SEMESTER II

ZY 2CT06 ECOLOGY: PRINCIPLES AND PRACTICES

ZY 2CT07 GENETICS AND BIO INFORMATICS

ZY2CT08 DEVELOPMENTAL BIOLOGY

ZY2CT09 BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

ZY2CP10 PRACTICAL - 2:
ECOLOGY,GENETICS AND BIO-INFORMATICS, DEVELOPMENTAL BIOLOGY, BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES.

ZY 2CT06 ECOLOGY: PRINCIPLES AND PRACTICES

90 Hours (5hrs/week) **Credit- 4**

Objectives:

- To provide an understanding on the basic theories and principles of ecology
- To help study various disciplines in ecology
- To learn current environmental issues based on ecological principles
- To gain critical understanding on human influence on environment

Module I. Ecology and Environment **15 hrs.**

Physical Environment- biotic and abiotic interactions. Concept of Homeostasis;Concepts of habitats-host as habitat, niche, niche width and overlap, fundamental and realized niche, resource partitioning, character displacement.

Cybernetic nature of ecosystem, stability through feedback control and through redundancy of components; resistance and resilience stability.Gaia hypothesis.

Concept of limiting factors- Liebig's law,
Shelford's law. Ecological indicators.

Prerequisite: *Definition, history and scope of ecology, sub divisions of ecology, Ecology Vs Environmental science.*

Module II. Ecosystem - Structure and Function **15 hrs.**

Ecosystem and Landscapes, pathways in ecosystem, energy in the environment-Laws of thermodynamics, energy flow in the ecosystem. Primary productivity, Biomass and productivity measurement.Food chain, food web, trophic levels. Ecological efficiencies, Ecological pyramids,Biogeochemical cycles- patterns and types (CNP).
Tropical versus Temperate Ecology.

Module III. Population Ecology **15 hrs.**

Population group properties, density and indices of relative abundance,Concept of rate. Natality and mortality. Population age structure, Growth forms and concept of carrying capacity.

Population fluctuations, density dependent and density independent controls.Life history strategies, *r & k* selection.

Population structure, aggregation, Allee's principle, isolation, dispersal and territoriality.

Population interactions- types, positive and negative, interspecific and intraspecific interactions.Ecological and evolutionary effects of competition.

Concept of metapopulation. Levin's model of metapopulation. Comparison of Metapopulation and Logistic population model. Metapopulation structure.

Module IV.Community Ecology **10 hrs.**

Concept of community - community structure and attributes, ecotone and edge effect.Development and evolution of the ecosystem, concept of climax.Species diversity in community and it's measurement-Alpha diversity,Simpson's diversity index, Shannon index, Fisher's alpha, rarefaction. Beta diversity-Sorensen's similarity index,Whittaker's index, Evenness, Gamma diversity, Guild and its functioning in the community.
Drivers of species diversity loss and conservation.

Prerequisite:*Community interactions*

Module V.Resource Ecology **15 hrs.**

Natural Resources: Soil-soil formation, physical and chemical properties of soil. significance of soil fertility.Mineral resources with reference to India. Impact of mining on environment; Forest resources-deforestation,forest scenario of India. Aquatic resources - Freshwater and water scarcity, water conservation measures - case studies from India; Wetlands and its importance, international initiatives for wetland conservation - Ramsar sites. Sand mining and its impacts. Wetland reclamation- causes and consequences. Depletion of resources and impacts on quality of life.

Energy Resources- solar, fossil fuels, hydro, tidal, wind, geothermal and nuclear.Energy use pattern in different parts of the world, recent issues in energy production and utilization; Energy audit, Green technology and sustainable development.

Ecosystem monitoring- GIS, Physics of remote sensing, role of remote sensing in ecology, GPS and its application; EIA- tools and techniques, Ecosystem Modelling (Brief account only).

Module VI. Applied Ecology **10 hrs.**

Environmental Pollution-types, causes and consequences.Concept of waste, types and sources of solid wastes including e-waste; Environmental biotechnology and solid waste management-aerobic and anaerobic systems. Concept of bioreactors in waste management. Liquid wastes and sewage. Bioremediation- need and scope of bioremediation in cleaning up of environment. Phytoremediation, bio-augmentation, biofilms, biofilters, bioscrubbers and trickling filters.

Radiation Biology - natural and man-made sources of radioactive pollution; radioisotopes of ecological importance; effects of radioactive pollution; nuclear disasters (two case studies), Disposal of radioactive wastes.

Toxicology- Principles, toxicants- types, dose and effects, toxicity of heavy metals.

Module VII. Biogeography and Conservation **10 hrs.**

Major terrestrial Biomes, theory of island biogeography, bio-geographical zones of India; Western Ghats and its significance.

Principles and major approaches to conservation and environmental management.Role of UN- conventions, protocols; Climate change and the emerging discussions – mitigation and adaptation; Role of UNFCC and IPCC. Country specific laws- mention major environmental/ conservation laws and rules in India-Wildlife Protection Act 1972 amended 1991, Forest Conservation Act, 1980, Air (Prevention and Control of Pollution) Act 1981, Water (Prevention and Control of Pollution) Act 1974, amended 1988, The Environment Protection Act, 1986 and Rules, 1991. The Biological Diversity Act 2002, Rules 2004.

Restoration Ecology- need and policies, case studies and success stories - global and national;

Global environmental problems and debates - past and present; Participatory resource management, community reserves, sacred groves, biovillages.

Role of Intergovernmental and Non-governmental organizations in conservation-IUCN, WCMC,WRI,WWF, CI and Green Peace.National and Local NGOs**.**

Prerequisite: *Ecological foot print, carbon footprint, carbon credit and eco-taxes.*

REFERENCES

Abbasi, S.A. and Ramasami, E.V.1998.*Biotechnological Methods of Pollution Control*. Oxford University Press, Hyderabad.

Benton, A.H. and Werner, W.E. 1976. *Field Biology and Ecology.* Tata McGraw Hill, New Delhi.

Boitani, L and T.K.Fuller.2000.*Research Techniques in Animal Ecology*. Columbia University Press, USA

Daniel,C.D. 2010.*Environmental Science*.(8th edn).Jones and Bartlett Publishers.

Mani,M.S. *Ecology and Biogeography in india*.1974. Dr.W. Junk, The Hague.

Misra, S P and Pandey S. N.2009. *Essential Environmental Studies*. Ane BooksPvt. Ltd.

Odum, E P .1996.*Fundamentals of Ecology*. W.B Saunders College Publishing, Philadelphia.

Peter, H.R., Berg, L.R., and Hassenzahl, D.M. 2008. *Environment.*(5th edn.).John Wiley Publishers.

Pianka, E. R. 1981. *Competition and Niche Theory in "Theoretical Ecology".*(2nd edn.).In: May, R.M. (Ed.). Blackwell, London.

Rana,S.V.S. 2009.*Essentials of Ecology and Environmental Science*.(4th edn.). PHI learning Pvt. Ltd., New Delhi

Simons, I.G. 1981. *Ecology of Natural Resources.* Edwin-Arnold Ltd., London.

Tietenberg, T.2004.*Environmental and Natural Resource Economics*.(6th edn.). Pearson, New Delhi.

Tyler, M. G. 2007. *Living in the Environment.*(15th edn). Thomson Brooks/cole, NewYork.

ZY2CT07 GENETICS AND BIO INFORMATICS

90 Hours (65+ 25) **Credit: 4**

Objectives:

- To give an in-depth understanding on the principles and mechanisms of inheritance
- To help study the fine structure and molecular aspects of genetic material
- To provide an opportunity to learn the importance of inheritance in Man
- To expose the learners to the emerging field of bioinformatics and equip them to take up bioinformatics studies

GENETICS 65 hrs.

Module I.Principles of Genetic Transmission 5 hrs.

Extension of Mendel's principles: allelic variation and gene function- incomplete dominance and co-dominance.Gene action-from genotype to phenotype-penetrance and expressivity, gene interaction-epistasis, pleiotropy, genomic imprinting, phenocopy.

Prerequisite: *Mendel's works and Mendelian Principles*

Module II.Molecular Organization of Chromosomes 6 hrs.

Genome size and C-value Paradox.Structure of eukaryotic chromosome,nucleosome model. Chromosome condensation - euchromatin and heterochromatin. Repetitive nucleotide sequences in eukaryotic genomes, kinetics of renaturation: Cot and Cot curve.Unique and repetitive sequences.Mini and micro satellites.Molecular structure of centromere and telomere.Polytene chromosomes and Lampbrush chromosomes.Chromosome banding techniques.

Prerequisite**:** *Sex determination,sex linkage, sex limited and sex influenced characters in Man*

Module III. Gene Fine Structure 10 hrs.

Evolution of the concept of gene function and structure.The definition of gene. The standard genetic code, redundancy and Wobble.DNA Structure- alternate forms of the Double Helix.Gene synthesis (in vitro synthesis) – works of Khorana and Kornberg. Modern findings on the nature of gene: Interrupted genes in eukaryotes, exons and introns-R loops, significance of introns. Genes-within-genes (overlapping genes) Bacteriophage Ö X174.

Transposable elements in Bacteria –IS elements, composite transposons, Tn3 elements,medical significance.Transposable elements in Eukaryotes-P elements, Retrotransposons, significance of transposons.

Prerequisite:*Works of Watson and Crick and Experiments by B. MacClintock*

Module IV. Genetic Linkage, Recombination and Chromosome Mapping 12 hrs.

Chromosome theory of heredity, Linkage and recombination of genes in a chromosome, crossing over as the physical basis of recombination, Stern's Experiment; molecular mechanisms of recombination (Holliday model), Gene conversion, Recombination mapping with two-point and three –point test cross in *Drosophila*, Coincidence and Interference.

Genetic mapping by tetrad analysis in *Neurospora*.Mitotic recombination.

Genetic recombination in Phage, rII locus, complementation test, deletion mapping, conjugation mapping, mapping by interrupted mating, mapping with molecular markers and mapping using somatic cell.

Prerequisite:*Recombination in bacteria- transformation, transduction, conjugation and sex- duction.*

Module V. Gene Mutation **6 hrs.**

Molecular basis of gene mutation; mutant types- lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants. Induced mutation, The Ames test for mutagen/carcinogen detection.

DNA damage and repair mechanisms

Prerequisite: *Chromosomal mutations – structural, numerical and genetic implications.*

Module VI. DNA Replication **9 hrs.**

The Meselson-Stahl experiment, semi conservative replication of DNA in chromosomes,Theta replication, rolling-circle replication,molecular mechanisms of eukaryotic replication.

Module VII. Human Genetics **5 hrs.**

Karyotype, pedigree analysis, Lod score for linkage testing, genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits; human genome and mapping.

Pre requisite: *Chromosome anomalies : autosomal and sex chromosomal disorders.*

Module VIII. Extra Chromosomal Inheritance **2 hrs.**

Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Module IX. Epigenetics **5 hrs.**

Epigenetics - from phenomenon to field, a brief history of epigenetics - overview and concepts; chromatin modifications and their mechanism of action, concept of 'histone-code' hypothesis, epigenetics in *saccharomyces cerevisiae,* position effect variegation, heterochromatin formation and gene silencing in *Drosophila.*

Module X. Quantitative and Population Genetics **5 hrs.**

Polygenic inheritance, analysis of quantitative traits, quantitative traits and natural selection, estimation of heritability, QTL mapping, genotype-environment interactions, molecular analysis of quantitative traits, phenotypic plasticity .

BIOINFORMATICS 25 hrs.

Module 1.Introduction to Bioinformatics **2 hrs.**

Definitions of bioinformatics, applications of bioinformatics and scope of bioinformatics.

Module II. Biological Databases **7 hrs.**

Primary databases - Nucleotide sequence databases: GenBank, EMBL, DDBJ ; Protein sequence databases: SWISSPROT, PIR; Structure databases: PDB, NDB; Secondary databases: PROSITE, Pfam, CATH; Composite databases: OWL; Literature database: PubMed; Database searching – Entrez; Database sequence submission – BankIt.

Module III.Sequence Analysis **6 hrs.**

Types of sequence alignment, methods of sequence alignment, scoring schemes, gaps and gap penalties, construction of phylogenetic trees.

Module IV.Genomics and Proteomics **7 hrs.**

Structural genomics, functional genomics, comparative genomics, data mining in proteomics – Microarrays, significance of proteomics and drug design.

Module V. Systems Biology **3 hrs.**

Introduction , metabolomics, gene network, synthetic biology.

REFERENCES

Genetics

Brooker , 1999. *Genetics: Analysis and Principles*. Addison- Wesley, NY.

David Allis and Thomas Jenuwein, 2007.*Epigenetics*.Cold Spring Harbor Laboratory Press.

Hartl, D.L. 2000.*A Primer of Population Genetics*.Suinuaer Associate, Inc, Massachusetts.

Gardner. J.E.,Simmons, J.M and D.P.Snustad.2007. *Principles of Genetics* (8th edn). John Wiley,India.

Gilbert, S.F. 2006.*Developmental Biology* (9th edn).Sinauer Associates, Inc., Publishers, Masachusettes.

Griffiths *et al.,* 2002. *Modern Genetic Analysis*.W.H. Freeman, NY, USA.

Hartl, L.D., and E.W. Jones.2009.*Genetics:Analysis of Genes and Genomes* (7th edn). Jones & Bartlett Pub.,Inc. MA,USA.

Herskowiz I.H, 1977. *Principles of Genetics* .Collier Macmillan.

Lewin B, 2008 .*Genes* (9th edn). Jones and Barlett Publishers Inc.

Klug, W.S. and Michael R. Cummings, 2009.*Concept of Genetics.*Pearson

Education.Inc. Russel,J,P., 2010. *Genetics*.Pearson International Edn.

Snustard,P and M. J. Simmons, 2010. *Principles of Genetics*. John Wiley and

Sons Strickberger, M.W.1968.*Genetics*. Macmillan Publishing Co.

Watson *et al.,* 2004. *Molecular Biology of Gene* (5th edn.). Pearson Education Inc.

Bioinformatics

Alberghina,L and H.V. Westerhoff (Eds).2008. *Systems Biology-Definitions & Perspectives*. Springer-Verlag, Berlin.

Attwood T.K. and Parry Smith, D. 2006. *Introduction to Bioinformatics*. Pearson Education.

Bourne P. E and Weissig H, 2003. *Structural Bioinformatics*.Wiley -Liss. USA

David W. M. 2004. *Bioinformatics, Sequence and Genome Analysis* (2nd edn). CSHP, New York

Krane, D. E and M.L. Raymer. 2006.*Fundamental concepts of Bioinformatics*. Pearson Education,New Delhi

Lesk A. M, 2005. *Introduction to Bioinformatics*. Oxford Press, New Delhi

Pengcheng Fu and Sven Panke, (Eds.) 2009. *Systems Biology and Synthetic Biology*. John Wiley & Sons, Inc. NJ,USA

Tisdall J. D, 2001. *Beginning Perl for Bioinformatics*.O'Reilly Media Inc.CA,USA

Masaru Tomita and Takaai Nishioka, 2005. *Metabolomics.The Frontier of Systems Biology*. Springer Japan.

ZY2CT08 DEVELOPMENTAL BIOLOGY

90 Hours (5hrs/week) **Credit - 4**

Objectives:

- To introduce the concepts and process in developmental biology
- To help students understand and appreciate the genetic mechanisms and the unfolding of the same during development
- To expose the learner to the new developments in embryology and its relevance to Man

Module I. Introduction: Basic Concepts of Development **14 hrs.**

Potency of embryonic cells, Commitment, Specification (Autonomous and Conditional), Induction, Competence, Determination and Differentiation, Morphogenetic gradients, Cell fate and cell lineages.Genomic equivalence and Cytoplasmic determinants.

Module II. Gametogenesis,Fertilization and Early development **12 hrs.**

Spermatogenesis,Oogenesis.Fertilization-(biochemical and molecular aspects), Polyspermy. Mechanisms and significance of cleavage.Blastulation and Gastrulation, Parthenogenesis.

Module III. Early Development of Model organisms **5 hrs.**

Early development and axis specification in *Caenorhabditis elegans.* Early development and axis specification in *Drosophila* (cleavage, midblastula transition, gastrulation).

Module IV. Axis and Pattern Formation in Animals **15 hrs.**

Anterior-posterior patterning in *Drosophila*(Maternal effect genes,zygotic genes, gap genes, pair rule genes,segment polarity genes; homeotic selector genes,realisator genes),Dorsal-ventral patterning and left right patterning, Dorsal protein gradient.

Axis formation in amphibia -Anterior-posterior patterning in Amphibia.Hox code hypothesis.

Module V. Cellular Interactions in Development **14 hrs.**

Nieuwkoop centre and mesodermal polarity. Molecular basis of mesoderm induction. Transcription factors induced in the organizer. Neural induction, Regional specificity of induction, Genetic specificity of induction (Paracrine factors - Hedgehog family, Wnt family, TGF, BMP). Surface receptors and signal transduction pathway - RTK pathway,Smad pathway,Wnt pathway, Hedgehog pathway and cell death pathway.

Module VI. Differential Gene Expression **13 hrs.**

Differential gene transcription - exons and introns, promotors, silencers, enhancers, transcription factors, DNA methylation, genomic imprinting, dosage compensation, differential RNA processing; Control of gene expression: translational and post translational control of gene expression.

Module VII. Metamorphosis and Regeneration **8 hrs.**

Metamorphosis of Amphibians and Insects; Hormonal control of metamorphosis.Heterochrony-neoteny, progenesis (Brief accounts); regeneration - different types of regeneration; Histological processes during regeneration; Polarity and Metaplasia in regeneration; Lens regeneration in amphibia; Bone and neural regeneration (Medical -Advances in regeneration).

Module VIII. Teratogenesis **4 hrs.**

Malformations and disruptions,Gene – phene relationship, Autophene, Allophene and Pleiotrophy; Teratogenic agents (Retinoic acid, pathogens, alcohol, drugs and chemicals, heavy metals); Environmental oestrogens.

Module IX. Human Welfare and Developmental Biology **5 hrs.**

Infertility-Test tube babies (*In vitro* fertilization and embryo transfer). Cloning experiments- (Amphibians, Mammals and Human). Stem cells and their applications, ethical issues.

REFERENCE

Balinsky, B.I.2004. *An Introduction to Embryology*. W.B.SaundersCo.,Philadelphia.

Berril, N.J. 1979. *Developmental Biology*.Tata McGraw-Hill Pub.Co.Ltd.,New Delhi.

Gilbert, S.F. 2006. *Developmental Biology* (9th edn).Sinauer Associates Inc., Publishers, Masachusettes, USA

Hopper, A.F. and Hart ,N.H.1985. *Foundations of Animal Development*.Oxford University Press, Oxford.

Lewis Wolpert. 2007. *Principles of Development*. Oxford University Press.Oxford

Saunders, J.W.1982. *Developmental Biology-Patterns,Principles and Problems.* Macmillan Publishing Co.,New York.

Subramanian, T. 2002. *Developmental Biology*.Alpha Science International Ltd.,New Delhi

Sunstard,D.P., Simmons, M. J. and J.B Jenkins.1997. *Principles of Genetics*. John Wiley and sons, New York.

Wolpert L. and C. Tickle. 2011. *Principles of Development*.(4th edn). Oxford University Press, Oxford, UK

ZY2CT09 BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

90 Hours (42+38+10) **Credit- 4**

Objectives:

- To learn the biophysical properties and functioning of life processes
- To introduce the tools and techniques available for studying biochemical and biophysical nature of life
- To equip the learner to use the tools and techniques for project work/ research in biology

BIOPHYSICS 42 hrs.

Module I. Diffusion and Osmosis 8 hrs.

Diffusion -Kinetics of diffusion, Fick's law of diffusion and diffusion coefficient, Biological significance in animals and plants, Electrochemical gradient, Stokes-Einstein equation and Graham's law, Facilitated diffusion, Gibbs-Donnan equillibrium.

Osmosis- osmotic concentration and osmotic pressure, Van't Hoff's laws. Biological significance of osmosis in animals and plants.

Module II. Biophysics of Cell Membrane 10 hrs.

Physico-chemical properties of cell membrane, conformational properties of cell membranes,Membrane Transport – endocytosis, exocytosis, Nutrient transport across membranes, porins facilitated diffusion, porter molecules; Facilitated transport:symport,antiport, uniport,anion porter,glucose porter; Active transport: proton pumps, Na^+ K^+ pumps and Ca^{++} pumps, ionic channels. Functions of cell membrane.Artificial membranes.

ModuleIII. Bioenergetics 14 hrs.

Thermodynamics- Laws of thermodynamics, Entropy, Enthalpy, Free energy.

Reversible thermodynamics and irreversible thermodynamics; Systems – open, closed and isolated. Photo bioenergetics. Photosynthesis – light and dark reactions, Redox couple and redox potential. Chemo-bioenergetics: electron transport and oxidative phosphorylation, Chemiosmotic theory and binding change mechanism of ATP synthesis.

Module IV. Radiation Biophysics 10 hrs.

Ionizing radiation, units of radioactivity, exposure and dose.

Interaction of radiation with matter – Photoelectric effect, ion pair production, absorption and scattering of electrons.

Biological effects of radiation: effect on nucleic acids, proteins, enzymes and carbohydrates. Cellular effects of radiation : somatic and genetic.

Nuclear medicine : Internally administered radioisotopes. Radioiodine in thyroid function analysis. Renal, liver and lung function analysis.

Application of radioactive tracers, Radiation protection and therapy.

INSTRUMENTATION & BIOLOGICAL TECHNIQUES 38hrs.

Module I. Microscopy 6 hrs.

Differential Interference contrast (Nomarsky) microscopy, Confocal microscope, Electron microscope – TEM, SEM, Scanning Tunnelling and Atomic Force Microscopes.

Prerequisite: *Light microscope and dark field microscope, Phase contrast microscope, Polarizing microscope, birefringence fluorescence microscope and camera lucida*

Module II. Chromatography **7 hrs.**

Paper chromatography,Thin layer chromatography, Ion exchange chromatography. Gel permeation chromatography,Affinity chromatography,Gas chromatography High pressure liquid chromatography (HPLC).

Module III. Electrophoresis **6 hrs.**

Paper electrophoresis,Gel electrophoresis, Polyacrylamide gel electrophoresis (PAGE) – SDS and non SDS , Agarose gel electrophoresis , Disc electrophoresis, High voltage electrophoresis, immuno-electrophoresis, isoelectric focusing.

Module IV. Colorimetry, Spectrophotometry and Spectroscopy **8 hrs.**

Principle and applications of colorimetry and spectrophotometry.

Spectroscopy :Flame emission spectroscopy, Atomic absorption spectroscopy, Nuclear Magnetic-resonance spectroscopy (NMR), Circular dichroism spectroscopy, ESR spectroscopy, Mass spectroscopy.

Module V. Centrifugation **3 hrs.**

Basic principles of sedimentation,Types of centrifuges, Analytical and Preparative centrifugation, Differential and density gradient centrifugation.

Module VI. Radioisotope Detection and Measurement **2 hrs.**

Dosimetry: Ionization chamber, GM counter, Solid and liquid scintillation counters, Autoradiography.

Module VII. Nanotechnology **3 hrs.**

Introduction to Nanobiology. Nanosensors and Nanomedicines.

Module VIII. Assays **2 hrs.**

Radio ImmunoAssay, Enzyme Linked Immuno Sorbant Assay (ELISA).

Module IX. pH meter **1 hr.**

Principle and working. Types of pH meters.

Module X. Biological and Histological Techniques **10 hrs.**

Fixation, preparation of temporary and permanent slides, whole mounts, smears, squashes and sections. Specimen preparation for TEM, SEM, shadow casting, freeze fracturing, freeze etching,negative staining.Microphotography.

Cytochemical and histological methods- Microtome techniques, fixation, staining.

Cytochemistry of nucleic acids, detection of carbohydrates, proteins and lipids.

REFERENCES

Ackerman, E. 1962. *Biophysical Science*. Prentice Hall Inc. NJ, USA

Alonso, A., and Arrondo, J.L.R.2006. *Advanced Techniques in Biophysics.*Springer,UK

Arora, M. P. 2007.*Biophysics*. Himalaya Publishing House, New Delhi

Baker, E.J. and Silverton R.E. 1978. *Introduction to Medical Laboratory Technology.* ELBS.London,UK

Das, D. 1991. *Biophysics and Biophysical Chemistry*. Academic Publishers,

Calcutta Edward, A.L. 1997. *Radiation Biophysics*. Academic Press,NY,USA.

Ernster, L. (Ed.). 1985. *Bioenergetics*. Elsivier, NewYork,USA.

Ghatak K.L. 2011.*Techniques and Methods in Biology*. PHI Learning Pvt. Ltd. New Delhi

Gupta A. 2009. *Instrumentation and Bio-Analytical Techniques*.PragatiPrakashan, Meerut.

Hoope, W. e*t.al*. 1983. *Biophysics.* Springer Verlag, Berlin.

Lehninger, A.L.1971. *Bioenergetics*. W.A. Benjamin, London,UK.

Narayanan, P. 2000. *Essentials of Biophysics*.New Age International (P) Ltd. Publishers, New Delhi. Pearse, A.G.E. 1980. *Histochemistry*. Vol.& Vol. II. Churchill Livingstone, NY, USA.

Pradeep T. 2007. *NANO: The Essentials. Understanding Nanoscience and Nanotechnology*.Tata McGraw Hill Education Pvt. Ltd., New Delhi.

Roy, R.N. 1996. *A Textbook of Biophysics*. New Central Book Agency (P) Ltd. Calcutta Sandhu,

G.S. 1990. *Research Techniques in Biological Sciences*. Anmol Publications, New Delhi

Srivastava,P.K. 2006. *Elementary Biophysics.An Introduction*.Narosa Publishing House, New Delhi.

Varghese, T. and Balakrishna, K.M.2012. *Nanotechnology-An Introduction to Synthesis, Properties and Applications of Nanomaterials.* Atlantic Publishers and Distributors. (P) Ltd. New Delhi

Weesner, F.M. 1960. *General Zoological Microtechniques*. The Williams & Wilkins Co., Baltimore, USA

ZY2CP10 PRACTICAL 2: ECOLOGY,GENETICS AND BIO-INFORMATICS, DEVELOPMENTAL BIOLOGY, BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES.

90 Hours (5 hrs./week) **Credit-3**

Ecology

Study of Pond/ wetland/ River ecosystem- Food web and food chain

(no museum specimen). Record the date, time, methodology, and observations in the record book. Determination of soil organic carbon and chlorides.

Separation and identification of soil arthropods using Berlese funnel.

Qualitative and Quantitative study of marine/freshwater planktons. Estimation of primary productivity.

Quantitative estimation of salinity, phosphates and nitrates in water samples.

Study of pH and conductivity using pH and conductivity meter (2different samples).

Principles and application of the following instruments: Rain Guage, Plankton Net, Secchi Disc, GPS.

Field Study Report: Three days field study covering River/ Wetland/ Marine and forests/ grassland. Record ecosystem components (Soil, water, flora, fauna) and interactions. Viva based on Field study.

Developmental Biology

Identification of different developmental stages of frog (egg, blastula, gastrula, neurula, tadpole, with external gill and internal gill).

Vital staining of early gastrula of chick – window method.

Blastoderm mounting of chick embryo using vital stains.

Morphological and histological studies of different types of placenta in mammals.

Study of serial sections of embryo (tadpole and chick).

Regeneration studies in fish (Zebra Fish/ Earth worm).

Genetics and Bioinformatics

Culture, sexing and etherization of *Drosophila.* Study of Mutants in *Drosophila.*

Genetics problems (Di hybrid cross, test cross and sex linked inheritance). Abnormal human karyotypes (any five).

Data base search and data retrieval-using NCBI, SWISS-PROT, PDB, Expasy. Methods of sequence alignment-BLAST and ClustalW.

Phylogenetic tree using PHYLIP.

Gene Prediction using GENSCAN/GRAI.

Protein structure visualization using RASMOL.

Biophysics/Instrumentation/Biological Techniques

Micrometry- principle and measurement of microscopic objects: Low power and high power.
Camera Lucida drawing with magnification and scale.
Principle and working of phase contrast microscope, micro-photographic equipment and pHmeter.
TLC using amino acids from purified samples and biological materials.
Study of Enzyme kinetics - Salivary amylase on maltose standards- influence of temperature and Substrate concentration on enzyme activity (Lineweaver Burk Plot) on enzyme activity.