BHARATHIAR UNIVERSITY: COIMBATORE – 641 046

M. Sc. MOLECULAR BIOLOGY AND HUMAN GENETICS (CBCS PATTERN)

(For the students admitted during the academic year 2011-2012 batch and onwards)

Duration of the course: 2 years

Eligibility Condition:

B.Sc. Zoology
B.Sc. Animal Sciences
B.Sc. Advanced Zoology
B.Sc. Applied Zoology
B.Sc. Animal Science and Biotechnology
B.Sc. Advanced Zoology and Biotechnology
B.Sc. Life Sciences
B.Sc. Microbiology
B.Sc. Biochemistry
B.Sc. Biotechnology
B.Sc. Genetics
B.Sc. Bioinformatics
B.E./B. Tech. Biotechnology
B. Tech. Genetic Engineering
B. Tech. Industrial Biotechnology
B.Tech. Agricultural Biotechnology

Scheme of Examination

Semester	Core/Elective /Supportive Paper	Subject Code 09ZOOC	Title of the Paper	Instructional Hours/week	Internal	External	Total Marks	Total Credits
I	Core-I	13A	Biochemistry	**4**	25	75	100	4
	Core-II	13B	Human Cytogenetics	**4**	25	75	100	4
	Core-III	13C	Medical Entomology	**4**	25	75	100	4
	Core-IV	13D	Molecular Cell Biology	**4**	25	75	100	4
	Core Practical- I	13P	Practical- I **(**Biochemistry, Human Cytogenetics, Medical Entomology and Molecular Cell Biology,)	**6**	25	75	100	4
	Elective-I	1EA	Immunotechnology	**4**	25	75	100	4
	Supportive-I	----	Offered to other Departments	**4**	12	38	50	2

II	Core-V	23A	Molecular Genetics	**4**	25	75	100	4
	Core-VI	23B	Transgenic Animal Technology	**4**	25	75	100	4
	Core-VII	23C	Nanobiology	**4**	25	75	100	4
	Core-VIII	23D	Medical Microbiology	**4**	25	75	100	4
	Core Practical-II	23P	Practical-II **(**Molecular Genetics, Transgenic Animal Technology, Nanobiology and Medical Microbiology**)**	**6**	25	75	100	4
	Elective-II	2EA	Stress and Biomarkers	**4**	25	75	100	4
	Supportive-II		Offered to other Departments	**4**	12	38	50	2
III	Core-IX	33A	Genomics & Proteomics	**4**	25	75	100	4
	Core-X	33B	Human Medical Genetics	**4**	25	75	100	4
	Core-XI	33C	Bioethics and Biosafety	**4**	25	75	100	4
	Core-XII	33D	Molecular Oncology	**4**	25	75	100	4
	Core-XIII	33E	Cell Signalling	**4**	25	75	100	4
	Core Practical-III	33P	Practical-III (Genomics & Proteomics, Human Genetics , Bioethics and Biosafety, Molecular Oncology and Cell Signalling)	**6**	25	75	100	4
	Elective-III	3EA	Genetic Counselling	**4**	25	75	100	4
	Supportive-III	---	Offered to other Departments	**4**	12	38	50	2
IV	Project and Viva	47V	Project Work	----	---	---	100	4
			Viva – Voce	----	---	---	50	2
			Field Trip* (Visiting Educational Institution, Research labs. And Industries etc.	----	---	---	25	1
			Skill Development* (Communication skills, Personality development, Summer Training Programme, On the Job training Programme etc.)	**----**	---	-----	25	1
			Total	**----**	---	----	**2250**	**90**

* To be submitted along with Project Work.

Practical Components:

The M.Sc. Molecular Biology and Human Genetics Core Practical Examination having the following Marks:

Internal Marks: 25 **Time: 1.30 minutes**

Major Practical		10 Marks
Minor Practical		5 Marks
Spotters (A, B, C & D)	4x21/2	= 10 Marks
	Total	= 25 Marks

External Marks: 75

Major Practical		20 Marks
Minor Practical		15 Marks
Minor Practical		10 Marks
Spotters (A, B, C & D)	4x5 =	20 Marks
Record		10 Marks
	Total	= 75 Marks

Theory Components:

The M.Sc. Molecular Biology and Human Genetics Core and Elective theory Examination having the following Marks.

Core and Elective Papers: Maximum Marks – 100

Internal Marks: 25

Test - 15 Marks
Assignment - 5 Marks
Seminar - 5 Marks

External Marks: 75

Section A - 10x1=10 Marks (Question No. 1 to 10)
Choose the best Answer type. Answer all questions. All questions carry equal marks.

Section B – 5x5 = 25 Marks (Either or type – Question No. 11 to 15)
Answer all questions. All question carry equal marks. Each answer should not exceed 2 pages.

Section C – 5x8 = 40 Marks (Either or type – Question No. 16 to 20)
Answer all questions. All Question carry equal marks. Each answer should not exceed 4 pages.

<u>Supportive Papers</u>: **Maximum Marks - 50**

Internal Marks: 12

Test - 6 Marks
Assignment - 3 Marks
Seminar - 3 Marks

External Marks: 38

Section A – 5x1=5 Marks (Question No. 1 to 5)
Choose the best Answer type. Answer all questions. All questions carry equal marks.

Section B – 3x3 = 9 Marks (Either or type – Question No. 6 to 8)
Answer all questions. All Question carry equal marks. Each answer should not exceed 1 page.

Section C – 4x6 = 24 Marks (Either or type – Question No. 9 to 12)
Answer all questions. All Question carry equal marks. Each answer should not exceed 2 pages.

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Core – I – 13A **BIOCHEMISTRY**

The objective of the biochemistry subject is help the student's to understand the molecular basis of human system. Lecture will address the study of biomolecules like proteins, carbohydrates, lipids etc., This subject also provide a basic knowledge of the fundamental chemistry and biology.

Unit -I

Introduction to Biochemistry – The cell – Thermodynamics – Water – pH, -Acids and Bases – Chemical bonding.

Unit-II

Amino acids – Structure - Classification - Properties - Isoelectric point - Zwitter ions- Biosynthesis of Essential and Non essential amino acids. **Proteins**- Structure - Classification – Mechanism of protein synthesis – Protein synthesis in Eukaryotes.

Unit-III

Carbohydrates – Classification - Structure of Mono, Oligo and Polysaccharides – Glycoproteins. – Synthesis of Glycosides. **Lipids** – Classification – Structure – Lipids and Biological membranes – Biosynthesis of Triglycerides – Cholesterol.

Unit-IV

Nucleic acids – DNA structure and Properties – Biosynthesis of Purines and Pyrimidines - Types of RNA – Replication of DNA. Enzymes – Classification – Enzyme kinetics – Enzyme Inhibition – Akkosteric enzymes – Coenzymes.

Unit-V

Energy – Introduction to Metabolism – Glycolysis – Citric acid cycle – Electron transport chain – Fatty acids – Fatty acid metabolism – Ketone bodies – Fatty acid Biosynthesis – Cholesterol.

References

1. Biochemistry, by D.Voet and J.G. Voet, 2004. John Wiley & Sons, USA
2. Biochemistry, by R.H. Garrett and C.M. Grisham, (3rd Edition) 2007Saunders College Publishers.
3. Principles of Biochemistry by A.L. Lehninger. 1984. CBS Publishers and Distributors, New Delhi.
4. Principles of Biochemistry by Albert L. Lehninger (4th edition) 2004. CBS Publishers and Distributors, New Delhi.
5. Biochemistry by Lubert stryer (4th edition) 2000. Freeman International Edition.
6. Biochemistry by Keshav Trehan, 1990. Wiley Eastern Publications.
7. Fundamentals of Biochemistry by J.L.Jain et. al. (4th edition) 1994. S.Chand and Company.
8. The Biochemistry of Nucleic acid – Tenth Edition-Roger L.P. Adams, John T. Knowler and David P. Leader, 1992. Chapman and Hall Publications.
9. Biochemistry. S. C. Rastogi, 2nd edition. 2003. Tata McGraw Hill Publishing Company, Ltd., N. Delhi.
10. Biochemistry: the Molecular Basis of Life. Trudy McKee and James R. McKee. Third Edition. WCB/McGraw-Hill Press, Boston, MA 2003.

Core – II – 13B HUMAN CYTOGENETICS

Unit - I

History of Human Chromosome Research - Denver Conference (1940) - Chicago Conference (1966) - Paris Conference (1971) - Nomenclature of Human Chromosome.

Unit - II

Identification of Human diploid chromosome - peripheral blood cultures - banding techniques - G-band; Q-band; C-band; R-band - Identification of 23 pairs of Human chromosomes by band position.

Unit - III

Chromosomal syndromes**:** Autosomal syndromes - Sex chromosomal syndromes - Structural chromosomal syndromes.

Unit - IV

Prenatal diagnosis**:** Chorionic villi sampling - Foetoscopy, Ultrascopy - Amniocentesis**.** b) Postnatal diagnosis**:** Peripheral blood leucocyte culture - Sister Chromatid Exchange - Fragile site - Mitotic index**.** c) Genetic Counseling.

Unit - V

Hereditary forms of Cancer - Oncogenes and Cancer - Chromosomes and Cancer - Cancer and the environment.

Reference books

1. Human Heredity Principles and issues -- by Michael R. Cumming's. 3rd Edition.
2. Genetics Medicine - by Karl. H. Muench Elsevier Pb. London
3. Human Genetics by Elof Axel Carlson, TATA Mc Graw-Hill Pb. New Delhi.
4. Attwood, T.K. and Parry Smith, D.J. 1999, Introduction to Bioinformatics, Longman Publications, Pearson Education Ltd., New Delhi.
5. Baxevanis, A.D. and Francis Ouelletle, B.P., 1998, Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins, Wiley – Interscience Publication, New York.
6. Bishop, M.J. and Ramlings, C.J., 1987, Nucleic Acid and Protein Sequence Analysis, A Practical Approach, IRL Press, Oxford.
7. Brown, T.A., Genomes, 1999, John Wiley and Sons Inc., New York.
8. Zhang, W.E.I. and Shmulevich, I.Y.A. 2002, Computational and Statistical Approaches to Genomics, Kluwer Academic Publishers, London.

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Core – III – 13C 3GS MEDICAL ENTOMOLOGY

Unit-I

Introduction to the Insects. External morphology. Overview of the Class Insecta. A guide to taxonomy. Insect/parasite interactions. Structure and function of the internal organs.

Unit-II

Basic Insect Biology. Internal anatomy and metamorphosis. Epidemiological concepts. Mosquitoes and Malaria. Biology of the parasites in mosquitoes and humans. Environmentally soft insecticides and botanical control.

Unit-III

Basic mosquito biology. External anatomy, mouthparts, feeding. Malaria: The disease. Vaccine development. The disease Pathology, chemotherapy, genetic antimalarials.

Unit–IV

Mosquitoes and Filariasis. Biology of the parasites. Diagnosis, symptoms and treatment of the disease. Microbial control of mosquito vectors. Tse-tse flies and African trypanosomiasis

Unit-V

Mosquitoes and arboviruses: Dengue and dengue hemorrhagic fever and Chikungunya.
Black flies and River blindness. Ticks and tick-borne disease presentations. Mites and mite-borne disease.

References:

1. The Insect Structure and Function - 4th Edition. by R. F. Chapman, USA.
2. Insect physiology by Wigglesworth, Vincent B. Sir, 1956,Methuen, Wiley edition, London.
3. Medical Entomology. 3rd Edition by Mike W Service M W Service Mike Service. Manchester, UK.

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Core-IV-13D MOLECULAR CELL BIOLOGY

Unit - I

Cells: The principal features of animal, plant and bacterial cells- Prokaryotic cells – Type study with Bacteria: Cell wall, plasma membrane, mesosome, flagella, pili and ribosomes, matrix and nucleoid. Sporulation in bacteria. Structural classification and biomedical importance of virus. Eukaryotic cells: Mammalian Cell types – Typical study with Human cells: Structure and functions of Nucleus, Nucleolus, Mitochondria, ER, Golgi apparatus, Ribosomes and Lysosomes.

Unit - II

Membrane Transport: Ionic concentration in cell, ion transport system: Active, passive, facilitated, simple diffusion, group translocation, antiport, symport, co-translocation of ions with suitable examples. Ion Channels and their functions. Intracellular Compartments and transport: Membrane bounded organelles- protein sorting-vesicular transport- secretory pathways-endocytic pathway.

Unit - III

Cell Communication: General principles of Cell signaling – types and Mechanisms- Cell surface receptors – GPCR Molecular structure and functions – Enzyme linked Receptors – Activated Tyrosine kinase and MAP kinase path-ways. Cell Division: Overview of cell cycle- Mitosis and Meiosis. Cell Cycle control in mammalian cells – Checkpoint in cell cycle regulation

Unit - IV

Cell biology of Cell aging process and its significance – Molecular Mechanism of Cell death : Cell necrosis and Apoptosis. CASPASE types and molecular mechanisms- Proapoptotic regulators. Inhibitors of Apoptosis -Molecular biology of Survivin and Bcl2 family members.

Unit - V

Tumour cells and the onset of cancer- the genetic basis of cancer- Onogenic mutations in growth promoting proteins- Mutations causing loss of growth – inhibiting and cell cycle controls- the role of carcinogens of DNA Repair in cancer.

Reference Books

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter. P, 2003, Essential Cell Biology, Garland Science, New York.
2. Cooper, G.M., 2000, The Cell – A Molecular Biological Approaches, ASM Press, Washington.
3. De Robertis, E.D.P. and De Robertis, E.M.F., 2001, Cell and Molecular Biology, Lippincott Williams and Wilkins, USA.

Core Practical – I – 13P - BIOCHEMISTRY, HUMAN CYTOGENETICS, MEDICAL ENTOMOLOGY AND MOLECULAR CELL BIOLOGY,

BIOCHEMISTRY

1. Determination of total carbohydrate by Anthrone method
2. Estimation of cholesterol by Zlatkis method.
3. Protein estimation by Lowry's method.
4. Estimation of GOT and GPT.
5. Estimation of DNA.
6. Extraction of RNA and DNA.
7. TLC separation of amino acids

HUMAN CYTOGENETICS

1. Problems related to Mendelian laws.
2. Pedigree analysis
3. Peripheral blood leukocyte culture for chromosomal studies
4. Mitotic indices
5. Sister chromatid exchange -determination
6. Micronucleus test
7. Chromosomal disorders-Numerical, Structural

MEDICAL ENTOMOLOGY

1. Mouth parts of Insects
2. Identification of adult mosquito
3. Identification of larval stages of mosquitoes
4. Malarial parasites
5. Filarial parasite, *Whucheraria banchrofti*.
6. Structure of Dengue and Chikungunya virus

MOLECULAR CELL BIOLOGY

1. Isolation and enumeration of bacteria from soil and water
2. Determination of bacterial growth curve (*E. coli*)
3. Evaluation of antimicrobial sensitivity by Kirby – Bauer method
4. Cultivation and enumeration of coli-phage from raw sewage
5. Slides for Mitosis and Meiosis
6. Preparation of medium and cultivation of Human cell lines

Elective – I – 1EA IMMUNOTECHNOLOGY

Unit - I

Historical perspective, lymphoid organs, lymphocytes. Cells of immune system, T and B cell activation and maturation, Haematopoiesis, Haematopoitic stem cells, programmed cell death and necrosis. Immunoglobulins, Class switching, Antigens. The molecular basis of antigen and antibody interactions. Types of immunity and immune responses.

Unit - II

Cytokines, interleukins, complement system – The classical pathway, alternate pathway and the membrane attack pathway. Immunostimulation, Immunosupression and its clinical significance, Immunopotentiation-adjuvants.

Unit - III

MHC gene in man and mouse, Genomic map, gene expression, antigen presentation and processing by MHC class I and class II molecules. Autoimmuno diseases. Transplantation Immunology- Tissue typing and organ transplantation. Tumour Immunology. Immunobiology of HIV infection.

Unit - IV

Immunization – active and passive. Vaccines – whole organism vaccine, synthetic peptide vaccine, multivalent subunit vaccine, anti idotype vaccine, designer vaccine, edible vaccine, DNA vaccine, recombinant vector vaccine. Production and applications of monoclonal antibodies genetically engineered monoclonal antibodies, Abzymes.

Unit - V

Radio Immuno Assay, ELISA, Immunofluoresence technique, immunohistochemistry. Karyotyping and molecular medicines in cancer therapy. Microarray as a tool for detection of human genetic disorders.

Reference Books

1. Kuby, J., 2008, Immunology, W.H. Freeman & Co., New York
2. Roit, I.N., Brostaff, J.J. and Male, D.K., 2007, Immunology, C. Mosby, St.Louis
3. Van Dam – Mieras, M.C.E., de Jeu, W.H., de Vries, J., Currell, B.R., James, J.W., Leach, C.K. and Patmore, R.A., 20044, Technological Applications of Immunochemicals, Butterworth – Heineman Ltd., Oxford.

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Core – V – 23A **MOLECULAR GENETICS**

Unit – I

Fundamentals of genes and chromosomes – DNA structure and function – Chromosome structure and function – Gene in pedigree.

Unit – II

Fundamentals of DNA cloning and molecular hybridization: Cell based BNA cloning – DNA hybridization assays – PCR based DNA cloning and DNA analyses.

Unit – III

Features of the human Genome: Organization and expression of the human genome – Human multigene families and repetitive DNA – Footprints of evolution – Mutation and instability of human DNA.

Unit – IV

Mapping of the human genome: Physical mapping - Genetic mapping – The human genome project.

Unit – V

Dissecting and manipulating genes: Studying human gene structure and function and creating animal models of disease – Gene theory and other molecular genetic based therapeutic approaches.

Reference Books:

1. Tom Strachan and Andrew. P. Read – Human Molecular Genetics – 'Bios' Scientific Pub UK. (1996).
2. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J. and Weinter, A.M. – Molecular Biology of Genes (4^{th} edition) 1987. The Benjamin/Cummings publishing Company inc., Joky.
3. Lewin, B. Genes VI (1997). Oxford University Press, Oxford, New York, Tokyo.
4. Darvell, J. **et. al.,** Molecular Cell Biology (7^{th} edition) 2002. Garland Publishing iwc., New York.

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Core – VI – 23B TRANSGENIC ANIMAL TECHNOLOGY

Unit - I

Animal cell culture: Stages of culturing - cell culture media, cell lines, large scale culture, bioreactor models for animal cell culture, characterization and maintenance of cell lines – telomerase and cellular aging.

Unit – II

Cryopreservation, cell bank. Applications of cell line. Gene transfer technology – Retroviral gene transfer method. Non-viral approaches – Physical and chemical methods.

Unit - III

Vectors for animal – Plasmids as cloning vectors for Streptomylces – Baculovirus expression system. Viral vectors – Biology, adenovirus, adeno associated virus, retroviral vectors, Herpes virus, vaccinia virus. Cloned genes and production of recombinant proteins and vaccines. Insulin, somatotrophin, somatostatin, β-endorphin, Human interferons. Hepatitis B virus vaccine, vaccine for foot and mouth disease virus – DNA vaccine.

Unit - IV

Transgenic animals – mice, cattle, Gene knockout mice. Transgenic sheep, Transgenic fish. Animal bioreactor and molecular farming. Selected traits and their breeding into livestock. Applications of molecular genetics in improvement of livestock..

Unit - V

Gene therapy - Current trends in Gene therapy. Genetic disorders – Thalasemia and Haemophilia. Molecular approaches in disease diagnosis using nucleic acid probes and antibodies. . Human Genome Project and its perspectives. Ethical issues in Animal Biotechnology.

Reference Books

1. Butler, M., 2005, Animal Cell Technology: Principles and Products, Open University Press, New York.
2. Dubey, R. C., 2006, A text book of Biotechnology, S. Chand Co., New Delhi.
3. Marx, J.L., 2005, A Revolution in Biotechnology, Cambridge University Press, Cambridge.
4. Mather, J.P. and Barnes, D., 2001., Methods in Cell Biology, Vol 57 Animal Cell Culture Methods, Academic Press, New York..
5. Potten, C.S, 2006, Stem Cells, Academic Press, London.
6. Spier, R.E. and Griffiths, J.B., 2002, Animal Cell Biotechnology, Academic Press, New York.

Core-VII – 23C NANOBIOLOGY

Unit -1. Introduction to Nanotechnology

What is nano?, nanoparticles, nanocomposities, nanoscience and nanotechnology? Importance of nanoscience and nanotechnology in biomedical applications. Types of chemical bonds. Types of solid and powder crystals. Interaction between biomolecules and nanoparticles. Applications of nanotechnology in biotechnology: killing cancer cells, providing oxygen and artificial mitochondria. Nanobiosensors.

Unit -2. Nanomaterials for biology

Carbon based nanomaterials - carbon nanotubes for biomedical applications, SWCNT and MWCNT. Magnetic nanoparticles - Quantum dots - Quantum dot biomolecular tags. Conjugation of quantum dots with biomolecules. Si nanowires. Nanobiomaterials: Biocompatibility; Antibacterial activity; DNA and Peptide based nanomaterials; Polymer nanostructures; DNA nano structures; DNA based nano mechanical devices; DNA based computation; DNA biochips.

Unit -3. Synthesis of nanoparticals

Top-Down approach, Bottom-Up approach, Nano-Lithography, PVD, CVD, Wet deposition techniques, Microemulsion method, Sol-gel processing. Biological synthesis of nanoparticals - Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the formation of nanostructured materials; Synthesis process and application, Role of plants in nanoparticle synthesis. Use of biological design strategies as removable scaffolds and templates for the bottom-up assembly of nanomaterials.

Unit -4. Characaterization of nanobiomaterials

Basic principles, operations and applications of UV-Visible spectroscopy, FI-IR spectroscopy, SEM, TEM, STM, Atomic and Molecular spectroscopy, Photoacoustic spectroscopy, Fluorescence spectroscopy, Fluorescent resonance energy transfer (FRET), computations, AFM of DNA, STM of DNA and Confocal microscopy.

Unit -5. Environmental Nanotechnology

Nanotoxicology, Environmental and Health impacts of nanomaterials, Waste remediation, Nanoporous polymers and their application in water purification, Energy conversion. Photo-catalytic fluid purification, Current status of nanobiotechnology, Future perspectives of nanobiology and safety measures of nanomaterials.

REFERENCE BOOKS

1. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
2. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers.
3. Bionanotechnology: Lessons from Nature by David S. Goodsell.

4. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas.
5. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology - Hari Singh Nalwa.
6. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.
7. Nanocomposite Science & Technology Ajayan, Schadler & Braun.
8. BioMEMS (Microsystems) - Gerald A. Urban.
9. Introduction to Nanoscale Science and Technology (Nanostructure Science and Technology) –Massimiliano DiVentra.
10. Nanosystems: Molecular Machinery, Manufacturing, and Computation - K. Eric Drexler.
11. Springer Handbook of Nanotechnology - Bharat Bhusha.
12. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.
13. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
14. Introduction to Nanotechnology", C. P. Poole and F. J. Owens, Wiley.
15. "Nano Materials", A. K. Bandyopadhyay, New Age International Publishers.
16. "Nano Essentials", T. Pradeep, TMH.
17. "Nanotechnology: A Gentle Introduction to the Next Big Idea", M. Ratner and D. Ratner, Pearson Education.
18. "Nanotechnology – Science, Innovation, and Opportunity", L. E. Foster, Pearson Eduction.
19. "Nanotechnology – the fun and easy way to explore the science of mater's smallest particles", Richard Booker and Earl Boysen, Wiley.
20. Nanotechnology: Content and Context, Christopher Kelty and Kristen Kulinowski.
21. *The Chemistry of Nanoparticles (Synthesis, Properties and Applications)* by C.N.R. Rao, A. Muller, A.K. Chutham. *Vol 1 & Vol 2:* –WILEY-VCH.
22. *Tissue, cell and organ engineering*, by Challa Kumar :Vol 9 WILEY-VCH, 2006.
23. *Nanomaterials for Medical Diagnosis and Therapy* – Vol 10 by Challa Kumar, WILEY-VCH, 2007.

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Core-VIII- 23D **MEDICAL MICROBIOLOGY**

Unit-I

Scope and historical development in Medical Microbiology – contribution of Robert Koch, Louis Pasteur, Edward Jenner – Safety precautions in microbiological laboratories. Aseptic techniques: Moist heat, dry heat, chemical disinfectants, filtrations and irradiation.

Unit-II

Isolation of Pathogenic microbes: Serial dilution techniques - pour plate techniques micromanipulation. Cultivation of microorganisms: Media – enriched and selective media; Pure culture techniques. Pathogenecity and mode of action of bacterial, viral and fungal infections (Mechanism only).

Unit-III

Etiology, mode of infection, Pathogenecity, diagnosis and treatment for Bacterial diseases: *Vibrio cholera. Salmonella typhii, Mycobacterium lepera, Mycobacterium tuberculosis,*

Unit-IV

Etiology, mode of infection, Pathogenecity, diagnosis and treatment for viral diseases: *HIV, HPV, Poliomyletis, Hepatitis virus.* Fungal disease: *Aspergilus niger and Mycosis*

Unit-V

Principles and applications of Immuno-Electrophoresis, ELISA. RIA, PCR Blotting techniques: Southern and Northern, Widal test and immune-precipitation methods.

References

1. Pelczar Jr.J.J, Chan., E.C.S. and Kvieg. R. 2009. Microbiology, McGraw Hill, New York.
2. Presscott, L.M., Harley, J.P. and Klein, D.A. 2010. Microbiology, Wm.C Brown Publication Lowa. U.S.A.
3. Ananthanarayan, R., Jayaram Panikar, C.K. 2002. Text Book of Microbiology. Orient Longman limited, Chennai.
4. Gunasekaran, P. 2000. Laboratory Manual in Microbiology, New Age International Publisher, New Delhi.
5. Kannan, N. 2005. Laboratory Manual in General Microbiology, Palani Paramount Publishers, Palani.
6. Cappucino, J.G. and Sherman, N.2010. Microbiology – A Laboratory Manual, Benjamin Cummings Publishers, California.

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Core Practical -II – 23P - MOLECULAR GENETICS, TRANSGENIC ANIMAL TECHNOLOGY, NANOBIOLOGY AND MEDICAL MICROBIOLOGY

MOLECULAR GENETICS

1. Isolation of genomic DNA & Plasmid DNA
2. Estimation of DNA and RNA
3. DNA-Restriction digestion and ligation
4. Southern blotting
5. Polymerase Chain Reaction
6. Gene cloning – Transfection in animal cell lines
7. Retrieval of sequences from Nucleic acid databases
8. Database similarity search tools – BLAST

TRANSGENIC ANIMAL TECHNOLOGY

1. Construction of eukaryotic expression vector with gene of interest
2. Transfection into animal cell lines
3. Immuno-precipitation and Western staining for expressed protein identification

NANOBIOLOGY

1. Carbon nanotubes
2. Si nanowires
3. Quantum dots
4. DNA biochips
5. UV-Visible spectrophotometer
6. SEM
7. TEM
8. Confocal microscope
9. Nanoporous polymers
10. Protective materials against nanoparticles

MEDICAL MICROBIOLOGY

1. Widal test
2. RA test
3. ELISA for Salmonellosis
4. Western blotting for bacterial infection

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Elective – II – 2EA **STRESS AND BIOMARKERS**

The aim of the subject Stress and Biomarkers is to provide students with the background and experimental evidences to study and to understand the nature and toxicity of xenobiotics and their impacts on animals. The primary objective of the course is to provide the basic principles of environmental toxicology, toxicological assessments, toxicological response, and the effects of toxicants that have been released into the environment (e.g., pesticides, metals, effluents etc,). Toxicity testing (acute and chronic) will be examined and toxicological endpoints (e.g. Behavioral Biochemical, Histopathological, Hematological, Physiological, Hormonal, etc.) will be presented.

Unit –I

Introduction – definition – sub disciplines – environmental toxicants – routes of entry of xenobiotics.

Unit –II

Toxicity tests – need for conduct of toxicity tests – bioassay – types of acute toxicity tests- terminologies in toxicity tests- chronic toxicity tests.

Unit –III

Bioassay – basic requirements – test organisms – test solutions – test procedures – data analysis –joint toxicity.

Unit –IV

Biomarkers – introduction – background – biomarker selection and development – methods – types – specific and non specific – organ and tissue specific.

Unit –V

Physiological biomarkers – definition – direct enzyme inhibition – endocrine – blood chemistry – energetics –growth rate –histopathology.

References

1. Principles of Ecotoxicology, 3rd edition. C.H. Walker, S.P. Hopkin, R.M. Sibly & D.B. Peakall. Taylor & Francis, New York. 315 pp. 2006.
2. Principles of Biochemical Toxicology, 3rd ed. J.A. Timbrell. Taylor & Francis, New York. 394 pp. 2000.
3. Huggett, R.J., Kimerle, R.A., Mehrle, P.M.,Jr., Bergman, H.L., eds.: Biomarkers: Biochemical, Physiological, and Histological Markers of Anthropogenic Stress. Lewis Publishers, Boca Ratan, FL, 1992.
4. McCarthy, J.F., Shugart, L.R., eds.: Biological Markers of Environmental Contaminants. Lewis Publishers, Boca Ratan, 1990.
5. Peakall, D.B.: Animal Biomarkers as Pollution Indicators, Ecotoxicological Series 1. Chapman and Hall, London, 1992.

6. Fossi, M.C., Leonzio, C., eds.: Nondestructive Biomarkers in Vertebrates. Lewis Publishers, Boca Ratan, FL, 1994.
7. Frant C.L.V. 1991, Basic Toxicology II (Eds.), Hemisphere publishing corporation, Washington, London
8. Casarett and Doulls's 1980. Toxicology: The Basic Science of Poisons.. II (Eds.) Macmillan publishing co., Inc, New York.
9. Thomas J. Haley and William O. Berndt, 1987. Handbook of toxicology. Hemisphere Publishing Corporation, Washington.
10. Water Toxicology V.V. Metelev, Kanaev, N.G. Dzasokhova-Amerind Publishing Co., Pvt., Ltd., New Delhi

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Core – IX – 33A GENOMICS AND PROTEOMICS

Unit - I

Genomics – gene-DNA and chromosome. Genome – structure and organization of prokaryotic and eukaryotic genome – genetic and physical mapping. Assembly of a contiguous DNA sequence – clone contig approach – whole genome shot gun sequencing. Human Genome Project – importance and impact.

Unit - II

Genomics of *E. coli*, *Arabidopsis thaliana* and *Mus musculus*. Pharmacogenomics – High throughput screening for discovery and identification of drugs. Drug targets and development, SNP analysis**.**

Unit - III

Function predictionof Gene – computational and experimental analysis. Transcriptomics – transcriptome – yeast transcriptome and the human transcriptome – link between the transcriptome and proteome. Transcripts analysis – SAGE, non-array based whole transcriptome analysis, differential display – Yeast two hybrid systems.

Unit - IV

Proteomics – tools for proteome analysis – 2D – PAGE, Mass spectrometry, MALDI – TOF, TANDOM-MS, LC-MS, protein microarray, SAGE. Protein – protein interactions & uses of their databases. Peptide finger printing, techniques for protein purification, sequencing of proteins.

UNIT V

Phylogenetics – construction of DNA & protein based phylogentic trees and its application. Pharmacogenomics – personalized medicine. Pharmacoproteomics – medical proteomics based diagnostics – proteomics of multi protein complexes and peptidomics technique for human body fluids and cancer proteomics.

Reference Books

1. Brown, T.A., 2006, Genomes, John Wiley and Sons, Pvt. Ltd., Singapore. Campbell A,Heyer,
2. 2004, Discovering Genomics, Proteomics & Bioinformatics , Pearson Education, New Jersey.
1. Liebler, Daniel,C.,2002, Introduction to proteomics tool for the new biology, Humana Press, New Jersey.
2. Lesk, A.M. 2007. Introduction to Bioinformatics, Oxford University Press, Oxford.
3. Old, R.W. and Primrose, S.B. 2006. Principles of Gene Manipulation, Blackwell Science Publication, Berlin.
4. Pennington, S.R , Dunn,M,J., 2002, Proteomics from Protein sequence to function, Viva Books Pvt., Ltd, New Delhi.

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Core – X – 33B HUMAN MEDICAL GENETICS

Unit - I

The application of Cytogenetic investigations to clinical practice – a) the detection of chromosome abnormalities in individuals with clinical features of genetics diseases. b) the interpretation and reporting of results. c) prenatal diagnosis. d) likely impact of emerging approaches to prenatal diagnosis.

Unit – II

Biochemical genetics: Concept of inherited metabolic disease – History, incidence, symptoms – Risk factor – diagnosis – treatment of a) carbohydrate – Diabetes, Glactosemia. b) Lipid – Jaysochs, Lipidosis. c) Aminoacid – Phenylketoneuria, Alkaptoneuria. d) Nucleic acid – Gout Syndrome – DMD.

Unit - III

Behavioral Genetics: Schizophrenia – simple mode of inheritance – Twins and family studies in schizophrenia – Empirical risk figures. Charcot marie – Menks-kinky.

Unit - IV

Pharmacogenetics and Ecogenetics: History, incidence, symptoms, risk factor, diagnosis, treatment of a) glucose – 6 – phosphate dehydrogenase deficiency. b) genetics disease, Niemann pick disease (lysosomal disease).

Unit - V

Genetics and Bioethics: Eugenics and law – New genetic technology and the law – future of genetics, law and bioethics.

Reference books

1. Strachan, T., Read, A.P. 2004, Human Molecular Genetics, London and NewYork.
2. Gardner, E.J., Simmons, H.J. and Snustad, D.P. 2004, Principles of Genetics, John Wiley and Sons, New York.
3. Hartl, D.L. and Jones, E.W. 1998, Genetics – Principles and Analysis, Jones and Barlett Publishers, London.
4. Sinnott, E., W., Dunn, L.C. and Dobzhansky, T., 1998, Principles of Genetics, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
5. Rooney, D.E. (Ed.) Human Cytogenetics: Constitutional analysis – Oxford University Press 2001.

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Core-XI- 33C BIOETHICS AND BIOSAFETY

Unit – I

Introduction to Bioethics in Biotechnology- Ethics – Bioethics - Biotechnology – Positive effects – Negative effects - Ethics in biotechnology- Biotechnology examples – Rice with Vitamin A - Slow Ripening Fruits- Saving the Banana- Virus Resistant Crops - Building with Silk- educed Need for Fertilizers- More from the Sun- Toxic Soils- Biological Pest Controls –

Fast Growing Trees- Fast Growing fish- The Monarch Butterfly Story- Consumer traits – food safety- Environmental concerns- Economic and Social Concerns.

Unit – II

Biosafety Regulations- National and International Guidelines.

Introduction – Regulation framework in various countries – USA- European Union-Canada-Australia- South Africa- Asian Region- International Guidelines.

Unit –III

CPCSEA Guidelines for Laboratory Animal Facility

Goal- Veterinary care- Animal procurement- Quarantine, Sterilization and separation – Surveillance, diagnosis, treatment and control of disease- Animal care and technical personnel- Personal hygiene- Animal experimentation involving hazardous agent- Multiple surgical procedures on single animal- Duration of experiments- Physical restraint- Physical plant- Physical relationships of animal facilities to laboratories – Functional areas- Physical relationship of animal facilities to laboratories- Functional area- Physical facilities- Environment- Animal husbandry- Activity – Food- Bedding- Water- Sanitation and cleanliness- Assessing the effectiveness of sanitation – Waste disposal- Pest control- Emergency , weekend and holiday care.

Unit – IV

GLP and Bioethics- Introduction – National Good Laboratory Practice (GLP) Programme- The GLP authority functions- Why follow Good Laboratory Practices?- The Aspiration – Who is responsible? – The IT Way- Role of a Sponsor- What are the quality standards for Clinical Trials?- Why is India a favorite destination for Clinical Trials worldwide?

Unit – V

Intellectual Property Rights - An introduction- Origin of the Patent Regime- Early patterns Act & Indian Pharmaceutical Industry – History of Indian Patent System- The Present Scenario – Basis of Patentability –Patent Application Procedure in India- Patent Granted Under Convention Agreement- Who can apply for a patent?- Patent Procedure – Opposition to Grant of Patent- Grant and Sealing- Exclusive Rights – Grant of Exclusive Rights- Special Provision for selling or distribution – Suits relating to infringements – Compulsory License- Termination of Compulsory License – Case study- Compulsory Licenses- Relief under TRIPS agreement.

Reference Books:

1. Bioethics, by Shaleesha A. Stanley (2008). Published by Wisdom Educational Service, Chennai.

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Core-XII – 33D **MOLECULAR ONCOLOGY**

Unit– I

History, scope and current scenario of cancer research. Cancer – Types and their prevalence – Carcinoma, Lymphoma and Malignancy - Classification based on origin/organ: breast, colon, lung, prostrate, cervical and oral cancers. Molecular biology of tumour invasion and metastasis.

Unit – II

Molecular mechanism of oncogenesis – Proto oncogenes, oncogene, oncoproteins, other tumour suppressor proteins and receptors proteins involved in cancer. Molecular significance of myc, ras, fas, cox, cPLA and Bcl2.

Unit- III

Apoptosis and cancer : Mechanism of apoptosis - proteins involved in apoptosis- Signaling pathways : types and their impact on apoptosis and oncogenesis - Significance of – RB , Cyclins, RTK, CDKs, SMADs, Ras cascade, PTEN, NF-κ, extracellular matrix signaling, hypoxia, angiogenesis related pathways – Relationship between cancer and antiapoptotic proteins.

Unit- IV

Principle and methods of cancer diagnosis: – Biochemical, Genetic, Cytotoxic and cell growth and viability tests. Current status of cancer proteomics.

Unit- V

Cancer therapy – at cellular level- at gene level- at protein level. Principles of cancer biomarker and their applications – chemotherapeutics for cancer, Phytotherapy for cancer. Development of anti cancer drugs.

REFERENCES

Ian F. Tannock, Richard P. Hill. 1998. The Basic Science of Oncology; Third edition; McGraw- Hill, New York.

Miguel H. Bronchud, Maryann Foote, Giuseppe Giaccone, Olufunmilayo olopade, Paul Workman. 2008 Principles of Molecular Oncology; Third edition;; Humana Press; New Jersey.

Klaus-Michael Depatin, Simone Fulda. 2008. Apotosis and Cancer Therapy; WILEY-VCH Verlag GmbH & Co. , New York.

M. A. Hayat; 2010. Methods of Cancer Diagnosis, Therapy, and Prognosis; Vol-7;; Springer; Netherland.

Sotiris Missailidis.2008. Anticancer Therapeutics; John Wiley & Sons, Ltd; USA.

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Core-XIII – 33E **CELL SIGNALLING**

Unit - I

Cell Signalling: Prokaryotes and Eukaryotes - The Cytoskeleton and Extracellular Matrix - Core Cellular Functions in cell Organelles - Metabolic Processes in Mitochondria - Cellular DNA to Chromatin - Protein Activities in the Endoplasmic Reticulum and Golgi Apparatus - Digestion and Recycling of Macromolecules- Organization and Signaling of Eukaryotic Cell- Signaling Malfunction Central to Human Disease.

Unit II

Cell signaling Mechanisms - Types of signaling pathways that control gene activity, Integration of signals and gene controls. Signaling at the cell surface receptors, Cell Communication: General principles of Cell signalling – types and Mechanisms- Cell surface receptors – Seven Transmembrane proteins

Unit –III

Molecular structure and functions – Enzyme linked Receptors – Activated Tyrosine kinase and MAP kinase path-ways. Cell Division: Overview of cell cycle- Mitosis and Meiosis. Cell Cycle control in mammalian cells – Checkpoint in cell cycle regulation

Unit - IV

Cell signaling in Cancer – Types of cancer and role of signalling proteins in oncogenesis- Cell Cycle and their check points – - the role of carcinogens of DNA Repair in cancer.- Role of oncogenes and tumour suppressor genes. Current scenario of cell signalling studies in oncology.

Unit - V

Signaling in the Endocrine and Nervous Systems Through GPCRs: GPCRs Classification - Subunits of Heterotrimeric G Proteins- The Four Families of G-apha Subunits - Adenylyl Cyclases. Key to Second Messenger Signaling – Hormones and endocrine Signaling (peptide hormoe) - Neuromodulators Influence Emotions, Cognition and pain - Ill Effects of Improper Dopamine Levels - GPCRs Transduce Signals Conveyed by Odorants- GPCRs and Ion Channels Respond to Taste buds - Current scenario of cell signalling studies.

Reference Books

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter. P, 2003, Essential Cell Biology, Garland Science, New York.
2. Cooper, G.M., 2000, The Cell – A Molecular Biological Approaches, ASM Press, Washington.
3. Lodish, H., Baltimore, D., Berk, A., Matsudaira, P, Kaiser, C.A., Krieger, M, Scott, M.P., Zipursky, S.L., and Darnell, 2005. Molecular Cell Biology , W.H. freeman & Company, NY, USA

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Core Practical – III – 33P GENOMICS AND PROTEOMICS, HUMAN MEDICAL GENETICS, BIOETHICS AND BIOSAFETY, MOLECULAR ONCOLOGY AND CELL SIGNALLING

GENOMICS AND PROTEOMICS

1. Bacterial transformation and IPTG induction for over expression
2. Submission of sequence to NCBI or DDBJ
3. Sequence similarity analysis for protein and nucleic acid using on-line bioinformatics tools
4. Construction of phylogenetic tree using known DNA and Protein sequence
5. Retrieval of sequences from Nucleic acid databases
6. Database similarity search tools – BLAST

HUMAN MEDICAL GENETICS

1. Gene polymorphism study by using RAPD and RFLP.
2. COMET Assay.
3. Serum Biomarker Assay – Glucose – 6- Phosphate Dehydrogenase.

BIOETHICS AND BIOSAFETY

1. Visit to Research institutes holding animal house facility.

2. Visit to pharmaceutical industry and report submission.

3. CPCSEA, GLP, IPR- Group discussion - report submission.

MOLECULAR ONCOLOGY

1. Characterization of cancer cell lines.
2. Detection of oncogene expression adopting Western Blot analysis.
3. Survey of incidence in India through oncological databases.

CELL SIGNALLING

1. MAP kinase activity (Demonstration).
2. Isolation and identification of Pheromone receptor.
3. Characterization of BCl_2activity.

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Elective - III – 3EA GENETIC COUNSELLING

Unit- I

History of Human Genetics: Pedigrees – gathering family history; Pedigree symbols; Construction of pedigrees; Presentation of molecular genetic data in pedigrees; Pedigree analysis of monogenic traits; Autosomal inheritance-dominant, recessive; Sex-linked inheritance – X-linked recessive, dominant; Y-linked; Sex-limited and sex-influenced traits; Mitochondrial inheritance; MIM number.

Unit -II

Genetics in Medical Practice; Genetic Principles and their application in medical practice; Case studies (Interacting with patients, learning family history and drawing pedigree chart); Syndromes and disorders; Definition and their genetic basis; Molecular pathology of monogenetic diseases; Cystic fibrosis; Tay Sch's Syndrome and Marfan Syndrome; Genetics of diseases due to inborn errors of metabolism; Phenylketonuria, Galactosemia and Mucopolysaccharidosis.

Unit-III

Complications to the basic pedigree patterns: Genomic imprinting and uniparental disomy; Spontaneous mutations; Mosaicism and chimerism; Male lethality; X-inactivation; Consanguinity and its effects in the pedigree pattern; Allele frequency in population; Complex traits-polygenic and multifactorial: Approaches to analysis of complex traits – Nature vs nurture; Role of family and shared environment; Monozygotic and dizygotic twins and adoption studies; Polygenic inheritance of continuous (quantitative) traits, normal growth charts, Dysmorphology; Polygenic inheritance of discontinuous (dichotomous) traits – threshold model, liability and recurrence risk; Genetic susceptibility in complex traits; Alcoholism, cardiovascular disease, diabetes mellitus, obesity and epilepsy; Estimati0on of genetic components of multifactorial traits; empiric risk; Heritability; coefficient of relationship; Application of Bayes theorem.

Unit – IV

Genetic counselling: Historical overview (Philosophy and ethos) and components of genetic counselling. Indication for and purpose; Information gathering and construction of pedigrees;

Medical genetic evaluation (Basic components of Medical History, Past medical history, social and family history).

Unit-V

Components of genetic counselling: Physical examination (General and Dysmorphology examination, documentation). Legal and ethical considerations; Patterns of inheritance, risk assessment and counselling in common Mendelian and multifactor syndromes; Genetic testing; biochemical and molecular tests; in children, Presymptomatic testing for late onset diseases (predictive medicine); Prenatal and preimplantation screening and diagnosis; indications for prenatal diagnosis. Indications for chromosomal testing. Noninvasive methods (Ultrasound, embryoscopy, MRI, etc.); Invasive methods; Prenatal screening for Down's syndrome (maternal serum) and Neural tube defect; Preimplantation genetic diagnosis; Ethical issues in pre-natal screening and diagnosis.