-Verlag
- 11 Lai Poh San & Eric P H Yap, 2001. Frontiers in Human Genetics: Diseases and Technologies, World Scientific.
- 12 James C. Thomas & David J.Weber, 2001. Epidemiological Methods for the Study of Infectious Diseases, Oxford University Press.
- 13 Vogel Motulsky, 1982. Human Genetics- Problems & Approaches, Springer-Verlag.
- 14 Max Levitan, 1971. Text book of Human Genetics (Second Edition), Oxford University Press.

### Part A: Bioinformatics

- 1 Introduction to Bioinformatics:** Applications, Gene, Genome and Genomics, Proteomics. 2hrs
- 2 Sequence Analysis:** Nucleotide and proteomic sequence analysis, Homology sequence analysis – BLAST, PASTA, Pairwise sequence analysis, Multiple sequences- CLUSTALW, Phylogenetic analysis. 6hrs
- 3 Biological Databases:** Significance, Primary and Secondary databases, Nucleotide and proteome databases, Database querying softwares. 5hrs
- 4 Introduction to Web tools and Softwares:** 3D structures and significance, Introduction to Human Genome project, Pharmacogenetics and Genomics, Drug design and Microarrays. 7hrs
- 5 Computer applications. Computer organization :** Computer hardware and computer software. Operating system. Spread sheet and its applications. Databases. Computer networks. Internet, world wide web and applications. Information technology, Multimedia. Computer applications in genomics. 8hrs

### Part B: Biostatistics

- 1 Introduction:** Data reduction. Frequency distribution, histogram and frequency curve. Stem and leaf and box plot techniques. Time series graph. Measures of central tendency and dispersion. Skewness and kurtosis. 6hrs
- 2 Probability:** Conditional probability. Addition and multiplication rules of probability. Probability distributions. Binomial, Poisson and Normal distributions. Applications in genetics. 5hrs
- 3 Bivariate data.** Scatter plot. Product moment coefficient of correlation, rank correlation. Simple linear regression. Fitting of equation of the type  $y = a + bx$  and  $y = a\chi^b$  to the given data. Random sampling - simple random and stratified random sampling. 7hrs
- 4 Tests of significance:** Tests for single population mean, two means. Variance, proportions, Chi-square tests. Analysis of variance of one-way and two-way classified data. 9hrs

### REFERENCES



- 1 Attwood, T.K. & D.J.Parry-Smith (1999): Introduction to bioinformatics, Pearson Education Asia, New Delhi
- 2 Bergeron(2005): Bioinformatics computing. Pearson Education.
- 3 Campbel (2004): Discovering Genomics, Proteomics and Bioinformatics, Pearson Education
- 4 Higgins, D and W. Taylor (2000): Bioinformatics Sequence, Structure and databanks, Oxford University Press.
- 5 Krane (2005): Fundamental concepts of Bioinformatics. Pearson Education.
- 6 Leon & Leon(1999): Information Technology, Leon and Leon publications, Chennai
- 7 Pagano, P and G. Kimberlee(2004): Principles of biostatistics. Thomson Publications.
- 8 Nabendu Pal and Sahadeb Sarkar (2006): Statistics- Concepts and applications. PHI.
- 9 Glover and Mitchel: Introductory Biostatistics: McGrawhill.
- 10 Zar (2005): Biostatistical Analysis 4/e Pearson Education.
- 11 Daniel: (2002): Biostatistics. John Wiley, ISE
- 12 J.Medthi. J. (1992) Basic Statistics, New Age Publications.

### **III SEMESTER – PRACTICAL SYLLABUS**

**PAPER-305:**

**CLINICAL CYTOGENETICS AND RDT**

**Total : 120 hrs**

1. Study of normal human karyotype
  - (a) Lymphocyte culture, harvesting, conventional staining and preparation of human normal karyotype.
  - (b) Chromosome staining and banding techniques.
  - (c) Chromosomal preparations using solid tumor/leukemia samples
2. Differential staining of human blood.
3. PCR amplification , agarose gel electrophoresis
4. AFLP/RFLP/RAPD
5. Blotting techniques: a) Southern  
b) Western  
c) Dot
6. Isolation of bacteriophage from sewage water.

**PAPER-306:**

**IMMUNOGENETICS AND BIOINFORMATICS**

**Total : 120 hrs**

1. PAGE of haemoglobin.  
Characterization and electrophoresis of serum proteins.
2. Single radial immunodiffusion and determination of immunoglobulin concentration.
3. Double radial immunodiffusion by Ouchterlony method
4. Enzyme-linked immunosorbent assay
5. Microscopy and image analysis
  - (a) Microphotography and digital microscopy
  - (b) Image analysis.
6. Probability and test of significance
7. Computer applications
8. Bioinformatics

**PAPER – 401: MEDICAL GENETICS**

**52hrs**

- 1 **Genetic factors in common diseases:** Genetic susceptibility to common diseases. Types and mechanisms of susceptibility. Genetic approaches to common diseases. Diabetes mellitus, Hypertension, Coronary artery, diseases, Schizophrenia, Alzheimer's disease, Congenital abnormalities. 6hrs
- 2 **Single Gene Disorders:** Huntington's disorder, Myotonic dystrophy, Neurofibromatosis, Cystic fibrosis, Duchenne Muscular Dystrophy (DMD), Becker muscular dystrophy, Hemophilia A and B. Trinucleotide Repeat Expansion mutations and their remediation. 5 hrs
- 3 **Genetics of disorders with complex inheritance:** Genetic analysis of quantitative traits, Genetic mapping of complex traits with examples, Diseases with complex patterns and their examples. 5 hrs
- 4 **Biochemical genetics:** Inborn errors of metabolism, molecular and biochemical pathways and their basis of Phenylketonuria, Alkaptonuria, Maple syrup urine disease, Mucopolysaccharide and Galactosemia, Albinism 10hrs
- 5 **Pharmacogenetics:** Definition, drug metabolism, Genetic variation revealed solely by the effect of drugs, Hereditary disorders with altered drug response, Evolutionary origin of variation in drug responses, Pharmacogenomics, Ecogenetics, Molecular detection of diseases after human genome project, Drug discovery, Animal models in pharmacogenomics. 10hrs
- 6 **Molecular pathology:** Classes of gene mutations in humans, Human mitochondrial diseases, Loss of Function and Gain of functional mutations in humans, Agammaglobinemia, Diseases of collagens. 10hrs
- 7 **Genetics and Society:** Population screening for genetic diseases, Ethical issues involved in medical genetics, Subsequent to human genome project & its practical implications, Eugenic & dysgenic effects on gene frequencies. 6 hrs

## REFERENCES

- 1 Peter Sudbery. 2002. Human Molecular Genetics (Second Edition), Prentice Hall.
- 2 Tom Strachan & Andrew P.Read, 1999. Human Molecular Genetics (Second Edition), John Wiley & Sons.
- 3 M.A.Jobling, M.E.Hurles & C. Tyler-Smith, 2004. Human Evolutionary Genetics-Origins, Peoples & Disease, Garland Science.
- 4 Jorge J.Yunis, 1977. Molecular Structure of Human Chromosomes, Academic Press.
- 5 Elaine Johansen Mange & Arthur P. Mange, 1995. Basic Human Genetics (Second Edition), Sinauer Associates, Inc.
- 6 Ricki Lewis, 1998. Human Genetics-Concepts & Applications (3<sup>rd</sup> Edition), McGraw-Hill.
- 7 Margarlet J.Barch, Turid Knutsen & Jack L.Spurbeck, 1997. The AGT Cytogenetics Laboratory Manual (3<sup>rd</sup> Edition), Lippincott-Raven.
- 8 K.C. Sawant 2003 Concise Encyclopedia of Human Genetics, Dominant Publishers & Distributors
- 9 Amita Sarkar, 2001. Human Genetics, Dominant publishers and Distributors.
- 10 Michael Baraitser & Robin Winter, 1983. A Colour Atlas of Clinical Genetics, Wolfe Medical Publications Ltd.

**PAPER -402: MUTATION AND CANCER BIOLOGY**

**52hrs**

- 1 **Radiation components:** Ionizing and non ionizing radiations, Radiation dosimetry, effect of radiation on cells and chromosome, Radiation implications on human population. 4hrs
- 2 **Mechanisms of gene mutations:** Molecular basis of gene mutations, Spontaneous mutation, Relation between mutagens and carcinogens, Clastrogens, Biological repair mechanism, Repair defects and human diseases. 10hrs
- 3 **DNA repair mechanisms and their role in mutagenesis:** DNA replication mechanism, Direct mutagenesis, Chemical alterations of nucleotide structure, Site directed mutagenesis, Repair mechanisms, Mismatch repair, SOS repair, photoreactivation. 8hrs
- 4 **Cancer as a genetic disease:** An overview of cancer and control of cell number, cell proliferation machinery, Machinery for Programmed Cell Death, Cancer, the genetics of aberrant cell control, cancer research in genomic analysis. 10hrs
- 5 **Oncogene in human cancer and their genetic relevance:** Tumor suppressor genes, Role of protooncogenes during development, Metastasis, Genetic basis of carcinogenesis, Genetics of Leukemia, Lymphomas, Myelomas, Myeloproliferative diseases. 10hrs
- 6 **Diagnostics and therapy:** Methods of diagnosis, Radiation therapy, Chemotherapy, Use of immunotoxins in cancer therapy. 10hrs

## REFERENCES

- 1 Kilbey, B.J., Legator, M. & Nocholas, W., 1984. Handbook of Mutagenicity Test Procedures, Elsevier Scientific Publishers, 2<sup>nd</sup> edition, N.Y.
- 2 Moore, M.M. 1987. Mammalian Mutagenesis, Banbury Report, 28.
- 3 Bishop, J.A. 1982. Retroviruses and Cancer Genes. Advances in Cancer Research, 37: 1-3.
- 4 Sanberg, A.A. 1980. The Chromosomes in Human Cancer and Leukemia. Elsevier, N. Y.
- 5 Vogel, F. 1982. Chemical Mutagenesis. Springer-Verlag.
- 6 Vogel, F. & Motulsky, A.G., 1982. Human Genetics. Problems and Approaches. Springer- Verlag, Berlin, Heidelberg.
- 7 Avery, Sandberg, A., 1980. The Chromosome in the Causation of Human Cancer and Leukemia, Elsevier, N.Y.
- 8 Catorsky, D., 1981. The Leukemic Cell, Churchill, Livingstone, N.Y.
- 9 Stich, H.F., 1982. Carcinogens and Mutagens in the Environment, CRC Press Inc. Bacaraton, Florida.
- 10 Sher, C.J., 1996. Cancer Cell Cycles, Science 274: 1672-1677.

**PAPER – 403: MOLECULAR MEDICINE**

**52hrs**

- 1 **Gene therapy:** Gene therapy towards molecular genetic disease through therapeutic approaches, Principles and different strategies, The technology of classical gene therapy, Therapeutics based on targeted inhibition of gene expression and mutation corrections *in- vivo*, Gene therapy for inherited diseases - SCID, DMD, Cystic fibrosis, Huntington's disease, Myotomic dystrophy, Neoplastic and infectious diseases, The ethical issues related to human gene therapy practices. vaccines. 14hrs
- 2 **Biology and genetics of stem cells:** Stem cells molecular circuitry of pluripotency and nuclear reprogramming, Stem cells and niches: mechanism that promotes stem cell maintenance through life, Mechanisms of asymmetric cell divisions, Cellular programming of plant gene Imprinting, Germ cells are for ever, Chromatin remodeling and epigenetic features, Cancer stem cells an experience with Leukemia, Development of neuronal stem cells, Prospectus for stem cell based therapy and tissue engineering, Ethical and social considerations of stem cell research. 12hrs
- 3 **The Genetics of RNA world:** Catalytic diversity of RNAs, RNA silencing in plants, The functions of animal micro RNAs, Cross talk between RNA metabolic pathways- an RNomics approach, Understanding alternative splicing: Towards a cellular code, Gene discovery by ribozyme and siRNA libraries. 12hrs
- 4 **Epigenetics a landscape takes center stage:** Genetics and epigenetic regulators of pluripotency, Non-coding RNA and gene silencing, The mammalian epigenome, Genome regulation by polycomb and trithorax proteins, Prions of yeast as epigenetic phenomena, Mammalian genomic imprinting elicited through human examples. 14hrs

#### REFERENCES

- 1 Leaf Huang, Mien-Chie Hung, Ernst Wagner, 1999. Nonviral Vectors for Gene Therapy, Academic Press.
- 2 Max Levitan, Ashley Montagu, Max Levitan, 1977. Text Book of Human Genetics, 2<sup>nd</sup> Ed., Oxford University Press, N.Y.
- 3 F. Vogel, A.G. Motulsky, 1982. Human Genetics- Problems and Approaches, Springer-Verlag Berlin Heidelberg, N.Y.
- 4 Harry Harris & Kurt Hirschhorn 1983. Advances in Human Genetics, Plenum Press, NY & London
- 5 Tom Strachan & Andrew P. Read. 2004. Human Molecular Genetics, 2<sup>nd</sup> Ed., John Wiley & sons (Asia) PTE Ltd.
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- 9 Amita Sarkar 2001. Human Genetics, Dominant Pub & Distributors, Vol. I & II, New Delhi.

**PAPER – 404: APPLIED BIOTECHNOLOGY**

**52hrs**

<b>1</b>	<b>Cell and tissue culturing practices:</b> Advantages and disadvantages in animal and plant tissues, Culture media, Preparation of tissue cultures for short term and long term utilizations, Large scale production, Cryopreservation, Plant tissue culture practices: Inoculation, Propagation and Explantation practices in the case of direct and indirect regeneration, Callus, Meristem culture, Isolation and propagation of gynogenic and androgenic haploids and diploids their significance in plant breeding.	10hrs
<b>2</b>	<b>Fermentation technology:</b> Fermenters, Bioreactors, Selection of microbes, Media and antibodies.	6hrs
<b>3</b>	<b>Protoplast technology:</b> Isolation, maintenance, Viability tests for protoplast generation, Regeneration from protoplasts, Methodology adopted in protoplast fusion and their application in plant research, Biofertilizers: Production and beneficial roles of <i>Rhizobium</i> , Inoculants of <i>Azotobacter</i> <i>Azospirillum</i> , Bluegreen algae, Mycorrhizal fungi and <i>Azolla</i> , Transgenic plants: Genetic manipulation of plasmids, Molecular mechanisms and differentiation of T4-DNA, Production and improvements of transgenic plants in crop improvement, Gene transfer in Dicots and Monocots, Altering crops at cellular level, Seed and Cell bank, Patent protection, Plant breeders Right.	10hrs
<b>4</b>	<b>Artificial animal breeding:</b> Cloning technology, <i>In-vitro</i> fertilization, Cell manipulation practices, Superovulation experiments, Transgenic animals, Expression of foreign genes in transgenic model organisms, Use of transgenics in animal and agricultural practices, Methods of recombinants into chicken and other embryo of animal systems, Transgenic goat and sheep.	10hrs
<b>5</b>	<b>Immunotoxicology:</b> Serological tests, Hybridoma technology, Immunotoxins, Nucleic acid probes, Animal vaccines, Pollution and environmental pollutants, Water and sewage treatment.	10hrs
<b>6</b>	Role of biosensors, biochips, Bioremediation and biodegradation	6hrs

#### REFERENCES

- 1 M.M. Ranga, 2004. Animal Biotechnology, II Ed., Agrobios, India.
- 2 J.E. Smith, 1990. Biotechnology, III Ed., Cambridge University Press, Cambridge, USA.
- 3 S.S. Purohit, 2004. Biotechnology, III Ed., Agrobios, India.
- 4 N. Yadav, 2003. A Handbook of Biotechnology, I Ed., Anmol Publication.

#### IV SEMESTER – PRACTICAL SYLLABUS

**PAPER-405 :**

**MEDICAL GENETICS AND CANCER BIOLOGY**

**Total : 120 hrs**

1. Differential gene expression: demonstration of ecdysone/heat-induced gene expression in polytene chromosome of *Drosophila*
2. Induction of chromosomal abnormalities by treating with cyclophosphamide – mitotic and meiotic chromosomes of Rat.
3. Genetic basis of insecticide resistance
  - (a) Susceptibility studies by using different insecticides in Culicine mosquitoes.
  - (b) Genetic basis of insecticide resistance by using adulticide.
4. Pedigree analysis
5. DNA isolation from blood/liver and electrophoresis
6. Molecular diagnosis of biochemical disorders (Phenylketonuria, Alkaptonuria, Survey of mucopolysaccharide disorders)
7. Studies on Serum proteins by electrophoresis

**PAPER-406 :**

**MOLECULAR MEDICINE AND BIOTECHNOLOGY**

**Total : 120 hrs**

1. Analysis of gene expression in carbon tetra chloride treated Rat livers
2. Restriction digestion and mapping.
3. Plant tissue culture- protoplast extraction
4. Observation of Green Fluorescent Protein (GFP) tagged reporter expression in embryos, imaginal discs and others.
5. Reporter lac gene expression in imaginal discs.
6. Bacterial culture and Gram's staining.
7. Extraction of DNA from bacterial cells
8. Replica plating technique
9. Methyl green-pyronin staining to localize nucleic acids in appropriate tissue.
10. Toluidine blue staining for RNA and DNA.

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