BHARATHIAR UNIVERSITY, COIMBATORE.

M. Sc BIOTECHNOLOGY DEGREE COURSE (CBCS PATTERN)

(**AFFILIATED COLLEGES)**

(Effective from the academic Year 2010 - 2011 onwards)

SCHEME OF EXAMINATIONS

Semester	Study Components	Course title	Ins. Hrs/ week	Exam			Credit
				CIA	Uni. exam	Total	
I	**Paper I**	Cell & Molecular Biology	5	25	75	100	4
I	**Paper II**	Biochemistry	5	25	75	100	4
I	**Paper III**	Microbiology	5	25	75	100	4
I	**Paper IV**	Biophysics & Biostatistics	5	25	75	100	4
I		**Practical I**	5	40	60	100	4
I	**Elective**	**Elective paper I**	5	25	75	100	4
II	**Paper V**	Immunology & Immunotechnology	5	25	75	100	4
II	**Paper VI**	Genetic Engineering	5	25	75	100	4
II	**Paper VII**	Microbial Biotechnology	5	25	75	100	4
II	**Paper VIII**	Molecular Genetics	5	25	75	100	4
II		**Practical II**	5	40	60	100	4
II	**Elective**	**Elective paper II**	5	25	75	100	4
III	**Paper IX**	Plant Biotechnology	5	25	75	100	4
III	**Paper X**	Bioprocess technology	5	25	75	100	4
III	**Paper XI**	Environmental Biotechnology	5	25	75	100	4
III	**Paper XII**	Bionanotechnology	5	25	75	100	4
III		**Practical III**	5	40	60	100	4
III	**Elective**	**Elective Paper III**	5	25	75	100	4
IV	**Paper XIII**	Animal Biotechnology	4	25	75	100	4
IV		**Practical IV**	5	40	60	100	4
IV	**Project**		--	-	-	150*	6
IV	**Elective**	**Elective Paper IV**	4	25	75	100	4
		Total				2250	90

*** For Project report – 120 marks, Viva-voce – 30 marks.**

List of Group Elective papers (Colleges can choose any one of the Group papers as electives)

Paper/ Sem	GROUP A	GROUP B	Group C
I	Introduction to Bioinformatics & Molecular Biology databases	Occupational health and industrial safety	Plant system Physiology
II	Biological Sequence Alignment	Bioethics, biosafety and IPR	Animal System Physiology
III	Structural Bioinformatics	Biotechnicques	Developmental Biology
IV	Genomics and Proteomics	Conservation biology	Evolution and behavior

PROJECT GUIDELINS

1) Project is pertain to the field of Biotechnology

2) Three review meetings should be conducted at regular intervals in the presence OF HOD and respective guide. The review should evaluate for a maximum of 20 marks.

Review	**Maximum Marks**
I Review	**20**
II Review	**20**
III Review	**20**
Dissertation Details	**60**

PAPER I

CELL & MOLECULAR BIOLOGY

Subject description:

This paper provides a thorough knowledge about structure and function of cells, cellular energetic, protein trafficking, bio molecules and cellular development.

Objective:

Understanding the structural and functional aspects of the cell provides the student with a strong foundation in the molecular mechanisms underlying cellular function.

Goal:

Students after completion of this paper will be exceptionally well prepared to pursue careers in cellular and sub cellular biological research, biomedical research, or medicine or allied health fields.

CONTENTS:

UNIT I

Types of cells Prokaryotic and Eukaryotic cell structure and intracellular organelles – nucleus, Mitochondria, Chloroplast, Ribosomes, Peroxysomes and Microbodies; Fractionation & Purification of subcellular organelles; Molecular events of mitosis & meiosis.

UNIT II

Cytoskeleton Cell motility and cellular movements, Microtubules, Microfilament. Protein localization: Protein targeting to various organelles and secretion of proteins by exocytosis, receptor mediated endocytosis .

UNIT III

DNA replication, RNA transcription and processing, interaction of mRNA,rRNA and tRNA on protein synthesis. Mitochondrial electron transport system, oxidative reactions in microbodies, pathways of photosynthesis – light & dark reactions.

UNIT IV

Structure and functions of plasma membrane cell recognition, cell to cell signaling, surface receptor and receptor – response mechanisms, cell adhesion. Cancer: characteristics & causes, oncogenes and tumour suppressor genes.

UNIT V

Homeotic genes in development, Developmental pattern of Drosophila & Arabidopsis. Spatial and temporal regulation of gene expression, specialized cell structure and function (Muscle cell, nerve cell & motile cell).

REFERENCES:

1. Molecular Biology of cell, Albert's. B et al
2. Molecular Cell Biology, Darnell Lodish Baltimore scientific Books. Inc 1994.
3. Molecular & Cellular Biology
4. Stephen. I. Wolfe. Wadsworth publishing company. 1993.

PAPER - II

BIOCHEMISTRY

Subject description:

This paper presents the study of identification and quantitative determination of the substances, studies of their structure, determining how they are synthesized metabolized and degraded in organisms, and elucidating their rile in the operation of the organism.

Objective:

On the successful completion of the course the students will get an overall understanding of structure of atoms, molecules and chemical bonds, enzyme kinetics, bio polymers and metabolic reactions in a living system.

Goal:

This paper in biochemistry has been designed to provide the student with a firm foundation in the biochemical aspects of cellular functions which forms a base for their future research.

Contents:

Unit 1:

Structure of atoms (C.H, N, O, S, and P) and molecules: chemicals bonds- covalent bonding and hydrophobic interactions.Principles of physical chemistry: Thermodynamics and it's principles in biology, Dissociation and association constants, concepts of pH. Acids, bases and buffers of biological importance. Bioenergetics: Laws of Thermodynamics, Concept of free energy and standard free energy, energy rich bonds , weak interactions, Biological energy transducers, Energy metabolism – exergonic, endergonic and coupled reactions.

Unit II

Enzymes and co –enzymes: IUBMB classification and nomenclature of enzymes, active site, Lock and key Machanism and induced fir hypothesis, Forces involved in enzyme substrate interaction. Mechanism of enzyme catalysis: Lysozyme, Enzyme kinetics- negative and positive co-operatively, MMKinetics, Transformations of MM equation and their significance, enzyme inhibition: Reversible – Competitive, Noncompetitive, uncompetitive, Irreversible inhibition, Kinetics of Enzyme inhibition. Isoenzymes, allosteric enzymes, ribozymes, abzymes and artifical enzymes.

Unit III:

Classification, structure, functions and reactions of carbohydrates, Metabolism of carbohydeates (including regulation and energerics): Glycolysis, Gluconeogenesis, Glycogensis,glycogenolysis, HMP shunt, TCA, and glyoxylate cycle, Inter conversion of pentose and hexoses.

Unit IV

Classification, Structure, functions and reactions of Lipids, Biosynthesis of saturated fatty acids, Triglycerides, phospholipids and Sterols (for sterols structure is not compulsory), Catabolism of Fatty acids: - oxidation, Catabolism of triglycerides and phospholipids, Structure and functions of Glycolipids and Lipoproteins.

Classification, structure, functions and reactions of nucleic acids, Biosynthesis of Purines and pyrimidines, Salvage pathway, Regulation of Purine and pyrimidine biosynthesis.

Unit -V

Proteins: Classification and structure of amino acids (Classification based on nutritional, chemical and polarity), peptides and poly peptides, classification of Proteins based on structure and function. Metabolism of aminoacids.

References:

1. Principles of Biochemistry – Smith et al., Mc Graw Hill International book Company 8th ed
2. Principles of Biochemistry – Lehninger, Nelson, Cox, CBS publishers.
3. Fundamentals of Biochemistry – Voet et al., Jhon Wiley and Sons Inc.
4. Biochemistry – Zubay, WCB Publishers.
5. Harpers Biochemistry, R.K. Murray, D.K.Granner, P.A Mayes and V.W. Rodwell, Practise Halt International
6. Biochemistry – Stryer.
7. Text book of Biochemistry with clinical Correlations – Homas. M.Devlin.H.John Wiley & sons. Publications.

Websites:

8. http://www.iubmb.unibe.ch/
9. http://www.iubmb-nicholson.org/
10. http://www.iubmb-nicholson.org/chart.html
11. http://www.iubmb-nicholson.org/animaps.html
12. http://www.iubmb-nicholosn.org/pdf/InbornErrors.Pdf

PAPER III

MICROBIOLOGY

Subject description: This course presents the types, morphology, biochemical, physiological characteristics of microorganisms.

Goals: To make the student to understand the concept of the biology of Microorganisms.

Objectives:

- On successful completion the subject student should have understand:
- Understood History and development of Microbiology and Taxonomy
- Basic concepts in Microbial physiology and cultivation of bacteria

Contents:

Unit I:

History of Microbiology

Discovery of the microbial world: Controversy over spontaneous generation; discovery of role of microbes in causation of disease, first pure culture, development of culture media by koch and his school, Microscopy: Light, phase contrast, fluorescent, TEM, SEM and scanning tunneling Microscopy, Methods of staining and Microscopic observation of Bacteria and Fungi.

Unit II

Classification and phylogeny of bacteria:

Species classification: problems in taxonomic arrangement: New approaches to bacterial taxonomy including ribotyping 16 S rRNA sequencing and phylogenetic analysis. Numerical taxonomy, Chemotaxonomy and sero-taxonomny. Morphoiogy, cell wall: Structure and composition. Cell membrane, Mechanisms of transport in Bacterial cell and functions of prokaryotic cells.

Unit III

Viruses: Discovery, structure, Baltimores classification of viruses : Lysogenic and lytic cycles. Cultivation of Viruses – detection and enumeration of viruses, viral assay. Fungi and Algae-morphological features and economic importances.

Unit IV

Methods of Microbiology:

Principles of Microbial nutrition – Carbon, nitrogen, sulphur, growth factors, nutritional requirements of Bacteria, Nutritional classification of Bacteria, Culture media preparation, Types of media Selective media, Enrichment media and Differential media, Sterilization methods (physical, Chemical and mechanical)

Unit V:

Biogeochemical cycles (P, O, N- symbiotic and asymbiotic nitrogen fixation, sulphur and carbon cycles). Symbiotic and asymbiotic associations, Biopesticides, Bioinsecticides.

References

1. General Microbiology – Roger, Y.Stanier. John. I.Ingraham. Mark. I.Wheelis and page R. Painter. 5th Ed.1986: Macmillion Press Ltd. Hampshire.
2. Microbiology – An Introduction: Cerald. J.Tortora . Berdell. R.Funke. Christine.I. Case 5th Ed. 1955: The Benjamin/ Cummings Publishing Co. Inc. USA.
3. Microbiology: Essential and Applications: Larry Mckane. Judy Kandel. 2nd Ed. 1996. McGraw hill Inc.
4. Microbiology – Present. Harley, Klein, 4th Ed. 1999: McGraw Hill Inc.

Paper IV

BIOPHYSICS AND BIOSTATISTICS

Subject description:

This course presents the basic concepts of Biophysics and biostatistics.

Goals:

To make the student to understand the fundamentals of Biophysics data analysis by Biostatistics.

Objectives

- On Successful completion the subject student should have understand:
- Understand fundamentals of Biophysics and Bio statistical Methods.

Contents:

Unit I:

Proteins: Amino acids – Conformations. Phi and Psi angles. Ramachandran plot. Peptides – peptide bond isomerisation. Disulphide bonds, short range repulsion, electrostatic forces, van der waals interaction. Hydrogen bonds, Determination structure of proteins: NMR, 3D structure by x- ray diffraction.

Unit II

Nucleic acids: Transitional angels and their ranges. Sugar puckering models, the pseudorotation cycle, syn – anti orientation of glycosyl bond. Details geometries of Watson- Crick and Hoogsteen base pairs- Thermodynamic description of stacking interactions – classification of A,B and Z type double helices. Biophysics of protein – DNA Interactions.

Unit –III

Basic principles of spectrophotometry. The laws of absorption, principles and instrumentation for UV-visible and IR spectroscopy. Principles, theory and applications of spectrofluorometry, and Flame photometry.

Unit – IV

Biostatistics – Definitions – Scope of Biostatistics, Classification and tabulation of data – Graphical and diagrammatic representation – scale diagrams – Histograms – frequency polygon- Frequency curves. Measures of Central tendency – arithmetic mean, median and mode. Calculation of mean, median, mode in series of individual observation discrete series, continuous open end classes.

Unit – V

Measures of Dispersion – standard deviation and standard curves. Chi – square test, student t test, regression, correlation, one way and two way ANOVA. Experimentation design: Completely randomized design, Factorial design, placket- Burman designs, resonse surface designs: Central Composite Designs (adapted from Montgomery) and Box-Behnken design. Application of experimental design for optimization of culture conditions. Demonstration of statease statistical software for media standardization., Application of statistical software for biological research.

References books:

1. Biophyscial chemistry – principles and Techniques- Upadhyay, Upadhyay Nath.
2. Biophysical chemistry – Cantor and Schinmel.
3. Introductory Biostatistics by chap. T.Lee (Wiley – Interscience
4. Statistical methods edited by Stephen W.Looney (Humana publications)
5. Biostatistics: A Methodology for the Health Sciences, Second Edition, by Gerald Van belle (Wiley – Interscience publication)
6. http://www.itl.nist.gov/div898/handbook/prisection3/pri3.htm(online e book)
7. http://www.statease.com/de7_man.html(software tutorial websidte)

PRACTICAL – I

(Lab in Microbiology and Microbial Biotechnology)

SUBJECT DESCRIPTION: This course deals with the study of microorganisms and its application in various fields.

GOALS: To learn the various microbiological techniques, Gene transfer mechanisms and applications of microorganisms in industries.

OBJECTIVE

After the successful completion of the course the students will be aware of

1. Handling of microorganisms
2. Various microbiological techniques – isolation and maintenance of pure cultures.
3. Microbial production of industrially important products
4. Impact of microorganisms on the environment.

Contents

1. Microbiology : 3 right field, phase Contrast & Fluorescent microscope
2. Culture media preparation –Selective and differential media
3. Enumeration of Bacteria, Fungi and Actinomycetes from soil.
4. Pure culture techniques – pour, Streak and Spread plate
5. Bacterial staining – simple, Gram, Spore and Fungal wet mount – LCB
6. Motility test.
7. Bacterial growth curve
8. Antibiotic sensitivity test.
9. Immobilization of microorganisms and enzymes.
10. Production of alcohol by yeast
11. Biochemical tests- carbohydrate fermentation test. IMVIC, TSI test, catalase test, oxidase test and urease test,
12. Production of extracellular enzyme from bacteria by shake flask method –Amylase or Lipase.

REFERENCES:

1. Microbiology: A laboratory Manual by James G. Cappuccino, & Natalie Sherman.
2. Experiments in Microbiology by K.R. Aneja.

PAPER V

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Subject description:

this course presents the defense system of the higher vertebrates against invading pathogen.

Goals:

to make the student to understand the defense mechanism and their regulations

Objectives:

on successful completion the subject student should have understand:

What is immunity, how it discriminate self and non-self, how it is regulated and what are the applications

Contents

Unit – I

History and scope of immunology. Types of Immunity: Passive, Active and Acquired immunity. Humoral, Cell Mediated immunity. Cells and organs of immune response and their functions. Antigens Types, haptens, epitopes and Factors influencing antigenicity. Antibodies Structure types, properties and functions of immunoglobulins.

Unit – II

Cells of immune system. T-Cells, B-Cells, antigen presenting cells, cell mediated subset of T- Cells helper and suppressor cells, natural killer cells. Lymphoid organs (primary and secondary) MHC molecules, Antigen presentation, B cell and T cell activation, cytokines Complement system. Structure, components, properties and functions.

Unit –III

Antigen antibody reactions: in vitro tests- precipitation, immune-electrophoresis, Heamagglutination, Labeled antibody (RIA ELISA and immuno – fluroscent techniques)Hypersensitivity and Allergic reactions Blood cell components, ABO blood grouping RH typing. Application of immunological techniques: hybridoma technology:- Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their applications. Human monoclonals catalytic antibodies and planti bodies.

Unit IV

Hyper sensitivity reactions, auto immuno disorders, deficiencies (Primary and secondary) and immuno tolerance. Tumor immunology: tumor antigens, immune responses and terapy \, tissue and organ transplant.

Unit V

Immunity to bacteria, viruses and parasites vaccines and immunization: passive and Active immunization Types of vaccines – Inactivated, attenuated and Recombinant Vaccines – Peptide and DNA vaccines, Synthetic vaccines, epitope mapping.

Reference books

1. Essentials of Immunology (6^{th} Edition): Ivan Riot – Blackwell Scientific Publications, Oxford, 1988
2. Fundamentals of Immunology: Paul W.E (Eds) Ravan prss, New York, 1988
3. Antibodies A laboratory Manual: Harlow and David Lane (1988), cold spring harbor laboratory.
4. Janis Kuby (1997) Immunology, WH Freeman & Company, New york.
5. Tizard (1995) Immunology IV Ed Saunders college publishers, New York.

PAPER VI

GENETIC ENGINEERING

SUBJECT DESCRIPTION:

This course presents the principles and applications of Genetic Engineering explaining the molecular techniques, cloning strategies and applications of Genetic Engineering.

GOALS:

To enable the students to learn the various molecular biology techniques, principles and applications of genetic Engineering.

OBJECTIVES:

On successful completion of the course the students will be aware of

1. The guidelines for genetic Engineering research which involves all the molecular Biology techniques
2. Cloning techniques
3. Application of Genetic Engineering

CONTENTS:

UNIT – 1

Guidelines for Genetic Engineering Research:

Basic techniques – Isolation and purification of nucleic acids, Agarose gel electrophoresis, southern, northern and western blotting, enzymology of recombinant DNA and DNA markers.

UNIT – II

Gone Cloning vectors: Bacteriophages – lambda and M13, phagemids, Cosmids, yeast vectors, Plant and animal vectors, Restriction mapping of DNA fragments and map construction, DNA sequencing. Vector engineering and codon optimization.

UNIT III

Cloning in E-coli, cloning in organisms other than E-coli, specialized vectors – expressions & fusion vectors. Genomic Library; c DNA library- types & screening, RFLP & RAPD.

UNIT IV

Site – directed mutagenesis, detection of mutation by SSCP and heteroduplex analysis, Protein Engineering : processing and stabilization of recombinant proteins. Applications pf protein Engineering.

UNIT – V

Gene therapy: Different types and applications, salient features of Human Genome project: chromosome jumping & Walking PCR: Types & applications, patenting of life forms, ethical issues in Genetic Engineering.

REFERENCE:

1. Gene cloning, An introduction, by T.A. BROWN
2. Molecular Biotechnology, By GLICK
3. Principles of Genetic Maniputaltion, By Old & primrose.

PAPER VII

MICROBIAL BIOTECHNOLOGY

SUBJECT DESCRIPTION:

This course presents the principles and applications of microorganisms for the production of useful biological materials.

GOALS:

To enable the students to learn the various microbial Biotechnology applications.

OBJECTIVES:

On successful completion of the course the students will be aware of screening and optimization and production of useful biomaterials from microorganisms

Contents:

Unit I :

Isolation, screening of microorganisms- strain selection and improvement methods; Principles of microbial nutrition, and media formulations for cell growth and product formation, Factors influencing the choice of various carbon, nitrogen sources; vitamins, minerals, precursors, and antifoam agents. Importance of medium pH and temperature. Development of inocula for industrial fermentations.

Unit II

Industrial and Agricultural Biotechnology – Microbial synthesis of commercial products, aminoacids, vitaminB2, and B12 antibiotics: Peniciilin, Tetracyclin and streptomycin, Organic acid: acetic acid and citric acid.

Unit III

Production of fermented beverages and industrial enzymes: amylase, Lipase and Cellulase. Food microbiology: Fermented dairy products – Cheese and Yogurt.

Unit IV

Biomass production, SCP, Biofuel and biofertilizers, Production of native and recombinant proteins in bacteria and yeast – vaccine production in microbes, biopolymers and Bioinsecticides.

Unit V:

Mushroom production- mushrooms-cultivation, edible mushroom-types, nutritional values. Food preservation : physical methods – freezing, heating, pasteurization, radiation, drying, food dehydrators, dehydrofreezing. Chemical preservatives, packing and storing dried foods.

Reference:

1. Microbial Biotechnology by Glazer et al., 1995 W.H. Freeman & Co. New York
2. Molecular Biotechnology by Glick, B.R and J.J. Pasternak, 1998. Second Edition ASM Press, Washington
3. Bioprocess technology- PT. Kalaiselvan, I. Arulpandi
4. Principles of Fermentation Technology by standbury, P, F. and H. whitaker, 1997 Aditya Books (P) Ltd, New Delghi
5. Industrial Microbilogy by Casida L.E.Jr New Age International Publishers.
6. Industrial Microbiology by Prescott and Dunn.]
7. Biotechnology by W.Cruger and A.Crueger. 2004 Panima Publication, New Delhi.
8. The Biology of Algae by F.E. Round, Arnold Publishers, London, 1965
9. Marine Botany by E.Yale Dawson, Holt, Rinehart and Winston, inc, 1966
10. Structure and Reproduction pf Algae Vol. I & II by FE. Fritsch, Cambridge University Prss, 1935
11. Physiology & Biochemistry of Algae by R.A. Lewin, Academic Press, New York, 1962
12. Smith, G.M. 1965. Cryptogamic Botany, Vol. I Alage & Fungi, McGRaw Hill, new York, 1965.

Paper VIII

MOLECULAR GENETICS

Subject description: This course presents the heredity and mechanisms of genetic regulation.
Goals: To make the student to understand the concept of genetics.
Objectives:
On successful completion the subject student should have understand:
What a gene is. How a gene is modulated and regulated. Models of transmissions and the defects
Contents

Unit I

Introduction to molecular genetics: Mendelian genetics – Mendel's work, Laws of heredity, Test cross, incomplete dominance Epistasis : Multiple allelism, Sex Determination in Plants and animals, concepts of allosomes and autosomes , XX-XY, XX-XO,ZW-ZZ, ZO-ZZ types, linkage and Crossing Over, linkage in maize and Drosophila, Mechanism of crossing Over, and its importance, chromosomal variations. General account of structural and numerical aberrations, Cytoplasmic inheritance Variations. Karyotype in man, inherited disorders – Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and Cri – Du-Chat syndrome).

Unit –II

Molecular organization of chromosome: DNA as the genetic material, DNA Replication in prokaryotes – Enzymes and proteins involved in replication, theta model and rolling circle model. Copy number control. Mutations Types: spontaneous and induced, Mutagens: Physical and chemical, Mutation at the molecular level. DNA Repair causes and mechanism – photo reactivation, excision repair, mismatch repair, SOS repair. Recombination in prokaryotes.

Unit –III

Transformation, Conjunction and Transduction in Bacteria, Structure of Prokaryotic and Eukaryotic genes- genetic code, properties and Wobble Hypothesis, Transcription in prokaryotes. Mechanism, Promoters and RNA polymerase, transcription factors. Translation mechanism in Prokaryotes.

Unit IV

Regulation of Gene expression in Prokaryotes – Operon concept (Lac and Trp). Attenuation and antitermination. DNA methylation, Regulatory sequences and Transaction factor, Transcriptional regulation in prokaryotes and translational regulation.

Insertional elements and transposons. Extra cnromosomal inheritance, Transposable elements in Maize and Drosophila.

Unit V

Genetic control and development: Genetic determinants of Development. Early embryonic development in animals, Population genetics and evolution: allele frequencies and genetic frequencies Hardy – Weinberg principle. Mutation and migration, Natural selection. Genetic Shift, causes of variation and artificial selection. Genetic and multifactorial interactions, causes of variation and artificial selection. Genetic Load and Genetic counseling.

References

1. Gardner (2001) Principles pf genetics, John Wiley & Sons Inc, New York.
2. Robert Tamarin, (1996) Principles of genetics, 5th Ed WMC Brown publication, Boston
3. Berjamin Lewin (2004) Genes VIII, Pearson Education Corporation, New jersey
4. Alberts B,(1994) molecular biology of the cell, Garland publishing Inc New York
5. Lodish & Baltimore, (2004) molecular cell biology, II Ed W H freeman & company, New York
6. Friedfielder.D,(1987) Molecular biology II Ed., Narosa publishing house , New Delhi.

PRACTICALS –II

(Molecular Biology, Biochemistry and immunology)

SUBJECT DESCRIPTION: This course deals with the study of biochemical analysis of various biomolecule and immunological techniques for the diagnosis of various diseases.

GOALS: To learn the various techniques in immunology and biochemistry for the study of biomolecules and for the detection of antigens.

OBJECTIVES: After the successful completion of the course the students will be aware of various biochemical analysis & Immunological techniques.

Contents

1. Principles of Colorimeter, Spectrophotometer and pH meter (Demonstration).
2. Estimation of proteins – UV method, Lowry and Bradford method.
3. Estimation of sugars – Anthrone method.
4. Quantification of Vitamin C.
5. Estimation of amino acids
6. Paper chromatography (circular and ascending)
7. TLC.
8. Molecular weight determination of any unknown protein (Purified) with molecular weight markers by SDS-PAGE, Staining of gels by Coomassie brilliant blue and silver staining.
9. Demonstration of HPLC
10. Amylase or Lipase enzyme assay : Effect of Enzyme concentration, pH and temperature
11. ABO Blood grouping
12. Blood smear preparation – WBC total cell counting
13. Differential staining
14. Routes of immunization
15. Immunoelectrophoresis
16. ELISA (Demonstration)

References:

1. Practical Biochemistry by Sadasivam., er al.,
2. Practical Biochemistry by J.Jayaraman
3. Modern Practical biochemistry by Boyer.

PAPER IX

PLANT BIOTECHNOLOGY

SUBJECT DESCRIPTION

The course deals with the study of various culturing techniques of plant cells and its applications. It also gives emphasis on Gene transferring methods.

GOALS

The enable the students to learn various culturing techniques of plant cells, Gene transferring mechanisms and production of transgenic palnts.

OBJECTIVES

On successful completion course the students will be aware of

- Various invitro culture techniques
- Preservation of plant cells
- Gene transferring mechanisms
- Transgenic

CONTENTS:

Unit – I

Conventional plant breeding methods- Selection, hybridization, mutation and polyploidy

Cell and tissue culture in plants: Tissues culture media (Composition and preparation), Micropropagation: Callus and suspension culture, somaclonal variation, somatic embryogenesis: Embryo culture, protoplast isolation and somatic hybridization; cybrids; Haploid plants, Artificial seeds and hardening.

Unit –II

Genome organization in plants: Nuclear genome, chloroplast genome, mitochondrial genome, CMS Protein targeting to chloroplast and mitochondria, Heat shock proteins, seed storage proteins

Unit –III

Molecular markers aided breeding, Rflp Maps, RAPD markers, STS, microsatellites SCAR (sequence characterized amplified Regions), SSCT (Single strand conformational Polumorphism), AFLP, molecular marker assisted selection. Arid and semi – arid technology, green house and green – home technology

Unit – IV

Plant transformation technology: features of Ti and Ri plasmids, uses of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, methods of nuclear transformation, virtual vectors and their applications. Transgenic biology; Role of virulence genes. Gene transfer methods in plants: multiple gene transfers, vector – less or direct DNA transfer.

Unit –V

Application of plant transformations for productivity and performance: Engineering plants for herbicide resistance, insect resistance, virus resistance, disease resistance, antifungal proteins, PR Proteins, nematode resistance, abiotic stress, long shelf life of fruits and flowers.

Reference:

1. An Introduction to genetic engineering in plants, Mantel. S.H, Mathews. J.A, Mickee, R.A, 1985 Black well Scientific Publishers, London.
2. In Vitro culture of plants by R.L.M. pierik, 1987. Martinus Nijhoff publishers , Dordrecht
3. Palnt cell culture, A practical approach,(2^{nd} ed). Edited by R.A. Dixon and R.A. Gonzales. 1994. Oxford University Press, Oxford.
4. Plant Molecular Biology by Grierson and son Ltd, New york
5. Palnt Molecular Genetics by Monica. A.Hughes,1999, Pearson Education Ltd, England
6. Plant Biotechnology by Mantell and Smith, 1983, Cambridge University Press
7. Plants, Genes and agriculture by M.J. Chrispeels and D.F.Sadava .2000. the American scientific publishers.
8. practical Application of plant molecular biology by R.J.Henry, 1997, Chepmans and Hall
9. Elements of Biotechnological by P.K.Gupta, 1996. Rastogi and Co.Meerut
10. Plant Biotechnology by J.Hammond, P.Mcgarey and V.Yusibov (Eds) 2000 Springer verag
11. Plant cell and tissue culture in the production of food ingredients by T.J. Fu. G.Sings and W.R. Curtis kluwer Academic/plenum press
12. Biotechnology in crop improvement by H.S Chawla. 1998 International Book Distributor Company.

PAPER X BIOPROCESS TECHNOLOGY

Subject description:

This paper presents the basics of fermentation technology, media components as applied to lab scale, pilot scale and industrial scale upstream and down stream processing.

Goals:

This paper is introduced to acquire requisite skills for the design and development bioreactors, production optimization, and preparation of sterile base materials for downstream processing.

Objectives:

On successful completion of the course the students should have:

- Understood the basics of fermentation technology
- Learnt the concepts screening, optimization and maintenance of cultures.

Unit -1

Advantages of bioprocess over chemical process.: Basic function ,design and body construction; Peripheral parts and accessories- Impellers types, sparger, temperature control; pH, control and foam, baffles. Sterilization of fermenter, air supply , Aseptic inoculation and sampling methods.

.**Unit -2**

Types of fermenters- CSTR, Tower fermenter, Jet loop, Air lift, Bubble column, Packed bed,. Fluidized, Tubular fermenter. Immobilized cells, Enzyme immobilization. Primary and secondary metabolites

Types of fermentation – Solid state fermentation – Tray fermenter, Column fermenter, and Drum fermenter, Submerged fermentation – Batch and continuous, fed batch

Unit -3

Transport phenomena in bioprocess – Mass transfer resistance, Rate of oxygen transfer, determination of oxygen transfer coefficients. Biological heat transfer for microbial cultivations

Unit -4

.Down stream processing: Removal of microbial cells,, cell disruption – enzymatic and chemical,physical methods., precipitation methods, filtration, centrifugation, liquid-liquid extraction, membrane filtration, chromatography, crystallization, drying ,lyophilisation, packaging and quality assurance.

Unit -5

Production of Biomass, Biotechnologically important Exopolymers – Dextran, Xanthan gum , Pullulan – method of Biopol production (Biodegradable plastics)

References

1. Principles of Fermentation Technology : Whitekar & Stanbury
2. Comprehensive Biotechnology : Murray Moo Young
3. Methods in Industrial Microbiology : Sikyta
4. Industrial Microbiology – A.H.Patel
5. Industrial Microbiology – Casida

PAPER XI

ENVIRONMENTAL BIOTECHNOLOGY

Subject Description :

To understand the natural environment, eco system ,environmental pollutions and treatment of waste water.

Objective:

Students will get an idea about the hazards of environment and findout the solutions to protect the environment.

Goal:

This course is important from the aspect of industrial biotechnology and will help students who want to take up a career in industries and for research in other areas like development, use and regulation of biological systems for remediation of contaminated environments (land, air, water), and for environment-friendly processes such as green manufacturing technologies and sustainable development.

UNIT - I

Basic concepts: Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; Concepts and theories of evolution - Population ecology - community structure.

UNIT - II

Ecosystem dynamics and management: Stability and complexity of ecosystems; Speciation and extinctions; environmental impact assessment; Principles of conservation; Conservation strategies; sustainable development. Global environmental problems: ozone depletion, UV-B green house effect and acid rain, their impact in biotechnological approaches for management.

UNIT - III

Environmental pollution: Types of pollution, Methods for the measurement of pollution; Methodology of environmental management – the problem solving approach, its limitations. Air pollution and its control through Biotechnology. Water Pollution and control: Need for water management, Measurement and sources water pollution. Kind of aquatic habitats, (fresh and marine), distribution and impact of environmental factors on the aquatic biota, productivity, mineral cycles and biodegradation different aquatic ecosystems.

UNIT - IV

Waste water treatment: Waste water collection, Physico-chemical properties of water, physical, chemical and biological treatment processes. Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries.

Management of estuarine, coastal water systems and man-made reservoirs; Biology and ecology of reservoirs.

UNIT - V

Xenobiotics: Ecological considerations, decay behaviour and degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biopesticides in integrated pest management. Bioremediation of contaminated soils and wastelands. Solid waste: Sources and management (composting, vermiculture and methane production). Environmental mutagenesis and toxicity testing.

References

1. Environmental Biotechnology by Alan Scragg. Pearson Education Limited, England.
2. Environmental biotechnology by S.N. Jogdand. Himalaya Publishing House.Bombay.
3. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata Mc Graw Hill, NewDelhi
4. Environmental chemistry by A.K. De Wiley Eastern Ltd. NewDelhi.
5. Introduction to Biodeterioration by D. Allsopp and k.J. Seal, ELBS/Edward Arnold.

PAPER XII

BIONANOTECHOLOGY

Subject description:

This paper presents the basic physical and biomolecular aspects of bionanomaterials, methods of analysis and characterization of Bionano Particles for drug modeling, docking microarray technology.

Goals:

This paper enables the student to understand the true applications of the upcoming field of Bionanotechnology in Biological world. It is also aimed to enhance the depth of knowledge about the use of Bionanoparticles in drug targeting and delivery and hence improve the scenario of the world of drug designing.

Objectives.

On completion of the course the students shall be made aware of

- Basics of Bionanotechnology.
- The latest trends in nano level application of bionanoparticles in the medical field.

Contents:

UNIT I

The journey of Biotechnology to Bionanotechnology. Historical perspectives. Introduction to Bionanotechnology: Opportunities & challenges of Bionanotechnology. Key features of Nano-size, Comparison of particle behavior at nanosize to macrosize .Strategies for Nanoarchitecture(top down & bottom up approaches). Biomolecular design and Bionanomachines in action.

UNIT II

Structural principles of Bionanotechnology: Natural Bionanomachinery .Overview of Nanodevices. Strategies for construction of Nanomachines. Carbon as a raw material.

Protein folding Aspects:Stable structure,Globular proteins, Role of chaperones in folding.lipid bilayer, DNA based nanostrucrures . Flexibility of biomolecules.

UNIT III

Functional principles of Bionanotechnology. Information driven nanoassembly: Energetics; Biomaterials- Filaments and fibrils. Biomolecular motors; ATP Synthase,flagellar motors; Traffic across membranes- K channels, Biomolecular sensing taste, light sensors., Bacterial sensors, Self-replication, Machine phase Bionanotechnology-Muscle sarcomeres and nerves.

UNIT IV

Applications of Bionanotechnology. Microarray technology. Principle, types and Applications of Bionanoimaging. Magnetic Nano particles, Nanobiosensors, Biochips,Biorobotics, Synthesis of gold, Titania, Nanopore technology, Nanoarrays, DNA computers.

UNIT V

Bionanotechnology- A remedy for all diseases. Invitro diagnosis. Medical Applications of Nanoparticles & Nanosystems. Nano drug delivery. Conventional drug delivery & targetted drug delivery and advantages. Delivery profile, Role of Nanotechnology in drug delivery & Cancer biology.Nanoparticle synthesis in plants, Bacteria and yeast.

References

1. Bionanotechnology: Lessons from Nature David S. Goodsell,.JOHN WILEY & SONS, INC., PUBLICATION
2. Implications of nanotechnology for environmental health research Editors Lynn Goldman and Christine Coussens, THE NATIONAL ACADEMIES PRESS www.nap.edu
3. Nanophotonics: Accessibility and Applicability This free PDF can be downloaded from: http://www.nap.edu/catalog/11907.html
4. *The Coming Era of Nanotechnology* by K. Eric Drexler. This free PDF can be downloaded from: Http://www.foresight.org/EOC/index.html

Article reference

1) Richard P. Feynman, Transcript of speech: "There's plenty of room at the bottom" (1959) http://www.zyvex.com/nanotech/feynman.html

2) Thomas Lawrence McKendree, "Implications of molecular nanotechnology technical performance parameters on previously defined space system architectures." Paper presented at the Fourth Foresight Conference on Molecular Nanotechnology (1995). http://www.zyvex.com/nanotech/nano4/mckendreePaper.html

3) National Space Society, "Position paper on space and molecular nanotechnology" http://www.islandone.org/MMSG/NSSNanoPosition.html

4) Admiral David E. Jeremiah, USN (ret.), "Nanotechnology and global security." Presentation at the Fourth Foresight Conference on Molecular Nanotechnology (1995). http://www.zyvex.com/nanotech/nano4/jeremiahPaper.html

5) Ralph C. Merkle, "Nanotechnology and medicine" http://www.zyvex.com/nanotech/nanotechAndMedicine.html

6) Ralph C. Merkle, "How long will it take to develop nanotechnology?" http://www.zyvex.com/nanotech/howlong.html

7) "Computers: History and development," Jones Telecom. & Multimedia Encyclopedia (Jones E-globe Library)

PRACTICALS-III

LAB IN ENVIRONMENTAL BIOTECHNOLOGY

1 . Industrial Visit and collection of industrial effuluents

2. Water Quality Analysis

Physical parameters-pH, , conductivity , Total solids .Total dissolved solids,Suspended solids,

Chemical parameters- Acidity, Alkalinity, Hardness, DO, BOD, COD, Chloride, Sulphate, Phosphate, Nitrate.

3. Soil Physical, Chemical and Biological Properties

Physical parameters pH – conductivity,

Chemical parameters organic carbon,cationic exchange capacity. Acidity ,Alkalinity, nitrate,Phosphate

Biological Parameters-Soil Bacteria and Fungi

PAPER XIII

ANIMAL BIOTECHNOLOGY

SUBJECT DESCRIPTION:

The course deals with the study of embryology, various culturing techniques of animal cells and its applications. It also gives emphasis on gene transferring methods.

GOALS:

To enable the students to learn various culturing techniques of animal cells, Gene transferring mechanisms and production of transgenic animals.

OBJECTIVES:

On successful completion of the course the students will be aware of

1. Various in vitro culture techniques
2. Preservation of animals cells
3. Gene transferring mechanisms
4. Transgenic & cloning

CONTENT:

UNIT 1

Animal cells; preparation of culture media: Role of carbon dioxide, serum, growth factors in cell culture, serum and protein free defined media.

UNIT II

Types of animal cell culture – Primary cell culture : organ culture; Primary explants culture ; cell lines . Tissue engineering, cell separation, cryo preservation. Biology of cells in culture ; tissue typing : measurement of cell growth and death cytotoxicity assays : production of native and recombinant proteins in animal cell .

UNIT III

Gene transfer in cells; physical, chemical and biological methods. Applications of animal cell culture – Hybridoma technology and its applications; gene targeting, silencing and knock-out.

UNIT IV

Gametogenesis ; spermatogenesis and oogenesis ; Fertilization in animals ; Blastulation ; gastrulation ; early embryonic development -- fate map. Conventional methods of improvement of animal live stock: artificial insemination , In Vitro fertilization ,Embryo culture , Embryo sexing , splitting and cloning .

UNIT V

Production of transgenic animals; applications of producing transgenic animals , clongin of animals: aquaculture biotechnology of silk worm -lie cycle of silk worm for the commercial production of silk, baculovirus in Biocontrol & foreign gene expression; improving qualities of silk, Integrated pest management.

REFERENCE:

1. Animal cell culture: A practical approach, 4th edition by Freshney. R.I. john Wiley publication
2. Mammalian cell biotechnology: A Practical approach. Rd.M. Butter, Oxford University Press
3. Animal cell culture by. S.J.Morgan and D.C. Darling

PRACTICAL -IV

Lab in Plant Biotechnology and recombinant DNA Technology

SUBJECT DESCRIPTION:
This course deals with the study of different techniques of plant and animals cells. It also includes the methods of generating haploids, disease – free plants and transgenic lines.

GOALS
To learn various culturing methods of plant & animal cells & also helps in the production of imp oval varieties of plants.

OBJECTIVES:
After successful completion of the course the students will be aware of
1. Various culture techniques in PTC & ATC
2. Gene- transfer mechanisms
3. Production of transgenic plants.

Plant Biotechnology:

1. PTC Laboratory organization
2. Aseptic manipulation
3. sterilization
4. Preparation of PTC medium
5. Callus induction
6. In vitro germination and differentiation
7. Embryo culture
8. Suspension culture
9. Somatic embryogenesis
10. Protoplast isolation and protoplast fusion
11. Artificial seeds production
12. Meristem culture

Animal Biotechnology:

1. Preparation of ATC medium and membrane filtration
2. Preparation of primary culture from chick embryo
3. Cell counting and cell viability

Recombinant DNA Technology:

1. Isolation of Genomic DNA from Bacteria
2. Isolation of Genomic DNA from animal tissues.
3. Isolation of Genomic DNA form plant tissues.
4. Isolation of RNA.
5. Isolation of Plasmid DNA.
6. DNA and RNA Agarose gel electrophoresis
7. PCR
8. Restriction digestion.
9. Legation experiments.

GROUP A
Elective Papers

Description
Computational biology is relatively a new field in involved in the development of algorithms and statistical techniques to the interpretation, classification and understanding of biological datasets. These typically consist of large numbers of DNA, RNA, or protein sequences. Sequence alignment is used to assemble the datasets for analysis. Comparisons of homologous sequences, gene finding, and prediction of gene expression are the most common techniques used on assembled datasets; however, analysis of such datasets have many applications throughout all fields of biology.

Paper I. Introduction to bioinformatics and Molecular Biology Databases

Unit I. Introduction to bioinformatics.

The dawn of sequencing: Protein sequencing and nucleic acid sequencing, The biological sequence/structure deficit, Genome projects, Human genome project, Goal and scope of bioinformatics, Applications of bioinformatics.

Unit II. Biological Information Networks.

The European molecular biology network (EMBnet)- Hinxton Hall, MIPS, UCL and The National centre for biotechnology information (NCBI). Information retrieval systems: SRS and Entrez. Submitting sequences: Bankit at NCBI, Sequin from NCBI, Webin from EBI and Sakura from DDJB.

Unit III. Databases.

What is a database? Types of databases: Relational databases and Object oriented databases. Databases management system. Structured query language (SQL). Biological databases.

Unit IV. Protein databases.

Primary sequence databases: PIR, MIPS, SWISS-PROT, The structure of SWISS-PROY entries, TrEMBL and NRL-3D. Composite protein sequence databases: NRDB, OWL, MIPSX and SWISS-PROT+TrEMBL. Secondary databases: PROSITE, The structure of PROSITE entries, PRINTS, BLOCKS, Profiles, Pfam and IDENTIFY. Composite protein pattern databse. Structure classification databases: SCOP, CATH and PDBsum.

Unit V. DNA databases.

DNA sequence databases: EMBL, DDBJ, GenBank, The structure of GenBank entries, dbEST and GSDB. Specialized genomic resources: *Sacharomyces* Genome Database (SGD), UniGene, TDB and ACeDB. Biological databases available on the web, Interconnection between biological databases, Pitfalls of biological databases.

Paper II. Biological Sequence Alignment

Unit I. Pairwise sequence alignment.

Evolutionary basis of sequence alignment, Sequence homology versus sequence similarity, Sequence similarity versus sequence identity, Methods of sequence alignment, Scoring matrices, Comparison between scoring matrices, Statistical significance of sequence alignment.

UNIT II. Database similarity searching.

Database similarity searching: Unique requirements for database searching. Heuristic database searching, BLAST: Varients of BLAST, statistical significance, Low complexity regions and BLAST output format. FASTA, Comparison of BLAST nad FASTA. Database searching with Smith-Waterman method.

Unit III. Multiple sequence alignment.

The goal of multiple sequence alignment, Scoring function, Exhaustive algorithms, Heuristic algorithms, Databases of multiple alignments, Searching databases with multiple alignments, PSI_BLAST, Practical issues of multiple sequence alignment.

Unit IV. Secondary database searching.

Secondary databases, What is in a secondary databases: Regular expressions/rules/fuzzy regular expressions, Fingerprints, Blocks, Profiles and Hidden Markov Models.

Unit V. Protein motifs and domain prediction.

Identification of motifs and domains in multiple sequence alignment, Motif and domain databases using regular expressions, Motif and domain databases using statistical models, Protein family databases, Motif discovery in unaligned sequences, Sequence logos.

Paper III. Structural Bioinformatics

Unit I. Protein Structure basics.

Amino acids, peptide formation, Dihedral angles, Hierarchy, Secondary structures, Tertiary structures, Determination of protein three dimensional structure, Protein structure database.

Unit II. Protein structure visualization, comparison, and classification.

Protein structure visualization tools: RasMol, Swiss-PDBViewer, Molscript, Ribbons, Grasp, WebMol, Chime and Cn3D. Protein structure comparison: Intermolecular method,

Intramolecular method, Combined method and Multiple structure alignment. Protein structure classification: SCOP, CATH and comparison of SCOP and CATH.

Unit III: Protein secondary structure prediction.

Secondary structure prediction for globular proteins, secondary structure prediction for trans membrane proteins, coiled coil prediction.

Unit IV. Protein tertiary structure prediction.

Methods, Homology modeling, Threading and fold recognition, *Ab Initio* protein structural prediction, CASP.

Unit V. RNA structure prediction.

Types of RNA structures, RNA secondary structure prediction methods: *Ab Initio* approach, Dot Matrices, Dynamic programming and partition function Comparative approach, Performance evaluation.

Paper IV. Genomics and Proteomics

Unit I. Genome mapping, assembly and comparison.

Genome mapping, Genome sequencing, Genome sequence assembly: Base calling and assembly programs, Genome annotation: Gene ontology, Automated genome annotation, Annotation of hypothetical proteins and Genome economy. Comparative genomics: Whole genome alignment, Finding a minimal genome, Lateral gene transfer, Within-genome approach and Gene order comparison.

Unit II. Functional Genomics.

Sequence based approaches: EST, EST index construction and SAGE. Microarray based approaches: Oligonucleotide design, Data collection, Image processing, Data transformation and normalization, Statistical analysis to identify differentially expressed genes and Microarray data classification. Comparison of SAGE and DNA Microarrays.

Unit III. Proteomics

Technology of protein expression analysis: 2D-PAGE, Mass spectrometry protein identification, protein identification through database searching, Differential in-gel electrophoresis and Protein Microarrays. Post translational modification: Prediction of disulphide bridges and Identification of posttranslational modifications in proteomics analysis. Protein sorting.

Unit IV. Protein-protein interactions.

Experimental determination of protein-protein interaction, Prediction of protein-protein interactions: prediction interactions based on domain fusion, predicting interactions based on gene neighbors, predicting interactions based on sequence homology, predicting interactions based on phylogenetic information and prediction interactions using hybrid methods.

Unit V. Applications of proteomics.

Medical proteomics-disease diagnosis: Biomarkers, Biomarker discovery using 2DGE and mass spectrometry and Biomarker discovery and pattern profiling using protein chips. Pharmaceutical proteomics-drug development: The role of proteomics in target identification, Proteomics and target validation, Proteomics in the development of lead compounds and Proteomics and clinical development. Proteomics and Plant biotechnology: Proteomics in plant breeding and genetics, Proteomics for the analysis of genetically modified plants and Proteomics and the analysis of secondary metabolism.

References

1. Xiong J. (2006). Essential bioinformatics. Cambridge, UK: Cambridge University Press.
2. Goodman N. (2002). Biological data becomes computer literature: New Advances in Bioinofrmatics. Curr. Opin. Biotechnol. 13: 68-71.
3. Hagen J.B. (2000).The origin of bioinformatics. Nat. Rev. Genetics. 1: 231-236.
4. Apweiler R. (2000). Protein sequence databases. Adv. Protein Chem. 54: 31-71.
5. Hughes A.E. (2001). Sequence databases and the internet. Methods Mol. Biol. 167: 215-223.
6. Stein L.D. (2003). Integrating biological databases. Nat. Rev. Genet. 4: 337-45.
7. Batzoglou S. (2005). The many faces of sequence alignment. Brief. Bioinformatics. 6: 6-22.
8. Xuang X.(1994). On global sequence alignment. Comput. Appl. Biosci. 10: 227-235.
9. Pearson, W.R. (1996). Effective protein sequence comparison. Methods Enzymol. 266: 227-258.
10. Spang R. and Vingron M. (1998). Statistics of large scale sequence searching. Bioinofrmatics. 14: 279-284.
11. Mullan L.J. (2002). Multiple sequence alignment- The gateway to further analysis. Brief. Bioinform. 3: 303- 305.
12. Brenden C, and Tooze J.(1999). Introduction to protein structure, 2nd ed. New York: Garland publishing.
13. Baker D. and Sali A. (2001). Protein structure prediction and structural genomics. Science 294: 93-96.
14. Stekel D. (2003). Microarray bioinformatics. Cambridge, UK: Cambridge university press.
15. Huynen M.A., Snel B., Mering C. and Bork P.(2003). Function prediction and protein networks. Curr. Opin. Cell Biol. 15: 191-198.
16. Attwood T.K. and Parry-Smith D.J. (2003). Introduction to bioinformatics, Singapore, Pearson education.
17. Twyman R.M.(2004). Principles of proteomics, York: Garland Science/Bios Scientific publishers.

Group B

Elective Papers

Paper -I Occupational Health & Industrial Safety

Subject Description :

This course deals with the study of industrial safety, various safety measures and its applications. It also gives emphasis on prevention and control methods.

Goals

Students get on idea about the advantages and disadvantages of occupational & Industrial safety applications, principles & functions in safety management.

Objectives :

To impart knowledge on various occupational health hazards and also safety measures to be taken in the work place.

UNIT -I

Parameters of safety - Factors affecting the conditions of occupational and Industrial safety - Concept of safety organization and Management - Safety Regulations.Definition and Role of Ergonomics in Designing Work-Place

UNIT -II

Work Environment - Effects of Light, Ventilation, Vibration, Noise etc - The Work Physiology and their Relevance to Safety - Performance Evaluation of Man - Environment systems.

UNIT -III

Occupational Health and Safety – Occupational Health and Hazards – Physical, Chemical and Biological hazards. Occupational Diseases and their Prevention and Control. Health Protection Measures for Workers. Principles of Arthropod Control.

UNIT -IV

Health Education Medical First-Aid and Management of Medical EmergenciesIndustrial Safety management Techniques - Industrial Safety Standards. Accidents-Definition, Frequency Rate, Prevention and Control. Work Study - Method of Study and Measurement. Measurement of Skills. Safety - Cost of Expenses.

UNIT - V

Principles of Functions in Safety Management Case Study - Visit to an Industry - Preparation of report on safety measures followed in Airport/Industry.

REFERENCE:

1. Environmental Strategies–Hand Book, Kolluru R. V, (1994) Mc Graw Hill Inc., New York.

2. A B C of Industrial Safety, Walsh, W and Russell, L, (1984) Pitma Publishing United Kingdom (1984)

3. Environmental and Industrial Safety, (1989) Hommadi, A. H (1989). I.B.B Publication, New Delhi (1989)

PAPER II
BIOETHICS, BIOSAFETY AND IPR

Scope:

This course has been designed to provide the students insights into the valuable areas of biotechnology, which plays a crucial role in determining its future use and applications.

Objective:
Students get an idea about the advantages and disadvantages of biotechnological applications, ethical implications and intellectual property rights.

Goal:
To study the diversity of plants and animal life in a particular habitat, ethical issues and potential of biotechnology for the benefit of man kind.

Unit I

Introduction to ethics/bioethics – framework for ethical decision making; biotechnology and ethics – benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare

Unit II

Ethical implications of cloning: Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy – ELSI of human genome project

Unit III

Introduction to biosafety – biosafety issues in biotechnology – risk assessment and risk Management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment

Unit IV

Introduction to intellectual property and intellectual property rights – types: patents, copy rights,Trade marks, design rights, geographical indications – importance of IPR - world intellectual Property rights organization (WIPO)

Unit V

What can and what cannot be patented? – Patenting life – legal protection of biotechnological Inventions – Patenting in India: Indian patent act.

References:

1. Principles of cloning, Jose Cibelli, Robert P. lanza, Keith H. S . Campbell, Michael D.West, Academic Press, 2002
2. http://books.cambridge.org/0521384737.htm
3. http://online.sfsu.edu/%7Erone/GEessays/gedanger.htm
4. http://www.actahort.org/members/showpdf?booknrarnr=447_125
5. http://www.cordis.lu/elsa/src/about.htm

PAPER-III

BIOTECHNICQUES

Subject description :

This course presents the principles and applications of Biotechnology explaining the biomolecules and applications of biophysical methods.

Goals :

To enable the students to learn the immuno techniques and radio labeling techniques.

Objectives :

On successful completion of the course the students will be aware of

1. Microscopic techniques
2. Electro physiological methods.
3. Biomolecules structure determination using x-ray diffraction and NMR

UNIT - I

Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, floweytometry and immunofluorescence microscopy, detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH.

UNIT - II

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

UNIT - III

Radiolabeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

UNIT - IV

Microscopic techniques: Visulization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

UNIT - V

Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT .

PARER-IV

CONSERVATION BIOLOGY

UNIT I - BIODIVERSITY; SPECIES CONCEPTS; ANIMAL DIVERSITY

What is Biodiversity- Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Species concepts - **Animal diversity**: (Distribution, inventory, species richness) - Biodiversity Hotspots (Western Ghats, Indo-Burma region).

UNIT II - LOSS OF ANIMAL DIVERSITY, STATUS OF SPECIES

Extinctions: Past rates of Extinctions - Concepts of Island biogeography and extinction rates on Islands - Human induced, Modern and local extinctions - Population reduction-threats to wildlife (examples)- Habitat loss, degradation and fragmentation. Threats to animal diversity in India - **Status**

of species: Rare, endemic and threatened species - Measuring status of species in the wild - IUCN Red list (Assessments and methodologies) - Status of Indian animals.

UNIT III - CONSERVATION: TOOLS IN ANIMAL CONSERVATION

What is conservation biology? - *In situ* and *Ex situ* conservation of Indian animals (Case studies) - Population management -Project Tiger and Elephant - Captive breeding programme - peoples participation in conservation - Successes and failures of conservation actions in India (Case study) - **Tools in Conservation**: Interpretation of various data on wildlife - GIS - remote sensing - Landscape model – PVA and CAMP processes.

UNIT IV - ANIMAL LAWS AND POLICIES IN INDIA; ECONOMICS OF BIODIVERSITY CONSERVATION

Wildlife (Protection) Act of India (1972) - Protected Area network - forest policy - Prevention of cruelty to Animal Act - Convention on Biological diversity, International Trade in endangered species - Zoo policy- Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves - Economics of biodiversity conservation.

UNIT V - CONSERVATION EDUCATION AND AWARENESS

Wildlife / Animal magazines, Journals- How to write popular and Scientific articles - Magazine and Journal information - Wildlife, nature, environment games (examples) – Role of NGO's and Government organizations in wildlife conservation - Wildlife celebration days in India - Biotechnology in conservation.

Selected References:

1. R. B. Primack 1993. Essentials of Conservation Biology, Sinauer Associates, USA
2. G. K. Meffe and C. R. Carroll 1994. Principles of Conservation Biology, Sinauer Associates, USA
3. B. Groom bridge 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
4. R. A. Mittermeier, N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's Biologically richest and most endangered Terrestrial Ecoregions. Cemex/Conservation International, USA
5. M.E. Soule 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
6. M. L. Reaka - Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
7. T. W. Clark, R. P. Reading and A.L. Clarke 1994. Endangered Species Recovery: Finding the Lessons, Improving the process. Island Press, Washington, DC.
8. http://www.redlist.org
9. W. V. Reid and K.R. Miller 1989. Keeping options Alive. World Resources Institute.
10. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
11. K. J. Gaston 1996. Biodiversity: Biology of numbers and Difference. Blackwell Science, Oxford.

ELECTIVE PAPER - GROUP C
ELECTIVE PAPER I -PLANT SYSTEM PHYSIOLOGY

Unit I

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C_3, C_4 and CAM pathways. **Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Unit II

Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. **Sensory photobiology:** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Unit III

Solute transport and photoassimilate translocation: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

Unit IV

Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Unit V

Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress

REFERENCES:

1. Frank. B. Salisbury and cleon Wross.. Plant Physiology CBS publishers and distributors, New delhi.
2. Malcolm S. Wilklins. Advanced Plant Physiology.
3. Pushit., S.S., Hormonal regulation of plant growth and development.
4. Sltyar, R.G Plant water relationships.
5. Roy, G.Noggle and George J. Friltz., Introductory Plant physiology.
6. Mayer and Anderson. Plant physiology.
7. Robert M. Devlin and Francis V. Witham Plant physiology.
8. Devlin, R.M. plant Physiology.
9. Devlin and Barker, 1973 Photosynthesis. Reinholod affliated east west press Pvt, Ltd, New Delhi.

ELECTIVE PAPER II
ANIMAL SYSTEM PHYSIOLOGY

Unit I

Blood and circulation: Blood corpuscles, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. **Cardiovascular System:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure.

Unit II

Respiratory system: anatomy and structure transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Unit III

Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. **Sense organs:** Vision, hearing and tactile response.

Unit IV

Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Unit V

Digestive system: Digestion, absorption, energy balance, BMR. **Endocrinology and reproduction:** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.

REFERENCE

1. Ganong, H, Review of Medial Physiology, 1989. 14th edition, *Appleton &Lange publisher*, New York
2. Physiology: A regulatory system approach, Fleur, and Strand, (1978). *Macmillan Publishing Company, New York; Collier Macmillan Publishers*, London.
3. Shier, D., Butler, J. and Lewis, R., Hole's Human Anatomy and Physiology, (10^{th} edition) 2003. *WCB/McGraw Hill*, Boston. 2003.
4. Animal Physiology, EcKert, R (5^{th} edition), 2002. W.H.Freeman.
5. Williams S. Hoar (1991) General and Comparative Physiology 3^{rd} edition. *Prentice Hall of India*- New Delhi.
6. Neilson, K.S. Animal Physiology, 1997. *Cambridge University Press*, Pergamon Press, Oxford.
7. Prosser, C.L. and Brown-Jr. F.A.: Comparative Animal Physiology, 1961. *W.B. Saunders*, Philadelphia.
8. Barrington, E.J.W. (1975): An Introduction to General & Comparative Endocrinology 2^{nd} ed., *Clarendon press*, Oxford.
9. Medical Physiology (4^{th} Edition) Guyton Arthur C., Hall John E., *W. B.* ***Saunders***

ELECTIVE PAPER III

DEVELOPMENTAL BIOLOGY

Unit I

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Unit II

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit III

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans;* eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Unit IV

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*

Unit V

Programmed cell death, aging and senescence.

References:

1. Essential developmental biology – Jonathan Michael Wyndham slack, Wiley-Blackwell, 2006.
2. Current topics in developmental biology – Geral P. Schatten, Academic press, 2006.
3. The origin of animal body plans: a study in evolutionary developmental biology – Wallace Arthur, Cambridge university press, 2000.
4.Developmental biology – Werner A. Muller, Springer, 1997.

ELECTIVE IV

EVOLUTION AND BEHAVIOUR

Unit I

Emergence of evolutionary thoughts: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis.

Unit II

Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller (1953); the first cell; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.

Unit III

Paleontology and evolutionary history: The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multicellular organisms; major groups of plants and animals; stages in primate evolution including Homo.

Unit IV

Brain, Behavior and Evolution: Approaches and methods in study of behavior; proximate and ultimate causation; altruism and evolution-group selection, kin selection, reciprocal altruism; neural basis of learning, memory, cognition, sleep and arousal; biological clocks.

Unit V

Development of behavior; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

Reference:

1.Carter.G.S. Animal evolution ,1951,Sedgwick and Jackson ,London ,England.

2 .Sobrig and sobrig : Population biology and evolution ,1981 Addition wiley

3.Stahl,V:vertebrate history: problems in evolution 1985,Mc GRAW-Hill,New Delhi

4.Mayer,S:Systematic and origin of species ,1942 ,University press, Colombia.