ANNEXURE I

M. Sc., Biotechnology

(Specialization: Marine Biotechnology)

CBCS Course Structure
&
Syllabus

(For those who joined in July 2008 or after)

Department of Biotechnology

(DST-FIST Sponsored Department)

Alagappa University

(A State University Accredited with "A" Grade by NAAC)

Karaikudi 630 003

DEPARTMENT OF BIOTECHNOLOGY

(DST-FIST Sponsored Department)

ALAGAPPA UNIVERSITY

(A State University Accredited with "A" Grade by NAAC)

M. Sc., Biotechnology Programme

Choice Based Credit System (CBCS)

For those who joined in July 2008 or after

Course Structure

S. No	Code	Name of the Course	Credits	Marks		
		SEMESTER – I		**Int.**	**Ext.**	**Total**
1.	501101	Core 1: Biochemistry	4	25	75	100
2.	501102	Core 2: Microbiology	4	25	75	100
3.	501103	Core 3: Molecular Biology and Genetics	4	25	75	100
4.	501104	Core 4: Cell Biology	4	25	75	100
5.	501105	Core 5: Lab I: Analytical Biochemistry	4	25	75	100
6.	501106	Core 6: Lab II: Microbiology	4	25	75	100
7.		Elective 1	5	25	75	100
			29	**175**	**525**	**700**
		SEMESTER – II		**Int.**	**Ext.**	**Total**
8.	501201	Core 7: Immunobiology	4	25	75	100
9.	501202	Core 8: Recombinant DNA Technology	4	25	75	100
10.	501203	Core 9: Plant Molecular Biology	4	25	75	100
11.	501204	Core 10: Lab III: Molecular Genetics	4	25	75	100
12.	501205	Core 11:Lab IV: Immunotechnology	4	25	75	100
13.		Elective 2	5	25	75	100
			25	**150**	**450**	**600**
		SEMESTER – III		**Int.**	**Ext.**	**Total**
14.	501301	Core 12: Bioinformatics	4	25	75	100
15.	501302	Core 13: Animal Biotechnology	4	25	75	100
16.	501303	Core 14: Marine Biotechnology	4	25	75	100
17.	501304	Core 15: Lab V: Recombinant DNA Technology	4	25	75	100
18.	501305	Core 16: Lab VI: Plant Biotechnology	4	25	75	100
19.		Elective 3	5	25	75	100
20.		Elective 4	5	25	75	100
			30	**175**	**525**	**700**
		SEMESTER – IV		**Int.**	**Ext.**	**Total**
21.	501401	Core 17: Project Work	**12**	**50**	**150**	**200**
		Total	**96**	**550**	**1650**	**2200**

II. Elective Courses

501501. Biophysics and Instrumentation
501502. Biostatistics
501503. Marine Aquaculture
501504. Marine Ecosystem and Principles of Oceanography
501505. Fermentation and Bioprocess Technology
501506. Gene Expression Technologies
501507. Marine Natural Products
501508. Biodiversity, Ecology and Evolution
501509. Marine Pollution and Biodeterioration
501510. IPR, Biosafety and Bioethics
501511 Genomics and Proteomics
501512. Functional Genomics
501513. Pharmacogenomics
501514. Gene Silencing Technologies
501515. Information Technology for Biologists

SEMESTER I

501101 BIOCHEMISTRY (Core – 4 credits)

UNIT-1

Buffering in biological systems. Structure and the biological role of the biomolecules - amino acids, carbohydrates and lipids. Structure and reaction mechanisms of coenzymes.

UNIT-2

Biological membranes- bilipid layer, fluid mosaic model, membrane proteins-intrinsic and extrinsic, lipid-linked proteins. Transport through membranes- Mediated (active and passive) and non-mediated (simple diffusion). Electron transport chain and oxidative phosphorylation. Photosynthesis- light and dark reactions.

UNIT-3

Thermodynamic quantities and laws. ATP- structure and its role as energy carrier. Biological oxidation-reduction reactions.

UNIT-4

Metabolism: basic concepts and design – glycolysis; gluconeogenesis; pentose phosphate pathway; TCA cycle; fatty acid oxidation and biosynthesis; amino acid biosynthesis; de novo synthesis and salvage pathways in nucleotide metabolism.

UNIT-5

Enzyme nomenclature and classification. Catalytic power and specificity of enzymes. Enzyme kinetics and general properties of enzymes like effect of pH, temperature. Extraction, assay and purification of enzymes. Clinical and industrial applications of enzymes. Abzymes and Ribozyme. Enzyme engineering and enzyme immobilization

REFERENCES

1. Harpers Illustrated Biochemistry (2006) by R.K. Murray, D.K. Granner and V.M Rodwell, The McGraw-Hill companies, Inc.
2. Textbook of Biochemistry with Clinical Correlations (2006) by Thomas M. Devlin, John Wiley & Sons Inc., Publications
3. Lehninger Principles of Biochemistry (2006) by D.L. Nelson and M.M. Cox, Macmillan worth Publishers.
4. Biochemistry (2004) by Donald Voet and Judith G. Voet, John Wiley and Sons, USA
5. Biochemistry (2007) by Jeremy M.Berg, John L. Tymoczke and Lubert Stryer, W.H. Freeman and Company, USA.
6. Enzymes- Biochemistry, Biotechnology and Clinical Chemistry (2004) by Trevor Palmer. Affiliated Fast- West Press Pvt Ltd, India.

501102 MICROBIOLOGY (Core – 4 credits)

UNIT-1

Historical perspectives of microbiology, Domain and Kingdom concepts in classification of microorganisms, Criteria for classification. Classification of Bacteria according to Bergey's manual. Diversity of prokaryotic microorganisms. Modern developments in microbiology.

UNIT-2

Microbial Anatomy – Procaryotic Cell structure & Organization, Cell membrane, Cytoplasmic and Inclusion bodies, Cell wall, Capsule, Slime layers, S layers, Fili & Fimbriae, Flagella & Motility. Bacterial endospores. Archaeal cell structures. Viruses, General properties of Viruses, RNA & DNA Virus, Classification of virus – Baltimore, Virions & Prions. Microbial Physiology. Nutrition, Growth and Metabolism of microorganisms - Respiration, Fermentation, Photosynthesis.

UNIT-3

Microbial Pathogenicity: Host - Pathogen relationships, Mechanism of microbial pathogencity Toxins, Drug resistance, Sensitivity tests. Bacterial pathogens – *Staphylococcus, Streptococcus, Escherichia & Salmonella.* Viral pathogens – Rabies, Enterovirus, Retrovirus, Oncogenic viruses.

UNIT-4

Microbial diversity: Molecular methods in assessing microbial diversity: Denaturing Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length Polymorphism (T-RFLP), Amplified Ribosomal DNA Restriction Analysis (ARDRA). Merits and demerits of culture dependent and culture independent method. Microbial functional genomics – Metagenomics, Construction of metagenomic library, analysis of metagenomic library – function driven analysis, sequence driven analysis. Stable isotopic probing for molecular ecology

UNIT-5

Microorganisms in the environment - Air, Water & Soil. Industrial application of microbes,Wine, Beer, Cheese, Yogurt and Antibiotics. Biodegradation and biodeterioration of Oil, Plastics and Xenobiotics.

REFERENCES

1. Microbiology (2005), Sixth edition by L.M. Prescott, J.P. Harley and D.A. Klein, McGraw Hill, Boston.
2. Environmental Microbiology, (2006), R.M. Maier, I.L. Pepper and C.P. Gerba, Elseiver Publication, New Delhi, India.
3. Microbiology – Diversity, Disease and the Environment, (2001), A.A. Salyers and B.D. Whitt. Fitzerald Scientific Press, Maryland.
4. Molecular Microbiology – Diagnostic Principles and Practice (2004), D.H. Persing, ASM Press, Washington, USA.
5. Microbial Functional Genomics (2004) by J.Zhou, D.K. Thomson. Y.Xu. J.M. Tiedje. J.Wiley & Sons Publishers.
6. Medical Microbiology (1997) by D. Greenwood, R. Slack and J. Peutherer, ELST with Churchill Livingstone, Hong Kong.
7. Microbial Ecology. Fundamentals and Applications (2000) by R. M. Atlas and R. Bartha.
8. Microbiology (1993) by M.J. Pelzer Jr., E.C.S. Chan and N.R. Kreig, McGraw Hill Inc., New York.

501103 MOLECULAR BIOLOGY AND GENETICS (Core – 4 credits)

UNIT 1

DNA as the genetic material- Nucleic Acid Structure- DNA Replication: Prokaryotic and eukaryotic DNA replication. Mechanics of DNA replication. Transcription: Initiation- Promoters and enhancers. Elongation, Termination and RNA Processing. Prokaryotic and eukaryotic

translation. The Genetic code. Wobble hypothesis. Translation machinery. Mechanism of initiation, elongation and termination. Regulation of translation, co and post translational modifications of proteins.

UNIT 2

Organization of Gene in Prokaryotes and Eukaryotes - Regulation of gene expression. Regulation in Prokaryotes: The Operon concept- i) lac and ii) trp; stringent response. Regulation of trancription and translation in eukaryotes. Biology of bacteriophage λ. Lytic growth of phage λ: DNA replication and phage production, recombination in the λ life cycle. Lysogeny: Immunity and repression, Lysogeny and prophage integration, prophage excision. Decision between lysis and lysogeny.

UNIT 3

Genetic nomenclature- Types of mutants, Isolation and characterization of mutants, Revertants and Reversion; Genetic analysis of mutants- Genetic recombination, Genetic mapping, Linkage and multifactor crosses, Deletion mapping, Complementation and Intrageic complementation; The need for isogenic strains for genetic analysis. DNA damage and repair: DNA damage by UV, alkylating agents, cross linkers. Mechanism of repair- photoreactivation, excision repair, recombinational repair. The SOS and adaptive responses and their regulation. Heat shock response.

UNIT 4

Transformation – competent cells, regulation, general process; Transduction – general and specialized; Conjugation – *Hfr*, triparental mating, self transmissible and mobilizable plasmids, pili. Introduction to Transposable elements - Discovery insertion sequences, complex and compound transposons – Tn5, Tn10, and retroposon – Nomenclature- Insertion sequences – Mechanism – Transposons of *E.coli*, Bacteriophage and Yeast.

UNIT 5

Eukaryotic Genome Organization- Repetitive DNA and Renaturation Kinetics. Eukaryotic DNA Packaging. Chromosome Structure. Whole Genome Organization. Genes and Cancer- Cell Cycle Regulation. Molecular Basis of Cancer. Genes that Influence Cancer. Etiology of Cancer. Eugenics. The Human Genome Project.

REFERENCES

1. Molecular Biology of the Gene, Fifth Edition (2004) by James D Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine and Richard Losick, Benjamin Cummings.
2. Essentials of Molecular Biology, Fourth Edition (2002) by G. M. Malacinski, Jones & Bartlett Publishers.
3. Genomes 3 (2007) by T. A. Brown, Garland Science Publishing.
4. Microbial Genetics (2006) by S.R. Maloy, J. E. Cronan Jr., and D. Freifelder, Jones and Bartlett Publishers, Sudbury, Massachusetts.
5. Genetics – A Molecular Approach, 2nd Edition (2006) by Peter J. Russel.

501104. CELL BIOLOGY (Core – 4 Credits)

UNIT-1

Introduction. Structure of Prokaryotic and Eukaryotic cell. Structure and function of Nucleus, Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast and Lysosomes. Organization

of Nucleus and nuclear transport. Three dimentional organization and functions of Cytoskeletons (Microfilaments, Intermediate filaments, Microtubules and associated proteins).

UNIT-2

Biological Membrane – Structure (lipid bilayer, membrane proteins and glycoproteins) and functions. Intra cellular Protein sorting in mitochondria, chloroplast, endoplasmic reticulum and nucleus. Protein insertion and processing in Endoplasmic reticulum. Protein trafficking from Endoplasmic reticulum to Golgi.

UNIT-3

Cellular differentiation in plants – Basic process and mechanism. Specific role of hormones and regulation of cellular differentiation. Plant cell wall- Nature, Composition, Organization and Function. Cell junctions - Classification, types and functions.

UNIT-4

Nuclear-Cytoplasm interactions. Cell fusion and its applications. Protein secretion. Proteosomes – Structural organization and function. Chaperons-Classification and cellular functions. Apoptosis-Process and Mechanism.

UNIT-5

Tumorigenesis – Oncogenes. Theories regarding tumor formation - Mutation, Virus, Metabolic and Hormonal disturbance theory. Aging Theories –Cellular, Systemic, Pace maker, Biological clock and Mutation theory.

REFERENCES

1. Molecular Biology of the Cell (2002), Fourth Edition, B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P Walter, Garland Publishing (Taylor & Francis Group), New York.
2. Genes V111 (2004), B. Lewin, Pearson Prentice Hall.
3. Molecular Cell Biology (2004), Harvey Lodish, Fifth Edition, W.H.Freeman and Company, New York.
4. The Cell: A Molecular Approach. Fourth Edition, Geoffrey M.Cooper and Robert E.Hausman, ASM Press, Washington D.C. & Sinauer Associates, Inc, Massachusetts.
5. Cell and Molecular Biology – Concepts and Experiments, Second Edition (1999), Karp, G.Harris, D(ed), John Wiley & Sons, New York.
6. Cell and Molecular Biology (Eight Edition) (1995), De Roberties, E.D.P. and De Roberties, E.M.F. B.I.Waverly Pvt.Ltd., New Delhi.

501105. LAB I- ANALYTICAL BIOCHEMISTRY (Core – 4 credits)

UNIT-1

Basic concepts and applications of the instruments used in biochemical analysis: Colorimetry, spectrophotometry and spectroflorimetry. Evaluation of complementary colour and wavelengh of coloured solutions. Determination of carbohydrate by DNSA method and Protein estimation by Lowry's and Bradford's method

UNIT-2

Collection of samples for enzyme assays: whole blood, serum, plasma, tissue homogenate. Subcellular fractionation: mitochondria, cytosol, nuclei. Enzyme assays: Derivation of Michaelis-

Menten equation and determination of Vmax, Km, optimum pH and optimum temperature. Clinical Enzymology: Clinical significance and assay of the enzymes- SGOT, SGPT, ALP, Amylase, ACP, Lipases. Estimation of blood glucose and determination of fasting, post-prandial and random blood sugar. Evaluation of risk of coronary heart disease- estimation of serum cholesterol.

UNIT-3

pH meter and preparation of buffers of pH range 2 to 11. Derivation of Henderson-Hasselbach equation and evaluation of pKa values in acid-base titrations. Determination of pI value of amino acids. Biochemical separation techniques: Separation of amino acids and sugars by – Paper chromatography and plant pigments by TLC.

UNIT-4

Production of extracellular enzymes from bacteria/fungus and downstream processing a) Ultrafiltration b) Ammonium sulphate precipitation c) Dialysis d) Ion exchange chromatography d) Gel permeation chromatography

UNIT-5

Electrophoretic techniques- separation of proteins by Polyacrylamide gel electrophoresis. Identification of proteins by 2D gels. Radioactive labeling and measurement of radioactivity. Biostatistics: Calculation of basic statistical parameters (mean, median, mode, standard deviation, standard error). Null hypothesis, parametric and non parametric tests (Student 't test, ANOVA

REFERENCES

1. Enzyme assays (2006) by R. Eisenthal and M.J.Danson, Oxford University Press.
2. Experimental Biochemistry- A Student Companion (2005) by Beedu Sashidhar Rao and Vijay Deshpande, I.K.International Pvt, Ltd.
3. Bioanalytical Chemistry (2004) by Susan R. Mikkelsen and Eduardo Corton, Wiley-Intersceince
4. Modern Experimental Biochemistry (2004) by Rodney and Royer, Pearson education, India.
5. Laboratory Manual for Analytical Biochemistry and Separation techniques (2000) by P. Palanivelu, Madural Kamaraj University.

501106. LAB II – MICROBIOLOGY (Core – 4 credits)

UNIT-1

Sterilization and preparation of media, Enumeration of bacteria and fungi from environmental samples - Soil, Water, Air and Marine environments. Techniques for isolating pure bacterial culture. Preservation and maintenance of microbial cultures.

UNIT-2

Stains and Staining techniques, Simple staining, Negative staining & Differential staining techniques. Motility and cell inclusion studies.

UNIT-3

Bacterial growth – Growth curve, factors affecting bacterial growth – pH, Temperature and Salinity. Screening and identification of Amylase, Protease, Lipase, Gelatinase, DNase enzymes and antibiotic producing microorganisms.

UNIT-4
Mass cultivation of commercially important compounds producing microorganisms using bioreactors. Culture of anaerobes, Water quality analysis - MPN method, Microbial analysis of food samples. Probiotics and Bacterial cell – cell communication system.

UNIT-5
The general principles of the biochemical and molecular methods employed in identifying an unknown bacterial organism.

REFERENCES

1. Microbiology: A Laboratory Manual (2002) by J.G. Cappuccino and N. Sherman, Addison-Wesley.
2. Laboratory Manual of Experimental Microbiology (1995) by R.M. Atlas, A.E. Brown and L.C. Parks, Mosby, St. Louis.
3. Laboratory Manual in General Microbiology (2002) by N. Kannan. Panima Publishers.
4. Bergey's Manual of Determinative Bacteriology. Ninth edition (2000) by J.G.Holt, N.R.Krieg, Lippincott Williams & Wilkin Publishers.

SEMESTER II

501201. IMMUNOBIOLOGY (Core – 4 credits)

UNIT-1
Immune system: lymphoid organs - primary and secondary; structure and functions; cells of the immune system. Identification of the immune cells using CD markers. Types of immunity : Innate and acquired. Acquired immunity: humoral and cell mediated immune response. Clonal selection theory.

UNIT-2
Cytokines- Properties and functions. Immunoglobulins - structure, distribution and function. Organization and expression of Immunoglobulin Light and Heavy chain genes. Immunogenicity- Immunogens, adjuvants, epitopes, haptens and carriers. T dependent and T independent antigens. Strength of antigen-antibody interactions: affinity, avidity, valency.

UNIT-3
The complement systems: mode of activation, classical and alternate pathway. Immunization- active and passive. Mechanisms of antigen processing and presentation-cytosolic and endocytic pathways.

UNIT-4
Major histocompatibility complex (MHC): structure and its interaction with peptide. Immune response to infectious diseases - bacterial, protozoan and helminthes. Autoimmune disorders.

UNIT- 5
Transplantation immunity - Organ transplantation and HLA tissue typing. Hypersensitivity reactions- Type I, II, III and IV. Oncogenes and antioncogenes. Immunodeficiency disorders - AIDS. Hybridoma and monoclonals. Edible vaccines. Immunotherapy for the treatment of cancer.

REFERENCES

1. Kuby Immunology (2007) by Kindt, Goldsby and Osborne. W.H.Freeman and Company
2. Immunology (2006) by David Male, Jonathan Brostoff, David B Roth and Ivan Roit. Elsevier.
3. Essentials of Clinical Immunology (2006) by Helen Chapel, Mansel Haeney, Siraj Misbah and Neil Snowden. Blackwell Publishing.
4. Immunology (2006) by Vaman Rao. Narosa Publishing House Pvt, Ltd
5. Immunobiology (2005) by Charles A. Janeway, Paul Travers, Mark Walport and Mark Sholmchik. Garland Publishing.
6. Immunology of Infectious Diseases (2002) Edited by Kaufmann, Sher and Ahmed. ASM Press.
7. Understanding Immunology (2001) by Peter Wood. Pearson Education Limited
8. Essential Immunology (2001) by Ivan M. Roit and Pete J. Delves. Blackwell Science

501202. RECOMBINANT DNA TECHNOLOGY (Core – 4 credits)

UNIT-1

DNA modifying enzymes and their uses in Molecular Biology a) Restriction enzymes b) DNA Polymerase i) Klenow ii) DNA polymerase I iii) T4/T7 DNA Polymerase c) Reverse Transcriptase d) Terminal Transferases e) T4 Polynucleotide kinases & Alkaline phosphatase f) DNA dependent RNA polymerases. g) DNA ligases h) Nucleases: - Bal 31, S1 nucleases, DNase I, Mungbean nucleases, Ribonucleases, EXO III. Thermostable DNA polymerases used in PCR.

UNIT-2

Host cells and Vectors- Host Cell Types (Prokaryotic and eukaryotic). Plasmid vectors for use in *E. coli* and Gram positive bacteria. Bacteriophage - Lambda and M13 vectors c) Cosmids d) Phagemids. Artificial chromosomes (YACs, PACs, BACs, MACs and HACs). Specialized vectors & their uses a) Expression vectors for Prokaryotes & Eukaryotes b) Gene fusion vectors.

UNIT-3

Cloning strategies: DNA cloning a) Sticky ends b) Blunt ends c) Homopolymeric tailing d) Use of adapters & linkers. Construction of genomic DNA libraries (shotgun cloning) and cDNA libraries. Screening and analysis of recombinants- Preparation of radiolabelled/non radiolabelled DNA & RNA probes. Southern/Northern/Western blot, dot blot. Screening of genomic libraries with oligo-probe. Immunological screening for expressed genes.

UNIT-4

PCR – basic process, types and applications. DNA sequencing- Principle of chemical and enzymatic methods. Automated DNA sequencing and high throughput Pyrosequencing. Site-directed mutagenesis and protein engineering. DNA footprinting, zoo blot, chromosome jumping, chromosome walking.

UNIT-5

Biotechnological applications of rDNA technology: Synthesis and purification of proteins from cloned genes- Native and fusion proteins. Yeast expression system. Production of enzymes. Therapeutic products for use in human health care- insulin, growth hormones, TPA, alpha interferon, Hepatitis B vaccine and Factor VIII. Medical and forensic applications of rDNA technology- DNA Profiling, Multiplex PCR, Diagnosis of inherited disorders and infectious diseases, diagnosis and management of cancer. Treatment using rDNA technology- gene therapy. Gene therapy for ADA and cystic fibrosis.

REFERENCES

1. Principles of Gene Manipulation and Genomics (2006) by S. B. Primrose and R. M. Twyman, Blackwell Scientific Publications.
2. Gene Cloning (2007) by Julia Lodge, Pete Lund and Steve Minchin, Taylor and Francis.
3. An introduction to Genetic Engineering (2004) by Desmond S.T. Nicholl, Cambridge University Press.
4. Gene Cloning and DNA Analysis. An Introduction (2006) by T. A. Brown, Blackwell Scientific Publications.
5. Recombinant DNA (1992) by J.D. Watson, M. Gilman, J. Witowski and Mark Zoller, Scientific American Books.
6. From Genes to Clones: Introduction to gene technology (1987). Winnacker, E.L.
7. Molecular cloning: A Laboratory Manual (2001). Sambrook, J., Russell, D.W., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
8. Comprehensive Biotechnology (Vol.1-4) (2004) by Moo-Young, Robinson Howell.

501203. PLANT MOLECULAR BIOLOLOGY (Core – 4 credits)

UNIT-1

Plant genome organization. Structural features of a representative plant gene with functions. Organization of chloroplast genome. Nucleus-encoded and chloroplast-encoded genes for chloroplast proteins. Targeting of nuclear encoded chloroplast proteins to different compartments of chloroplast. Organization of mitochondrial genome. Targeting of proteins to mitochondria. Chloroplast engineering and Transplastomic plants. Promiscous DNA.

UNIT-2

Molecular markers – RAPD, STS, Microsatellites, and AFLP for plant identification, improvement and analyzing genetic diversity. Artificial seeds and their applications in commercial seed industry. Cryopreservation and its applications in germplasm maintenance. Maize transposons and their role in transgenic plants.

UNIT-3

Agrobacterium and crown gall tumors. Mechanism of T-DNA transfer to plants. Co -integrate, binary and super binary Ti-plasmid based vectors for plant transformation. Agro infection. Agrobacterium mediated transformation of food crops.

UNIT-4

Molecular biology of plant stress response - drought, salinity, dehydration, UV, and osmotic stress**.** Plant transformation technology - Direct and Indirect methods. Direct transformation of plants by physical methods (Biolistic, Microlaser, Ultrasonication and Silicon carbide WHISKER™ method). Transposan Tagging. Molecular Farming and case studies – Polyhydroxy butyrate (PHB), Polyfructons and Cyclodextrans.

UNIT-5

Genetic engineering in plants- selectable markers and reporter genes used in plant gene expression vectors. Genetic engineering of plants for virus resistance, pest resistance, herbicide tolerance, and delays of fruit ripening. Gene silencing in transgenic plants.

REFERENCES

1. Introduction to Plant Biotechnology (2001), H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Plant Biotechnology-New Products & Applications (2000). J. Hammond, P.McGarvey &V.Yusibov (Eds), Springer-Verlog.
3. Plant Biotechnology: The Genetic Manipulation of Plants (2003) Adrian Slater, Nigel W.Scott and Mark R.Fowler, Oxford University Press.
4. Plants, Genes and Agriculture (2000). Maarten J.Chrispeels and David E.Sadava, Jones and Barlett Publishers.
5. Plant Biotechnology & Molecular Biology (1999), Second Edition, Peter J.Lea, Richard C.Leegood, John Wiley &Sons.
6. Plant Genetic Transformation Technology (1997). Wagdy A.Sawahel, Daya Publishing House, New Delhi.
7. Methods in Plant Molecular Biology (2005), Mary A.Schuler, Raymond E.Zielinski, Academic Press, An Imprint of Elsevier.

501204. LAB III – MOLECULAR GENETICS (Core – 4 credits)

UNIT-1

Single colony isolation and checking for genetic markers. Measurement of growth rate; one step growth curve using a T even phage. Titration of phages.

UNIT-2

Induced mutagenesis and isolation of antibiotic resistant and auxotrophic mutants; Enrichment methods for auxotrophic and antibiotic resistant mutants.

UNIT-3

Genetic mapping by P1 transduction. Isolation of specialized transducing phage

UNIT-4

Genetic mapping by conjugation.

UNIT-5

Transposon mutagenesis of chromosomal and plasmid DNA

REFERENCES

1. A Short Course in Bacterial Genetics (1992). Miller, J.H.
2. Methods for General and Molecular Bacteriology (1994). Murray, R.G.F., Wood , W.A. and Krieg, N.B.
3. Microbial Genetics (1987). Freifelder, D.

501205. LAB IV – IMMUNOTECHNOLOGY (Core – 4 credits)

UNIT-1

Techniques to raise antibodies in animal models:- selection of animals (rats, rabbits, mice), preparation of antigens, route of injection and dosage, protocol of immunization, methods of bleeding and serum collection, conventional antibody preparation. Hybridoma technology and monoclonal antibody production. Application of monoclonals in biomedical research, in clinical diagnosis and treatment.

UNIT-2

Detection of antigen-antibody reactions:- Agglutination reactions- Haemagglutination, passive HA. Precipitation reactions- precipitin ring test, immunodiffusion, immunoelectrophoresis. Immunohistochemical staining

UNIT-3

Blood cell counts: Total RBC , WBC and differential count of WBC. Peripheral blood mononuclear cell separation and enumeration of live, dead cells and apoptosis in a fluorescent microscope. Lymphocyte subset (B and T lymphocytes) identification and enumeration by FACS (Demonstration).

UNIT-4

Preparation of media, preparation of primary culture, sub-culturing and maintenance of secondary culture, large-scale cultures. Cell synchronization - preservation and revival of cells. Transformed mammalian epithelial cell cultures. Transient and stable transfection methods. Evaluation of host-pathogen interaction using *C. elegans* as model organism and monitoring the expression of Immunoglobulin genes by RT-PCR.

UNIT-5

Immunodiagnostic procedures: RIA, ELISA, ELISPOT, Western blotting, IFAT (indirect fluorescent antibody test). Diagnostic kits for identifying infectious agents: HIV, malaria, tuberculosis, hepatitis B surface antigen and detection of VDRL and pregnancy test.

REFERENCES

1. Principles and Practice of Animal Tissue Culture (2007). Sudha Gangal. Universities Press (India) Private Ltd
2. Antibodies- A Laboratory Manual (2006) by Ed Harlow and David Lane, Panima Publishing Corporation
3. Basic Cell Culture (2005). Edited by J.M.Davis. Oxford University Press
4. Methods for General and Molecular bacteriology (1994). Edited by Phillip Gerhard, RGE.Murray, Willis A. Wood and Noel R. Krieg. American Society for Microbiology
5. Manual of Clinical Laboratory Immunology (1986). Noel R.Rose, Herman Friedman and John L. Fahey. American Society of Microbiology.
6. WormBook: The Online Review of *C. elegans* Biology (wormbase.org)

SEMESTER III

501301. BIOINFORMATICS (Core – 4 credits)

UNIT-1

Biological databases – Retrieving information and sequences from databases. Open Access databases, Proprietary and Open Source software: Bioinformatic analysis packages available – EMBOSS, Visualisation of macromolecules – Rasmol, Swiss PDB Viewer.

UNIT-2

Sequence alignment - Global Vs local alignment, Pair wise alignment, Principles of sequence similarity search algorithms, Database searching.

UNIT-3
Multiple sequence alignment, Alignment viewers, Formatting and editing multiple sequence alignments. Phylogenetic analysis.

UNIT-4
Protein secondary and tertiary structure prediction - and motifs. Drug designing concepts, RNA structure analysis.

UNIT-5
DNA sequencing-chemistry and software needed. Sequence assembly and finishing. Restriction mapping and Primer design using programs from public domain, Prediction of Genes and Regulatory sequences in DNA. Computing in Proteomics.

REFERENCES

1. Bioinformatics(2006) N. Gautham, Narosa Publications
2. Bioinformatics. Sequence and Genome Analysis (2001) by David W. Mount, Cold Spring Harbor Laboratory Press.
3. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins (2005) by A.D. Baxevanis and B.F. Francis Ouellette (3rd Ed.) Wiley Student Ed
4. Introduction to Bioinformatics (2006) by Arthur M. Lesk, Oxford University Press.
5. Introduction to Bioinformatics (2006) by T.K. Attwood and D.J. Parry-Smith, Pearson Education Asia.
6. Developing Bioinformatics Computer Skills (2001) by C. Cibas and P. Jambeck (1st Ed) O'Reilly Publications
7. Bioinformatics for Dummies (2003) by J-M Claverie and C. Notredame, Wiley Publishing, Inc.

501302. ANIMAL BIOTECHNOLOGY (Core – 4 credits)

UNIT-1
Transgenesis; Methods of transferring genes- physical, chemical and biological methods. Transgenic animals (Mice, Cows, Pigs, Sheep, Goat, Birds, fish and Insects). Transgenic animals as models for neurodegenerative disorders, carcinogenesis and hypertension. Assisted reproduction biotechnology: Artificial insemination and embryo transfer.

UNIT-2
Methods for the construction of recombinant animal viral vectors for gene transfer into cell lines. Biology of Animal viral vectors - SV40, adeno virus, retro virus, vaccinia virus, herpes virus, adeno associated virus and baculo virus. Baculovirus in biocontrol.

UNIT-3
Applications of yeast system to study eukaryotic gene function. Animal biotechnology for production of regulatory proteins, blood products, vaccines and hormones. Signal transduction.

UNIT-4
Gene therapy - *Ex Vivo* and *in Vivo* , viral and non- viral. Synthetic viral vectors in gene transfer. Biotechnological applications for HIV diagnostics and therapy. DNA based diagnosis of genetic diseases. Phage display technology and its applications.

UNIT-5

History of stem cells. Preparation and applications of embryonic, adult and umbilical cord blood stem cells. Stem cell differentiation and transplantation. Bioethics and stem cell research.

REFERENCES

1. Gene Expression Systems (2006). Edited by Joseph M. Fernandes and James P. Hoeffler. Academic Press.
2. Principles of Gene Manipulation and Genomics (2006). S.B. Primrose and R.M. Twyman. Blackwell Publishing
3. Biotechnology: Fundamentals and Applications (2004). S.S.Purohit. Students Edition
4. Principles of Gene Manipulation (2001). Sandy Primrose, Richard Twyman and Bob Old. Blackwell Science
5. Gene Cloning and Analysis (2001). T.A.Brown. Blackwell Science Ltd
6. RNA Viruses (2000). Alan J.Cann. Oxford University Press
7. Recombinant DNA (1992) by J.D. Watson, M. Gilman, J. Witowski and Mark Zoller, Scientific American Books
8. Molecular Biotechnology (1998), Second Edition, Glick, B.R., and Pasternack, J.J., ASM Press, Washington, DC,

501303. MARINE BIOTECHNOLOGY (Core – 4 credits)

UNIT-1

Marine Biotechnology- Marine organisms as sources of untapped resources. Bioactive compounds from marine organisms (Microorganisms, Sponges, Corals, Bryozoans and Tunicates). Seaweeds as a source of polysaccharides. Seaweeds for removal of heavy metal pollutants.

UNIT-2

Hydrothermal vents: vent biodiversity, Hyperthermophilic and barophilic microorganisms and their applications. Biotechnological applications of extremozymes from extremophilic organisms. Unculturable bacteria, occurrence, characteristics and exploitation.

UNIT-3

GFP characteristics and applications. Probiotics bacteria and their importance in aquaculture. Vaccines for aquaculture. PCR and other techniques for identification of bacterial and viral pathogen in aquaculture.

UNIT-4

Chromosomal manipulation of commercially important marine organisms. Transgenic fish technology. Transgenic fishes with growth hormone (GH)\antifreeze genes. Transposon in fishes.

UNIT-5

Bacterial cell – cell communication system - Quorum sensing and its inhibition – types of autoinducers - QS inhibitor compounds and its role in expression of virulence genes among bacterial pathogens.

REFERENCES

1. Advances in Biochemical Engineering/Biotechnology- Marine Biotechnology I & II ; (2005) Y. LeGal, R. Ulber, Springer Verlag Berlin Heidelberg.
2. Aquaculture Medicine, (2003), First edition, I.S. Bright Singh, S. Somnath Pai, Rosamma Philip and A. Mohan Das, Paico Printing Press, Kochi, India.

3. Drugs from the Sea. (2000), Fusetani N. Karger, Tokyo
4. Recent Advances in Marine Biotechnology. Vol 2 (1998) by Fingerman, M., Nagabhushanam, R., Thompson, M. Oxford & IBH Publ.
5. Biotechnology and Biodegradation Advances in Biotechnology Series, Vol. 4 (1990) by Kamely, D Chakrabarty, A & Omum, G.S. Gulf Publishing Company, Houston.
6. The Microbiology of Deep-sea Hydrothermal Vents (1995) Karl, D. M. CRC Press, Boca Raton.

501304. LAB V – RECOMBINANT DNA TECHNOLOGY (Core – 4 credits)

UNIT-1

Isolation of plasmid and chromosomal (bacterial, plant and animal) DNA. Isolation of RNA from Gram negative bacteria. Quality and quantity checking of DNA and RNA by UV Spectrophotometer and Submarine agarose gel electrophoresis.

UNIT-2

Partial digestion of chromosomal DNA with restriction enzyme. Construction of genomic DNA Library using plasmid and phage vectors. Screening of the Library - Southern blotting and hybridization. Subcloning in M13 and plasmids.

UNIT-3

DNA fingerprinting- Multilocus and single locus DNA profiling. PCR for Molecular identification of microbes -16S rDNA amplification and cloning in T/A vector- Sequencing of 16S rDNA insert. Site-directed mutagenesis.

UNIT-4

Growth and maintenance of *C. elegans*. Identification of wild-type and mutant *C. elegans*. Isolation of genomic DNA and RNA from different stages of *C. elegans*. Single worm PCR. Studies on expression of antimicrobial genes. Expression of GFP-tagged proteins on live *C. elegans* model. Real Time PCR and Reverse Transcriptase PCR. Expression of cloned genes in *E.coli*.

UNIT-5

Fermentation- Downstream processing of protein products/bioactive compounds- recovery and purification of products. Analysis of expressed proteins by SDS-PAGE and Western blotting.

REFERENCES

1. Molecular Cloning: Laboratory Manual (2001) Sambrook,J., Russell, D.W., Sambrook, J.
2. Genome Analysis. A Laboratory Manual. Vol I- Analysing DNA (1997) by Bruce Birren et al (Vol. eds.), Cold Spring Harbor Laboratory Press.
3. Cloning, Gene Expression, and Protein Purification. Experimental Procedures and Process Rationale (2001) by C. Hardin et al , Oxford University Press.
4. Analysis of Genes and Genomes (2004) by R.J. Reece, John Wiley & Sons, Ltd.
5. www.wormbook.org

501305 LAB VI - PLANT BIOTECHNOLOGY (Core – 4 credits)

UNIT-1

Preparation of stock solutions and nutrient media for callus culture initiation and plant regeneration. Processing of various explants (mature seed, leaf base, node) for culture initiation. Aseptic techniques-Sterilization of nutrient media and surface sterilization of explants collected from field for aseptic culture initiation.

UNIT-2

Callus initiation and maintenance from various explants of food crops and medicinal plants. Regeneration of shoots and roots from callus cultures. RAPD analysis of medicinal plants.

UNIT-3

Synthetic seed preparation from intact regenerable explants of medicinal plants using sodium alginate. Plant conversion from synthetic seeds. Micropropagation of economically and commercially important medicinal plants.

UNIT-4

Genomic DNA extraction and purification – Principle and methods. Isolation and purification of Ti-plasmid DNA. Introduction of binary plasmids into Agrobacterium cells by Triparental mating. Restriction digestion and elution of genes from agarose gel for cloning

UNIT-5

Agrobacterium mediated transformation of plants - Culture initiation, explant preparation, co-cultivation, selection, and regeneration. PCR analysis of transformd plants. Transient *ß-glucuronidase* (GUS) gene expression assays in transformed intact explants and callus tissues by histochemical method.

REFERENCES

1. Plant Cell Culture Protocols – Second Edition (2006), Edited by Victor M.Loyola- Vargas and Felipe Vazquez-Flota, Humana Press Inc, Totowa, New Jersey.
2. Plant Cell Tissue and Organ Culture: Fundamental methods (1998), O.L.Gamborg and G.C.Phillips (Eds.), Narosa Publishing House, New Delhi.
3. Introduction to Plant Biotechnology (2001), H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd.
4. Plant Cell Culture-A - Practical Approach (1995) Edited by R.A.Dixon, IRL Press, Oxford.
5. Fundamentals of Plant Biotechnology (2001), Amla Batra, Capital Publishing Company, New Delhi.
6. Methods in Plant Molecular Biology. A Laboratory Course Manual (1995) Pal Maliga Cold Spring Harbor Laboratory Press.
7. Plant Tissue Culture: Theory and Practice, Revised Edition - 2004 (Studies in Plant Science), S.S.Bhojwani and M.K.Razdan, Elsevier Publications, Netherlands.

SEMESTER IV

501401 PROJECT WORK (Core – 6 Credits)

SYLLABUS FOR ELECTIVE COURSES

501501 BIOPHYSICS AND INSTRUMENTATION (Elective – 5 credits)

UNIT-1

Basic concepts of Biophysics: Bonding: Strong (covalent, ionic, peptide and coordinate bonds) and Weak interactions (Hydrogen bonding and van der Waals force) in macromolecules. Structure and properties of water: Hydrophobic and hydrophilic interactions.

UNIT-2

Organization of proteins at different levels - primary, secondary, tertiary and quaternary structure of protein; forces stabilizing structure of protein; protein folding, Ramachandran plot; Structure-Function relationships; Structural polymorphisms of DNA and RNA.

UNIT-3

Radiation Biophysics or Radioisotope techniques: Stable and radio-isotopes. Measurement of radioactivity in biological samples: Gas ionization (GM counter), Scintillation counter, autoradiography and dosimeter. Radiation units; Safety aspects in handling radioactive isotope; Application of radioactive isotopes in biological studies.

UNIT-4

Separation techniques: Centrifugation - Basic principles of sedimentation, types of centrifuges and rotors. Preparative ultracentrifugation - differential and density gradient; Chromatography: General principles and definitions. Methods based on polarity - Partition chromatography, adsorption chromatography, gas liquid chromatography, and reverse phase liquid chromatography. Methods based on partition - Gel filtration and Affinity chromatography. HPLC and FPLC. Ion-exchange chromatography.Electrophoresis - basic principles, PAGE - Native-PAGE, SDS-PAGE, Isoelectricfocussing and 2Dimensional gels. Capillary electrophoresis. Principle and application of Agarose gel electrophoresis, denaturing agarose gel electrophoresis, Pulse-field gel electrophoresis, Mobility shift electrophoresis.

UNIT-5

Basic principles of biophysical methods used for analysis of biopolymer structure, X-ray diffraction, fluorescence, ORD\CD, NMR, IR, MS and ESR spectroscopy. Use of analytical microscopy in elucidating the structure function relationship in prokaryotes: light, phase contrast, fluorescence microscopy, Transmission and Scanning electron microscopy and confocal microscopy.

REFERENCES

1. Biophysical Chemistry Part I, II and III (2004) by Charles R. cantor & Paul R. Schimmel, W.H. Freeman and Company, USA
2. Biochemistry (2004) by Donald Voet & Judith G. Voet, John Wiley and Sons, USA
3. Lehninger's Biochemistry (2006) by Nelson, D.L. & Cox, M.M. W.H. Freeman and company, USA.
4. Principles and practice of bioanalysis (2004) by Richard F.venn, Taylor & Francis, London, New York.
5. Basic methods in microscopy: Protocols and concepts from cells: A laboratory manual (2006) by David L. spector & Robert D. Goldman, Cold Spring Harbor Laboratory Press, New York.

6. Instrumental Methods of Analysis (1986) by Willard, Herrit, Dean and Settle, CBS Publishers and Distributors.

501502 BIOSTATISTICS (Elective – 5 credits)

UNIT-1

Introduction to biostatistics. Numerical Summary Measures - Measures of Central Tendency – Mean, Median, Mode. Measures of Dispersion-Range, Interquartile Range, Variance and Standard Deviation Coefficient of Variation. Grouped Data- Grouped Mean, Grouped Variance. Chebychev's Inequality.

UNIT-2

Data Presentation -Types of Numerical Data. Tables -Frequency Distributions, Relative Frequency. Graphs- Bar Charts, Histograms, Frequency Polygons, One-Way Scatter Plots, Box Plots ,Two-Way Scatter Plots, Line Graphs.

UNIT-3

Confidence interval- The Standard Deviation, The Gaussian Distribution, The Confidence Interval of a Mean, Survival Curves. Comparing groups with confidence intervals-Confidence Interval of a Difference between means, Confidence Interval for the Difference or Ratio of Two Proportions.

UNIT-4

Introduction to p values-What is a P value? Statistical significance and hypothesis testing, Multiple comparisons. Probability, Bayesian logic - Bayes' theorem in genetics. Population genetics, gene pool, allele frequency, genotype frequencies, Hardy-Weinberg equation, implications of Hardy-Weinberg equation. Diagnostic Tests -Sensitivity and Specificity, ROC Curves, calculations of prevalence.

UNIT-5

Simple correlation - correlation coefficient. Regression - simple linear regression. Basic idea of significance test - hypothesis testing, level of significance.

REFERENCES

1. Statistics for the Life Sciences (3rd Edition) (2002) Jeffrey A. Witmer Myra L. Samuels Prentice Hall
2. Principles of Biostatistics (2nd Edition) (2000) Marcello Pagano Kimberlee Gauvreau, Brooks Cole
3. Primer of Biostatistics(2001) Stanton A. Glantz, McGraw-Hill
4. Fundamentals of Biostatistics (1999) Bernard Rosner Duxbury Press
5. Basic & Clinical Biostatistics (LANGE Basic Science) (2004) Beth Dawson Robert G. Trapp Beth Dawson Robert Trapp, McGraw-Hill.
6. Intuitive Biostatistics **(**1995) Harvey Motulsky, Oxford University Press.

501503. MARINE AQUACULTURE (Elective – 5 credits)

UNIT-1

Status, need and future prospects of aquaculture in India. Coastal Aquaculture Development Program. Types of Aquaculture - Extensive, Semi-intensive and Intensive cultures (Re-circulatory system) – Tanks, Race ways, Cage and Pen culture.

UNIT-2

General Principles, Basic considerations - Site selection, design and construction of Grow out ponds, pond preparations, species selection, water quality and general aspects of pond management.

UNIT-3

Productivity of the ponds and the brackish water ecosystem - Fertilizers (Organic and Inorganic fertilizers) and supplementary feeding.

UNIT-4

Shrimp culture – Hatchery and grow out pond management. Mussel culture. Live feed and artificial diet formulations. General principles of induced breeding and hybridization in Marine teleosts.

UNIT-5

Pathology and parasitology - bacterial, fungal, protozoan and helminthes infections, their control and prophylactic measures. Environmental issues and management strategies - ground water, land use pattern and social implications.

REFERENCES

1. Aquaculture - Principles & Practices by TVR. Pillai, (1998) Fishing News Books.
2. Nutrition and feeding of fish. Vol. I, by T. Lovell. (1998) Kluwer Academic Pub.
3. Environment Management for Aquaculture (1998) by Alex Midlen and Theresa Redding.
4. Pond Aquaculture Water Quality Management (1998) by Claude E. Boyd and C.S. Tucker.
5. Introduction to Aquaculture by Mathewlandu, (1992) J. Wiley & Sons. Inc.

501504. MARINE ECOSYSTEM AND PRINCIPLES OF OCEANOGRAPHY

(Elective – 5 credits)

UNIT-1

Divisions of marine environment. Ecological factors – light, temperature, salinity pH, and pressure. Marine ecosystems: Intertidal ecosystems - Rocky, Sandy and Muddy shores, Estuaries, Salt marshes, Mangroves, Coral reefs, Coral bleaching & its diseases. Deep sea, Plankton, Nekton and Benthos.

UNIT-2

Marine biodiversity, molecular methodologies in measuring biodiversity, Maintenance and conservation of endangered species - captive breeding, habitat fragmentation, ecosystem restoration, and rehabilitation. Threats to marine biodiversity – overexploitation, physical alteration, pollution and alien species.

UNIT-3

Introduction to waves and tides, Origin, Growth, Propagation and Decay of Waves, Significance of Wave Height and Period. Spring and Neap tides and tide generating forces. Currents-Western and Eastern boundary currents, Somali current thermohaline and abyssal circulation. Winds and general oceanic circulation. ENSO (El Nino Southern Oscillation).

UNIT-4

Composition of seawater, Major and minor elements in the seawater. Dissolved gases in the seawater: their source and sinks. Oceanographic instruments and general sampling procedures.

UNIT-5

Marine food web dynamics, Primary and Secondary productions and factors influencing primary production. Properties of light in sea and biological consequences orientation, bioluminescence & biological rhythm. Global Warming - climatic changes- Ozone depletion, UV– B, Green house effect, acid rain and its potential effects.

REFERENCES

1. Marine Biology – an ecological approach (fifth edition) (2001) by J.W. Nybakken.. Addison Wesley Longman Inc.
2. Marine Biology, (2005), First Edition, SK.Dubey, Dominant Publishers, New delhi.
3. An Introduction to World Oceans (sixth edition) (2000), A.C. Duxbury, A.B. Duxbury, K.A. Sverdrup, Mc Graw Hill Publishers.
4. Fundamentals of Ecology (1996) by Eugene P Odum. Nataraj Publishers.
5. Textbook of Marine Ecology (1989) by Nair, N.B. & Thampy, D.M**.** Macmillan Company of India (Wasani)
6. Oceanography (second edition), (1995) by T. Garrison. Wadsworth Publishing Company
7. An Introduction to Marine Ecology, Barnes, R.S.K. and R.N. Hughes, (1999), Third edition, Blackwell Science.

501505. FERMENTATION AND BIOPROCESS TECHNOLOGY (Elective – 5 credits)

UNIT-1

Basic principles of Biochemical Engineering. Isolation and screening of industrially important microbes. Improvement of strains for increased yield and other desirable characteristics.

UNIT-2

Concepts of basic modes of fermentation - Batch, Fed batch and Continuous fermentation. Bioreactor designs. Air and media sterilization, Aeration & agitation in bioprocess. Scale up fermentation processes. Instrumentation & control bioprocess. Computer application in control of bioprocess.

UNIT-3

Fermentation economics of large-scale fermentation.

UNIT-4

Down stream processing. Bioprocess for the production of biomass, primary and secondary metabolites, extracellular enzymes, biotechnologically important intracellular products and exopolymers.

UNIT-5

Immobilization of enzymes and microbial cells, Secondary metabolites.

REFERENCES

1. Comprehensive Biotechnology. The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4 (2004). Edited by M. M. Young, Reed Elsevier India Private Ltd, India
2. Fermentation Microbiology and Biotechnology (2002) by E.M.T.EL. Mansi and C.F.A. Bryle, Taylor & Francis Ltd, UK.

3. Biotechnology: A Textbook of Industrial Microbiology (2000) by Wulf Crueger and Anneliese Crueger, Punima Publishing Corporation, India.
4. Principles of Fermentation Technology (1997) by P.F. Stanbury , A.Whitaker and S.J.Hall, Aditya Books Pvt Ltd, India.
5. Encyclopedia of Bioprocess Technology. Vol 1-5 (1999) Edited by Flickinger, M.C & Drew S.W
6. Fermentation Technology (1994). Cassida
7. Bioprocess engineering: Down Stream processing & recovery of bioproducts, safety in biotechnology and regulations (1990). Behrens, D. & Kramer, P. (Eds)

501506. GENE EXPRESSION TECHNOLOGIES (Elective – 5 credits)

UNIT-1
Prokaryotic and eukaryotic gene organisation and expression. Expression vectors specific for plants and animals. Gateway cloning technology.

UNIT-2
Expression of foreign genes - in *E. coli*, Bacillus, Yeast and filamentous fungi.

UNIT-3
Expression of foreign genes in adenovirus, adenoassociated virus, retrovirus, herpes virus, vaccinia virus and baculovirus. Viral vectors.

UNIT-4
Expression of foreign genes in plants and mammalian cells. Generation of Transient and stable transformed mammalian cell cultures

UNIT-5
Gene silencing and knockout technologies in model animals (Mice and *C. elegans*). Tissue specific Knockout in Mice.

REFERENCES

1. Prokaryotic Gene Expression (1999) Simon, B. Oxford University Press, Oxford
2. Gene Structure and Expression (1991) Hawkins, J. D., Cambridge University Press.
3. Chromatin structure and gene Expression (1995) Elgin, S.C.R. Oxford University Press, Oxford
4. Expression Genetics: Accelerated and High Throughput Methods (1999). McClelland, M. and A. Pardee, A (Eds), Eaton Publishing, MA.
5. Genetic Engineering of microorganisms (1993) Puhler, A. VCH, Germany.

501507. MARINE NATURAL PRODUCTS (Elective – 5 credits)

UNIT-1
Marine macroalgae/seaweeds as sources of Medicine and Food. Macroalgal polysaccharides:- Properties , applications and manufacture of agar, agarose and carrageenan. Alginate- general uses and applications of alginate microcapsules for transplantation of cells (like Islets of Langerhans)

UNIT-2
Marine pharmacology- Bioactive natural products (anti-bacterial, anti-fungal, anti-viral, anti-inflammatory, anti-tumour, anti-parasitic and anthelminthic) from macroalgae, marine bacteria, dinoflagellates, coelenterates (corals), bryozoans, sponges, and tunicates

UNIT-3
Eicosanoids and related compounds from Marine Algae. Biological uses of Omega-3 polyunsaturated fatty acids and production of DHA and EPA from microalgae.

UNIT-4
Biotechnoligical application of commercially important enzymes from marine microorganisms & Extremozymes from Extremophiles. Global CO_2 levels and reduction by ocean farming.

UNIT-5
Applications of chitosan in separation and purification of metals. Molecular biology and applications of green mussel adhesive protein.

REFERENCES

1. Marine Biotechnology Vol I. Pharmaceutical and Bioactive Natural Products (1993) Edited by D.H. Attaway and O.R. Zaborsky, Plenum Press, USA
2. Highlights of Marine Natural Products Chemistry (1972-1999). D. J. Faulkner, Natural Products Report, 2000, 17, 1-6
3. Marine Pharmacology. D. J. Faulkner, Antonie van Leeuwenhoek, 2000, 77, 135-145
4. Biosynthesis of Marine Natural Products: Microorganisms and Macroalgae. B. S. Moore, Natural Products Report, 1999, 16, 653- 674
5. Recent Advances in Marine Biotechnology. Vol 2 (1998). Fingerman, M., Nagabhushanam, R., Thompson, M.
6. Marine Natural Products- Diversity and Biosynthesis. Current Chemistry Vol 167 (1993). Scheuer PJ
7. Marine Natural Products Reviewing the literature Published in 1995. Faulkner DJ.

501508. BIODIVERSITY, ECOLOGY AND EVOLUTION (Elective – 5 credits)

UNIT-1
Introduction to Biodiversity, Different types of Biodiversity and Concepts. Values and uses of Biodiversity (food, genes, biocontrol agents, natural products and medicines). Measures of biodiversity (alpha, beta and gamma).

UNIT-2
Vegetation types of India. Hotspot biodiversity areas in India, Red Listed plants and RED Data Book, Threatened plants and animals of India. Role of biotechnology in reintroducing commercially and economically important plants to wild.

UNIT-3
Conservation biodiversity, Sustainale uses of plant genetic resources and biotechnology assisted plant conservation - *In situ* and *ex situ* methods. Molecular markers and their application in plant conservation.

UNIT-4

Concept and dynamics of ecosystem, Components of Ecosystem- Biotic and Abiotic, Food chain, Food web, and energy flow. Trophic levels and ecological pyramids. Biogeochemical cycles.

UNIT-5

Theories of Evolution (Lamarckism, Neo –Lamarckism, Darwinism, Neo-Darwinism and De Vries theory of mutation), Molecular evolution. Theory of natural selection. Gene pool and gene frequencies. Mechanism of Isolation. Genetic basis of evolution.

REFERENCES

1. An advanced Text Book of Biodiversity (2004) K.V.Krishnamoorthy, Oxford &IBH, New Delhi.
2. Biodiversity and Conservation (2004). Joshi PC and Namitha Joshi, APH Publishing Company, New Delhi.
3. Biodiversity and Conservation (2001) Melchias Oxford and IBH Publishing Company Pvt Ltd., New Delhi
4. Fundamentals of Ecology (1971) E P Odom B Saunders &co, Philadelphia, USA.
5. Evolution (1975) Savage, Amerind Publishing Company Ltd, New Delhi.
6. The Theory of Evolution (1993) John Marynard Smith, Canto.
7. Evolution (2004) Mark Ridley, Wiley-Blackwell.

501509. MARINE POLLUTION & BIODETERIORATION (Elective – 5 credits)

UNIT-1

Marine Pollution: Definition and Historical background. Major Pollutants. Organic wastes Consequences of organic discharges to estuaries. Sewage treatment: Primary, secondary and tertiary treatment and disposal of sewage sludge.

UNIT-2

Oil Pollution, Fate of spilled oil, Treatment of Oil at Sea, Toxicity of Petroleum, Consequence of oil pollution on coastal environment. Control of oil pollution in seawater. Pesticide Pollution: inputs, fate in the sea, biological effects of pesticides and their preventive methods.

UNIT-3

Conservative pollutants. Measures of contamination, toxicity, measurement of toxicity, acute and chronic exposure. Detoxification. Heavy metal pollution in coastal waters (Hg, Pb, Cd, As, Cu, Zn and Fe). Speciation of pollutants in sediments and biological systems.

UNIT-4

Radioactive pollution sources, nature and ecological impact of radioactivity and their control methods. Thermal pollution: Sources, nature and ecological impacts. Assessing Pollution Damage.

UNIT-5

Micro and macro fouling on marine structures. Protection methods against corrosion and fouling. Deterioration of wood in the sea. Present status of coastal pollution in India and Future strategies. The state of some seas in the world. Pollution indicator organism.

REFERENCES

1. Marine Pollution, third edition, (1992) by R.B. Clark, Clarendon Press-Oxford
2. Introduction to Marine Pollution Control, (1987) by Williams. J, Wiley, Interscience Publications.
3. Chemical Speciation in the Environment. (1995) by Ure, A.M. & Davidson C.M
4. Thermal and Radioactive pollution, (1994) by Sharma B.K & Kaur, H
5. Quantitative Aquatic Biological Indicators, (1980) by Phillips J.D. H
6. Marine Bio-deterioration, (1984) by Costlow J.D
7. Marine and Offshore Corrosion (1985), by Chandler K.A

501510. IPR, BIOSAFETY AND BIOETHICS (Elective – 5 credits)

UNIT-1

Introduction. Definitions. General Agreement on Trade and Tariff (GATT) and World Trade Organizations. Establishment and functions of GATT, WTO and WIPO. WTO Summits. Physical and Intellectual Property.

UNIT-2

TRIPS. Different types of intellectual property rights (IPR) - Patents, Trade mark, Trade secret and Copy right. Biotechnological examples of patents, trademark, trade secret and copy right.

UNIT-3

Patent application. Rules governing patents. Licensing - Flavr Savr™ tomato as a model case. Case studies on patents (Basmati rice, Turmeric, and Neem). Indian Patent Act, 1970.

UNIT-4

Biosafety-Introduction. Different levels of biosafety. Guidelines for rDNA research activities. General guidelines for research in transgenic plants, Good Laboratory Practices (GLP). Containments- Types. Basic Laboratory and Maximum Containment Laboratory.

UNIT-5

Bioethics-Introduction. General issues related to environmental release of transgenic plants, animals and microorganisms. Ethical issues related to research in embryonic stem cell cloning.

REFERENCES

1. Recombinant DNA safety guidelines (January1990), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.
2. Revised guidelines for research in Transgenic plants (August 1998), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.
3. Patents (2003), N.Subbaram, Pharma Book Syndicate, Hyderabad.
4. Molecular Biotechnology (1998), Second Edition, Glick, B.R., and Pasternack, J.J., ASM Press, Washington, DC.
5. Introduction to Plant Biotechnology (2001), H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd.

501511. GENOMICS AND PROTEOMICS (Elective – 5 credits)

UNIT-1

Introduction to Genomics- Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes- Recognition of coding and noncoding regions and annotation of genes. Mapping of genomes: mapping strategies –linkage maps- physical maps- low and high resolution physical mapping.

UNIT-2

Genome sequencing projects – Microbes, plants and animals. Comparative genomics of relevant organisms such as pathogens and non-pathogens. Human genome project- Taxonomic classification of organisms using molecular markers- 16S rRNA typing/sequencing. Computational analysis – Sequence analysis – similarity searches and pairwise alignment- multiple sequence alignment- phylogenetics.

UNIT-3

Functional Genomics of microbes, plants and animals- Global gene expression analysis- Microarray- comparative transcriptomics- Differential gene expression. Databases of expressed sequence tags. Data mining.

UNIT-4

Proteomes: definition of proteomes; genome-proteome relationaship; deducing proteome from genome. Tools for proteomics: Isoelectric focusing, 2D protein gels, hplc , MS, Tandem mass spectrometry and protein sequencing and peptide fingerprinting.

UNIT-5

Data base search in proteomics: hidden Markov models- protein family based homology detection. Proteome applications: Protein expression profiling. Protein-protein interaction- Yeast Two hybrid system. Application in drug discovery. Systems biology and metabolomics.

REFERENCES

1. Genome 3 (2007) by T.A. Brown, Garland Science Publishing, New York.
2. Genomics: The Science and Technology Behind the Human Genome Project (2000). Edited by C. Cantor and C.L. Smith, Wiley-Interscience, New York.
3. Genome Analysis – A Practical Approach (1995) by J.M. Davies, Oxford University Press, Oxford.
4. Genome Mapping – A Practical Approach (1997) by P.H. Dear, Oxford University Press, Oxford.
5. DNA microarrays: A practical approach (1999). Edited by M. Schena, Oxford University press, Oxford, England.
6. Introduction to Proteomics: Tools for new biology (2002) by Totowa NJ, Humana Press.
7. Proteomics (2002) by Timothy P, Kluer Academic Publishers.
8. Proteomics: From protein sequences to function (2001) by Pennington A and Dunn MJ, Springer Publications.
9. Reviews and Articles from Journals such as Nature, Science, PNAS (USA), Nucleic Acids Research, Trends Series & Current Opinion Series.

501512. FUNCTIONAL GENOMICS (Elective – 5 credits)

UNIT-1

Brief introduction to Human and other genome projects. Transcript analysis: DNA microarray, Differential gene expression, Real-Time PCR

UNIT-2

Protein Analysis: Protein micro array. Analysis of protein by 2-D gel electrophoresis, 2-D NMR and Mass spectroscopy. .

UNIT-3

Proteomics- definition, identification and analysis of proteins by mass spectrometry. Differential display proteomics, protein-protein interactions, Yeast two –hybrid system and phage display. Functional characterization of proteins, Use of reporter gene GFP to visualize proteins in live-culture; Role of proteomics in diseases.

UNIT-4

Microbial Functional genomics- Functional Genomic analysis of bacterial pathogens and environmentally significant microorganisms. Studies on human microbial pathogens using model animals (Mice and *C. elegans*).

UNIT-5

Pharmacogenetics- high throughput screening for drug discovery – identification of drug targets, pharmacogenetics and drug development.

REFERENCES

1. Proteome Research: New frontiers in Functional Genomics (1997). Edited by M.R.Wilkins, K.L.Williams, R.D. Appel and D.F. Hochstrasser, Springer-Verlag, New York.
2. Expression Genetics: accelerated and High Throughput Methods (1999). Edited by M. McClelland and A. Pardee, Eaton Publishing, MA.
3. 2-D Proteome Analysis Protocols (1998). Edited by A.L. Link, Humana Press, Totowa, New Jersey.
4. DNA microarrays: A practical Approach (1999). Edited by M. Schena, Oxford University Press, Oxford.
5. Microbial Functional Genomics (2004). J. Zhou, D.K. Thomson, Y.Xu and J.M. Tiedje, Wiley Liss.
6. Reviews and articles from Journals such as Nature, Science, PNAS(USA), Nucleic Acids Research, Trends and Current Opinion Series.

501513. PHARMACOGENOMICS (Elective – 5 credits)

UNIT-1

Computational Chemistry: Concepts of computational chemistry, Born-Oppenheimer approximations, Application of Hartree-Fock equations to molecular systems, approximate Molecular orbital theories, semi-emperical methods.

UNIT-2
Docking and Drug Design: DOCK algorithm, Discovery and design of new drugs, computer representation of molecules, 3D database searching, scoring functions, Pharmacophore keys, Structure-based *De Novo* Ligand design, Quantitative Structure Activity Relationship QSAR, Combinatorial libraries.

UNIT-3
Clinical Applications of Pharmacogenetics/Pharmacogenomics in HIV, Pharmacogenomic based therapeutic applications.

UNIT-4
Genetics effects to predict efficay of toxicity, ADMET, Virtual screening, Combinatorial library designing.

UNIT-5
Pharmocogenomics related curated Databases. Pharmacogenomics and the Future of Pharmaceuticals

REFERENCES:

1. Molecular Modelling, Principles and Applications, IInd Edition, A.R. Leach, 2001, Prentice Hall
2. Pharmocogenomics and Proteomic enabling the practice of personalized medicine, Steven H. Y. Wong, 2006, American Association for Clinical Chemistry
3. Pharmocogenomics applications to patient care ACCP, 2004, American College of Clinical Pharmacy

501514. GENE SILENCING TECHNOLOGIES (Elective – 5 credits)

UNIT -1
Antisense tools: Introduction of Antisense Oligos, Antisense RNA, PTGS, siRNA, dsRNA, shRNA and miRNA. DICER, RISC and RdRPs.

UNIT-2
RNA-interference in Caenorhabditis elegans: Introduction, application of RNAi in C. elegans, Generation of dsRNA, various methods of introducing RNAi into C. elegans, Genome-wide RNAi Based Screen for Genes Important in Cell Division, RNAi Database for C. elegans

UNIT-3
RNAi in Plants and Drosophila: Introduction, application of RNAi in plants and Drosophila, Methods of introducing RNAi into Plants, Drosophila and Drosophila cell lines.

UNIT-4
RNAi in Mammals: Introduction, siRNA synthesis and modifications, Tuschl rules, Delivery of siRNAs: Transient and Stable transfections of siRNA into mammalian cell lines, shRNA-synthesis and cloning in vector with promoters; viral mediated delivery of shRNA, inducible RNAi cassettes.

UNIT-5

Applications of RNAi in Mice, Generation of Transgenic and Knock-out mice with RNAi, RNAi in Gene therapy, RNAi in Microarray, High-Throughput screening with RNAi, RNAi in immunology.

REFERENCES

1. RNA Interference in Practice: Principles, Basics, and Methods for Gene Silencing in C. elegans, Drosophila and Mammals (2005) by Ute Schepers.
2. RNAi: A Guide to Gene Silencing (2003) by Gregory J. Hannon
3. Additional information can be obtained from World Wide Web resources

501515. INFORMATION TECHNOLOGY FOR BIOLOGISTS (Elective-5 credits)

UNIT-1

Overview and organization of a computer system, storage, devices, memory, etc, Parallel and cluster computing.

UNIT -2

Operating Systems: Introduction, Process management, Memory management, File management, Device management and security. Introduction to proprietary software, Free and Open Source Software (FOSS).

UNIT-3

Computer Networking: Topologies and protocols, designing networks, Networking gadgets (Router, Switch, etc); Communication Links (Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc). Data security fundamentals and protection mechanism. An overview of Computer viruses and worms.

UNIT-4

Internet: The Internet and its Resources, Internet protocols, and services. Web browsers and browser add-ons. Internet programming language - HTML. Basics in web designing.

UNIT-5

Basic use of office applications: toolbar buttons, Entering and editing text, formatting, inserting and editing images, orientation, borders and shading, bullets and numbering, creating and modifying tables. Basics of a spreadsheet: columns, rows, cells. Tools, using formulas, formatting, creating charts and graphs. Presentation utilities: creating, editing presentations, adding images, charts, motion and sound, printing.

REFERENCES:

1. Introduction to Computers (2005) by Peter Norton, Sixth Edition, Tata Mcgraw Hill.
2. Computer Network (2003) by Andrew S. Tanenbaum, Fourth Edition, Prentice Hall.
3. The Internet For Dummies (2007) by John R. Levine, Margaret Levine Young and Carol Baroudi, 11th Edition, Willy Publishing Inc.,
4. IBM Pc And Clones Hardware, Troubleshooting And Maintenance (2002) by Govindarajalu, Second Edition, Tata Mcgraw Hill.
5. HTML The complete Reference (2001) by Thomas Powell, Third Edition, Tata Mcgraw Hill. Internet resources on Microsoft Office.

DEPARTMENT OF BIOTECHNOLOGY

(DST-FIST Sponsored Department)

ALAGAPPA UNIVERSITY

(A State University Accredited with "A" Grade by NAAC)

M. Sc., Biotechnology Programme

Choice Based Credit System (CBCS)

For those who joined in July 2008 or after

Question Paper pattern for both Theory and Lab Courses (Written):

Max: 75 Marks

Part – A

Ten questions (No choice) — 10 x 2 = 20 marks
(Two questions from each Unit)

Part – B

Five questions (either or type) — 5 x 5 = 25 marks
(One question from each Unit)

Part – C

Three questions out of five — 3 x 10 = 30 marks
(Minimum of one question from each Unit)