Goa University
P.O. Goa University, Taleigao Plateau, Goa 403 206, India

Syllabus of the M.Sc. (Marine Biotechnology) Programme

(As approved by the Board of Studies on 29 March 2011)

The Purpose : Since its inception in 1988, the M.Sc. Marine Biotechnology programme has been funded by the Department of Biotechnology (Ministry of Science &Technology, Govt. of India, New Delhi). The courses offered for the Programme are covered in four Semesters and while ensuring that all the key aspects of general Biotechnology are covered, the outgoing students are, in addition, fully equipped for a career in Marine Biotechnology, as proven by their excellent placements over the years.

Pre-requisites : Bachelor's degree under 10+2+3 pattern of education in Physical, Biological Agricultural, Veterinary and Fishery Sciences, Pharmacy, Engineering/Technology, 4-years B.Sc.(Physician Assistant Course); OR Medicine (MBBS) OR B.D.S., with at least 55% marks. The admissions are made on the basis of the "National Combined Entrance Examination in Biotechnology" conducted by the Jawaharlal Nehru University (New Delhi) at various centres.

Studentship: Students qualifying through the Combined Entrance Examination receive a studentship of Rs. 3,000/-p.m. for the duration of the course.

Semesters & Coursework distribution : The programme follows a Choice-Based Credit System under which 80 credits need to be successfully completed for award of the degree. A student must obtain 60 credits from the parent Department, of which 40 credits shall be from the compulsory courses of the Department and 20 from the courses listed as optional. The remaining 20 credits may be earned by the student by opting for courses within the Department of from any other Department of the University. The Assessments of all courses comprise of continuous intra-semester assessment (ISA) and semester-end assessment (SEA) and are fully internal. The weightage of marks for the ISA and SEA components is 50:50 for each course. The marks allotted per course are as per the number of credits, one credit carrying 25 marks.

Dissertation / Project work : Summer training (4-6 weeks) is mandatory after completion of the second semester and the students are placed by the Department in R& D laboratories of nationally recognized institutes and industries. During the third and fourth semesters, the students undertake independent in-house research projects as part of the curriculum.

The overall Scheme of Instruction appears on pages 2 - 4 of this document. The last column of the table therein identifies the page location of the detailed contents of each of the courses. The detailed syllabus follows from pages 5 - 49.

M. Sc. (Marine Biotechnology) : List of Courses

(L refers to lectures, **T** to tutorials and **P** to practicals.)

Compulsory Courses

Optional Courses

Course Number and Name	L-T-P	Credits	Page Number
MBT 106 : Communication Skills & Scientific Writing	2 – 0 - 0	2	14
MBT 113 : Bioinformatics	2 – 0 - 0	2	19
MBT 212 : Plant Tissue Culture Technology	2 – 0 - 0	2	21
MBL 113 : Lab in Bioinformatics	0 – 0 - 2	2	23
MBL 114 : Lab in Plant Tissue Culture	0 – 0 - 1	1	24
MBT 221 : Bioprocess & Industrial Biotechnology	3 – 0 - 0	3	25
MBT 222 : Recombinant DNA Technology	3 – 0 - 0	3	27
MBT 223 : Animal Cell Culture	2 – 0 - 0	2	28
MBT 224 : Enzymology	3 – 0 - 0	3	30
MBT 225 : Molecular Immunology	3 – 0 - 0	3	31
MBL 221 : Lab in Fermentation Technology	0 – 0 - 2	2	34
MBL 222 : Lab in Recombinant DNA Technology	0 – 0 - 2	2	35
MBL 121 : Lab in Animal Cell Culture	0 – 0 - 2	2	35
MBL 223 : Lab in Enzyme Characterization	0 – 0 - 2	2	36
MBM 222 : Dissertation (Marine Biotechnology) (Stage I)	2	2	
MBT 332 : Applications of Recombinant DNA Technology	3 – 0 - 0	3	39
MBT 232 : Biosafety & IPR	3 – 0 - 0	3	41
MBT 131 : Cellular Biophysics	3 – 0 - 0	3	42
MBT 333 : Genomics and Proteomics	3 – 0 - 0	3	46
MBM 331 : Dissertation (Marine Biotechnology) (Stage II)	6	6	
MBM 131 : Scuba Diving	1 – 0 - 1	2	47

Recommended semester-wise distribution of courses ***(go to pg. 4)***

Semester	Course Code[#]
Semester I	MBT 101
”	MBT 102
”	MBT 103
”	MBT 104
”	MBT 105
”	MBL 101
”	MBL 102
”	MBL 103
”	MBT 106
Semester II	MBT 111
”	MBT 112
”	MBT 211
”	MBT 113
”	MBT 212
”	MBL 111
”	MBL 112
”	MBL 113
”	MBL 114
”	MBM 111
Semester III	MBT 221
”	MBT 222
”	MBT 223
”	MBT 224
”	MBT 225
”	MBL 221
”	MBL 222
”	MBL 121
”	MBL 223
”	MBM 221
”	MBM 222
Semester IV	MBT 331
”	MBT 231
”	MBT 332
”	MBT 232
”	MBT 131
”	MBT 333
”	MBM 231
”	MBM 331
”	MBM 131

Syllabus of the M. Sc. Marine Biotechnology Curriculum

SEMESTER I

MBT 101: FUNDAMENTALS OF GENERAL AND MARINE MICROBIOLOGY

Module I

A brief history of microbiology: discovery of the microbial world, controversy over spontaneous generation, role of microorganism in causation of disease, development of pure enrichment culture methods.

Modern /contemporary microbiology in 21st century

An overview of the organization and cell structure of prokaryotes and archaea:

i) cell wall ii) outer membrane iii) cytoplasmic membrane iv) flagella & specialized movements in microbes v) cell inclusions iv) differences among the groups

Characteristics of marine microorganisms.

Module II

Microbial nutrition: i) autotrophic & heterotrophic modes, ii) defining culture media to support growth, iii)selective and differential culture media.

Bacterial growth kinetics: i) growth curve, the mathematical expression of growth & measurement of growth ii) synchronous growth iii) factors affecting growth iv) chemostat & turbidostat.

Microbial taxonomy: i) nomenclature ii) polyphasic identification, traditional & molecular, iii) Bergey's manual & scheme for identification of marine bacteria.

Module III

i) Structure & classification : Algae, Fungi, Cyanobacteria, Bacteria, Viruses, Viroids & prions

ii) Specialized microorganisms : extremophiles, barophiles, thermophiles,

psychrophiles, halophiles, anaerobes.

REFERENCES:

1. Brock's Biology of microorganisms. (2007). Madigan, M., Martinko & Parker, J.Pearson Prentice Hall
2. Microbiology: Fundamentals and Applications. (1989). Atlas, R.M.
3. Microbiology (1996). M J Pelezar, Chan E C S and Krige
4. Industrial Microbiology. (1987). G Reed, Prescott & Dunn, CBS Publishers.
5. General Microbiology. (1987). Stanier, R.Y., Ingraham, Wheelis and Painter
6. Aquatic Microbiology:An ecological approach. (1993). Ford T E.Blackwell Scientific Publication. Aquatic Microbiology
7. Aquatic Microbiology (1980) Rheinhemer,G, John Wiley and sons. New York
8. Microbial ecology of the ocean (2000) Wiley,New York.
9. Marine and Estuarine Microbiology Laboratory Manual. (1975). Colwell, R. et al.
10. Microbiology Methods. (1975). Collins, C.H. and Lyne, P.M.
11. Source book of Experiment for the teaching of Microbiology. (1982). Primrose, S.B. and Wardlaw, A.C.
12. Laboratory Methods in Microbiology. (1973). Harrigan, W.F. & McCance, M.E.

MBT 102: CONCEPTS IN BIOCHEMISTRY

Module I

Biochemistry: the molecular logic of life.

Biochemical evolution: principles and mechanisms.

Buffering in biological systems.

Enzymes: catalytic power and specificity

Amino acids; structure and functional group properties.

Peptides and covalent structure of proteins

Levels of structural organization, sequencing, 3-D structure and functional diversity of proteins, the concept of the proteome.

Elucidation of primary and higher order structures

Structure-function relationships in model proteins

Module II

Carbohydrates - structure and biological role.

Basic concepts and design of metabolism - glycolysis, gluconeogenesis, the pentose phosphate pathway; the TCA cycle.

Structure and diversity of biological membranes; mechanisms of membrane transport.

Bioenergetics – basic principles. Thermodynamic quantities and laws, equilibria and concept of free energy, ATP as the main carrier of free energy in biochemical systems.

Module III

Lipids – Structure and biological role

Fatty acid synthesis, β-oxidation.

Overview of amino acid biosynthesis.

General principles of intermediary metabolism and regulation of pathways.

De novo synthesis and salvage pathways in nucleotide metabolism.

Electron transport

Oxidative phosphorylation.

Photosynthesis.

Vitamins and hormones: chemistry and physiological role.

REFERENCES:

1. Principles of Biochemistry (2008). Lehninger A.L. (ed.)
2. Biochemistry. (2002). Stryer, L.
3. Principles of Biochemistry. (1995). Zubay, G.L., Parson, W.W. & Vance, D.E.
4. Harper's Biochemistry.(1990). Murray, R.K. et al
5. Biochemistry. (2004). Voet, D. & Voet J.G.
6. Biochemistry and Molecular Biology.(2005). Elliott, W.H. & Elliott, D.C.
7. Fundamentals of Biochemistry. (1999). Voet, D., Voet, J.G & Pratt,C.W.
8. Introduction to Protein Structure (1999). Branden C. & Tooze J.

MBT 103: PRINCIPLES OF GENETICS & MOLECULAR BIOLOGY

Module I

DNA structure & topology; organelle genomes.

DNA reassociation kinetics, DNA repetitive sequence

DNA packaging in viruses, bacteria & eukaryotes.

Epigenetics

Mutation: spontaneous & induced mutation; types of mutagens

DNA repair in prokaryotes & eukaryotes

Transposon, retroposons

Module II

Transcription

Prokaryotic & eukaryotic promoters, mRNA, rRNA, tRNA, RNA polymerases

Transcription initiation & termination, transcription factors, RNA processing

Ribosomes

Initiation, elongation & termination

Translation factors

Genetic code: genetic code is triplet, codon – anticodon

Wobble hypothesis

Characteristics of genetic code

Operon: lac, Trp

Genetic diseases

Module III

Gene transfer in bacteria: transformation, conjugation, transduction

Population genetics: Hardy Weinberg law

Biology of λ-bacteriophage

Recombination

DNA replication in prokaryotes & eukaryotes: DNA polymerases (prokaryotes & eukaryotes), replicon (prokaryotes & eukaryotes), model for DNA replication (prokaryotes & eukaryotes), termination, D-loop & rolling circle model for DNA replication

REFERENCES:

1. Genes X (2010). Lewin, B.
2. Essential Genes (2006) Lewin.
3. Essential Genetics: A genome perspective. Hartl and Jones. (4th Edition)
4. Principle of Genetics. Gardner, E.J., Simmons, M.J. & Snustad, D.P. (8th Edition)
5. Genetics (2002). Strickberger, M.
6. Molecular Biology of the Cell (2002) Alberts. e*t al.*
7. Molecular Biology of the Gene (2008) Watson *et al.*
8. Cell and Molecular Genetics (1987) Schlesf, R.
9. Microbial Genetics (2006). S.Maloy, J.Cronan Jr and Friefelder, D
10. Concept of Genetics (2002). Klug, W.S. & Michael, R & Cummins, M.R.
11. igenetics: A molecular approach (2005). Russel, P.J.

MBT 104 : PRINCIPLES OF OCEANOGRAPHY

Module I

Discovering the oceans. Scope of Oceanographic research and Premier world Institutes.

Temperature, salinity and density – horizontal, vertical and temporal variations.

Introduction to tides and waves. Currents and water masses.

Wind patterns and general oceanic circulation. ENSO (El Nino Southern Oscillation).

Upwelling.

The Ocean Floor: Landforms, sediments and global plate tectonics.

Module II

Major and minor elements in the sea water.

Importance of micronutrient elements and dissolved oxygen in the ocean.

Biological productivity processes: primary, secondary & tertiary; marine food web dynamics.

Properties of light: light penetration & distribution, euphotic zone, compensation depth & bioluminescence

Remote Sensing: principles & techniques; applications of ocean remote sensing.

Marine natural disasters.

REFERENCES:

1. Biological Oceanography.(1999). Lalli, C.M.
2. An introduction to Marine Sciences.(1988). Meadiws, P.S. & Campbell J.J.
3. General Oceanography – An introduction.(1980). Dietrich, G., Kalle, K, Krauss, W. & Siedler, G.
4. Marine Biology.(1984). Thurman, H.V. & Webber,H.H.
5. Introduction to Dynamic Oceanography.(1983). Pond,S. & Pickard,G.H.
6. Chemical Oceanography.(1992). Millero & Saha. M.L.
7. Descriptive Physical Oceanography – An introduction.(1989). Pickard, G.B. & Emery, W.J.

MBT 105 : BIOSTATISTICS

Module I

Scope of Biostatistics

Brief description and tabulation of data and its graphical representation, frequency distributions

Measures of Central Tendency and dispersion: mean, median, mode, range, standard deviation, variance, coefficient of variation, skewness, kurtosis

Displaying data: Histograms, stem and leaf plots, box plots

Probability analysis: axiomatic definition, axioms of probability : addition theorem, multiplication rule, conditional probability and applications in biology.

Module II

Counting and probability, Bernoulli trials, Binomial distribution and its applications, Poisson

distribution

Normal distribution, z, t and chi square tests, levels of significance

Testing of hypotheses: null and alternative hypothesis, Type I and Type II errors

Simple linear regression and correlation

Analysis of variance

REFERENCES:

1. Introduction to Biostatistics (1973). Sokal,R. et al.
2. Statistical methods: George, W.S. & Harward,W.G.
3. Statistical method in Biology. University Press Ltd.
4. Biostatistics. (1984). Zar, J.

MBL 101: LAB IN MARINE MICROBIOLOGY

- Sterilization and disinfection.
- Preparation of solid & liquid media:
- Differential and Selective media
- Enumeration: serial dilution methods, plating.
- Isolation and maintenance of organisms:
- Streaking, slants and stabs cultures, storage of microorganisms.
- Isolation of bacteria from marine samples
- Study of morphology and cultural characteristics
- Gram staining.
- Motility
- Cell inclusion studies: metachromatic granules
- Spore staining
- Biochemical characterization and identification of marine bacteria
- Cultivation of fungi: Slide,chunk and coverslip techniques
- Culture of anaerobes.

REFERENCES:

1. Brock's Biology of microorganisms. (2006). Madigan, M., Martinko & Parker, J.

2. General Microbiology. (1987). Stanier, R.Y., Ingraham, Wheelis and Painter

3. Marine and Estuarine Microbiology Laboratory Manual. (1975). Colwell, R. et al.

4.Microbiology Methods. (1975). Collins, C.H. and Lyne, P.M.

5. Laboratory Methods in Microbiology. (1973). Harrigan, W.F. & McCance, M.E.

6. Source book of Experiment for the teaching of Microbiology. (1982). Primrose, S.B. and Wardlaw, A.C.

MBL 102: LAB IN BIOCHEMISTRY

- Principles of colorimetry
- Spectral characteristics of coloured solutions.
- Estimation of proteins by the Biuret method
- Estimation of proteins by the Lowry's method
- UV absorption of proteins
- Estimation of sugars.
- Titration curves of amino acids
- Paper chromatography.

REFERENCES:

1. Modern Experimental Biochemistry (2003). Boyer, R.
2. Principles & Techniques of Biochemistry and Molecular Biology (2005). Wilson, K. & Walker, J.
3. An Introduction to Practical Biochemistry (2005). Plummer, D.T.
4. Laboratory Manual of Biochemistry (1998). Jayaraman, J.

MBL 103: LAB IN MOLECULAR GENETICS

- DNA isolation a) bacterial cell , b) bacteriophage.
- RNA isolation from bacterial cell.
- UV survival curve for *E.coli.*
- Chemical mutagenesis & isolation of auxotrophs by replica plating.
- Transformation.
- Conjugation & gene mapping by Transduction.
- Transposon mutagenesis.
- Transduction.

REFERENCES:

1. Experiments in Molecular Genetics (1972) Miller J.H.
2. Laboratory Manual in Molecular Genetics (1979). Jayaraman, K & Jayaraman, R.

MBT 106: COMMUNICATION SKILLS & SCIENTIFIC WRITING

Module I

Process of communication

Concept of effective communication- Setting clear goals for communication; Determining outcomes and results;

Initiating communication; Avoiding breakdowns while communicating;

Creating value in conversation; Barriers to effective communication;

Non verbal communication- Interpreting non verbal cues; Importance of body language, Power of effective listening; recognizing cultural differences.

Presentation skills

Formal presentation skills; Preparing and presenting, using Overhead Projector, Power Point;

Defending Interrogation;

Scientific communication skills, poster preparation & presentation; participating in group discussions.

Module II

Technical Writing Skills

Types of reports; Layout of a formal report; Scientific writing skills:

Importance of communicating Science; Problems while writing a scientific document; Plagiarism;

Scientific Publication Writing

Elements of a Scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References;

Drafting titles and framing abstracts.

Computing Skills for Scientific Research

Web browsing for information search; search engines and their mechanism of searching; Hidden Web and its importance in Scientific research; Internet as a medium of interaction between scientists; Effective email strategy using the right tone and conciseness.

Texts/References:

1. Mohan Krishna and N.P. Singh, Speaking English effectively,
Macmillan, 2003

SEMESTER II

MBT 111: THE MARINE ECOSYSTEM

Module I

The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents.

Classification of marine organisms; living resources of the Indian sea;

Marine Biodiversity: defining, measurement and conservation strategies.

Module II

Nutrients cycling: carbon , nitrogen sulphur & phosphorus.

Global climate changes: impact on species diversity & productivity, oceans as a carbon sink, effects on corals bleaching.

Biological rhythms.

REFERENCES:

1. Biodiversity (2004) Borua, P.K

2. Ecology of Coastal water (1988). Mann,K.H.

3. Elements of Ecology (1982). Tait, R.V.

4. Text book of Marine Ecology (1989). Nair N.B. & Thampy, D.M.

MBT 112: INTRODUCTORY IMMUNOLOGY

Module I

Introduction – History and scope of immunology

Phylogeny of immune system

Innate and acquired immunity:- factors, features, processes

Clonal nature of immune response

Organization and structure of lymphoid organs

Cells of the immune system: Hematopoiesis and differentiation, lymphocyte trafficking, B lymphocytes, T lymphocytes, macrophages, dendritic cells, natural killer and lymphokine active killer cells, eosinophils and mast cells, lymphocyte subpopulations and CD markers.

Nature and biology of antigens and superantigens: haptens, adjuvants, carriers, epitopes, T dependant and T independent antigens.

Module II

Theories of antibody formation.

Humoral immunity: cells, antibody formation, primary and secondary response.

Immunoglobulins – structure, distribution and function.

Antigen – Antibody interactions: forces, affinity, avidity, valency and kinetics.

Immuno-diagnostics

Module III

Major histocompatibility complex.

Complement system: mode of activation, classical and alternate pathway.

Cell mediated immune responses: cell activation, cell-cell interaction and cytokines.

Cell-mediated cytoxicity: Mechanism of T cell and NK cell mediated lysis, antibody-dependant cell-mediated cytoxicity, and macrophage-mediated cytoxicity.

Hypersensitivity: An introduction to the different types.

Hybridoma technology and monoclonal antibodies.

Introduction to autoimmune diseases.

REFERENCES:

1. Essential Immunology (2005) Roitt I.M. and Delves P.J.
2. Immunology – Roitt I, Bostoff J. & Male D.
3. Immunology (2006) Luttmann M, Bratke K, Kupper M & Myrtek D.
4. Immunology (2007) Goldsby R.A., Kindt T.J., Osbrne B.A. and Kuby J.

MBT 211 : CELL AND DEVELOPMENTAL BIOLOGY

Module I

Biochemical organization of the cell; diversity of cell size and shape; cell theory, the emergence of modern Cell Biology.

Principles underlying microscopic techniques for study of cells : Light, phase contrast and interference, Fluorescence, Confocal, Electron (TEM and SEM), Electron tunneling and Atomic Force Microscopy.

Cellular junctions and adhesions; structure and functional significance of plasmodesmata.

Membrane assembly.

Structure and function of cellular organelles; subcellular fractionation; organization of cytoskeleton and nucleus; the plant cell wall.

Module II

The eukaryotic cell cycle and its regulation.

Molecular aspects of cell division.

Cell signaling

Cell fusion.

Apoptosis.

Protein localization – synthesis of secretory and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes, receptor-mediated endocytosis.

Chaperones.

Proteosomes.

Module III

Germ cells and fertilization; embryogenesis.

Laying of body axis planes; cellular polarity: differentiation of germ layers.

Morphogens, gradients, concept of compartmentalization and fate mapping

with particular reference to development in *Drosophila*, *Caenorhabditis* and

mammalian systems.

Stem cells and cell differentiation.

Nuclear–cytoplasmic interactions.

Differentiation of cancerous cells and role of proto-oncogenes.

Oncogenes and theories regarding tumour formation.

Ageing.

REFERENCES:

1. The Molecular Biology of the cell. (2002). Albert et al.
2. Molecular Cell Biology. (1986). Darnell, J. et al.
3. Genes X (2010). Lewin, B.
4. Molecular Biology of the Gene. (2003). Watson, J.D., Hopkins,N.H. et al.
5. Developmental Biology. (1997). Gilbert, S.F.
6. Handbook of the Biology of Aging. (1990). Schneider,E.L. & Rowe,J.W.(Eds.)
7. Introduction to Protein Structure (1999). Branden C. & Tooze J.
8. Molecular Cell Biology (2008) Lodish H., *et al*.
9. Cell Biology (1996). Smith, C.A.& Wood, E.J.

MBT 113 : BIOINFORMATICS

Module I

Databases - Definition, data mining methods and analysis tools

Biological Database- Primary, secondary and composite

Various types of databases

Nucleic acid sequence database

Protein sequence database.

Protein structure database

Taxonomic database.

Genomic database.

Protein families, domains and functional sites

Enzyme/metabolic pathway database (EMP and Brenda),

Regulatory pathway (KEGG)

Tools for similarity searches and sequence alignments.

Alignment of pair sequences- methods and scoring alignments (Global Alignments

Needleman Wunsch Algorithm and Local Alignments - Smith Waterman Algorithm)

Scoring matrices: PAM and BLOSSUM

Alignment of multiple sequence alignment and phylogenetic analysis- method of evaluation of multiple alignment. Phylogenetic analysis and tree evaluation methods.

Profiles and Hidden Markow model. Artificial neural networks, support vector machines (supervised machine learning)

Module II

Gene identification and prediction: pattern recognition and gene prediction methods

Protein structure prediction- primary and secondary structure analysis and prediction, motifs, profiles, patterns and fingerprint search, *comparative protein model* for protein prediction, methods of 2-D structure prediction, protein function prediction from a DNA sequence.

Pharmacogenetics- high throughput screening for drug discovery- identification of drug targets; Drug development.

Functional Genomics-global gene expression analysis; Micro-array; comparative transcriptomics; Differential gene expression

Proteomics: definition; identification and analysis of protein by 2D analysis; techniques for studying proteome.

REFERENCES :

1. Bioinformatics-sequence, structure and databanks, (2000) D. Higgins and W. Taylor A practical approach.
2. Bioinformatics computing (2003). B. Bergeman.
3. Bioinformatics databases and algorithms (2007) N. Gautham.
4. Basic Bioinformatics (2005) S. Ignacimuthus.
5. Bioinformatics:concepts skills and applications (2004). S.C. Rastogi, N. Mentiratta and P. Rastogi.
6. Bioinformatics: A modern approach, (2005) V.R. Srinivas.
7. Essential Bioinformatics (2006). J. Xiong).
8. Statistical methods in Bioinformatics: An introduction. (2005). W. Even and G. Grant.

MBT 212: PLANT TISSUE CULTURE TECHNOLOGY

Module I

Laboratory requirement and general techniques.

Tissue culture media.

Cellular totipotency, somaclonal variation, micropropagation techniques

Somatic embryogenesis.

Haploid production.

Protoplast isolation and culture.

Production of pathogen-free plants.

Module II

Axenic culture of seaweed and tissue culture.

Germplasm storage.

Embryo culture

Ovule and seed culture.

REFERENCES:

1. Plant Tissue culture: Basic and applied (2006) T. Jha and B. Ghosh.
2. Plant Biotechnology: Methods in tissue culture and gene transfer (2006). R. Keshavachandra and K.V. Peter.
3. Plant, cell, tissue and organ culture (2005) Gamborg and Phillips.
4. Plant cell and Tissue culture.(2005). I Vasil and T. Thorpe.
5. Plant tissue culture: Theory and practice- revised editions. Bhojwani and M. Rajdan
6. Plant cell & tissue culture. (1994). Vasil, I.K. & Thorpe, T.A.
7. Plant tissue culture: Applications and limits. (1990). Bhojwani, S.S.
8. Plant propagation by tissue culture (1984) George, E.F. & Sherrington, P.D.
9. *In Vitro* cultivation of Animal Cells (1995) Butterworth – Heinemann
10. Animal cell culture (2000) – A Practical Approach John R.W. Masters
11. Culture of animal cells – A manual of Basic techniques (2005) R.I. Freshney

MBL 111 : LAB IN MARINE BIOLOGY & CHEMISTRY

- Samplers : water samplers, dredges, grabs, snappers.
- Sampling (Field trips) and identification: phytoplankton, zooplankton, nekton, benthos.
- Estimations:
  Nutrients nitrate, phosphate,silicate
- Dissolved oxygen
- pH & alkalinity
- Salinity
- Chlorophyll
- Primary productivity

REFERENCES:

1. Methods of Sea Water Analysis. (1995). Grasshoff, K., Ehrhardt, M. & Kremling,K.
2. Quantitative Ecology Ecology & Marine Biology. (1990). Bakus,G.J.
3. Methods of study of Marine Benthos. (1984). Holme,N.A. & McIntyre, A.D.
4. Methods in Marine Zooplankton Ecology. (1984). Omori,W & Ikeda,T.

MBL 112: LAB IN IMMUNOLOGY

- Blood grouping
- Single and double immunodiffusion
- Assessment of antigen similarity using Ouchterlony double diffusion test.
- Determination of antibody titre using double diffusion
- Estimation of Ag/Ab using radial immunodiffusion
- Quantitative precipitin assay
- DOT ELISA test
- Immunoelectrophoresis
- Antibody – HRP conjugation
- Latex Agglutination test
- Counter current immunoelectrophoresis
- Immunoblotting
- Rocket immunoelectrophoresis

REFERENCES:

1. Practical Immunology (2003) 4th edition Frank, C. Hay & O.M.R. Westwood

MBL 113: LAB IN BIOINFORMATICS

- Search engines for bibliographic search
- Construction of plasmid map.
- Database search engines (Entrez/SRS) and submission of DNA/protein sequence.
- Exploring protein structure using RASMOL/Discovery studio/view
- Designing PCR primers and probes.
- Fundamentals in C-programming and construction of small programs in Bioinformatics .
- Reconstruction of phylogenetic tree using molecular data (Distance-based method or Neighbor-joining).
- Tools for Genomic Data Mining
- Basic of Genome Annotation
- Special tools for searching genomic data
- Prediction of ORFs and Genes
- Prediction of Signal sequences (Promoters, splice sites, UTRs etc. sequence
- analysis tools (Bioedit/MEGA)
- Browsing & viewing genome data
- Ensembl@EBI
- MapViewer@NCBI
- Drug designing.
- Immunoinformatics
- ---Prediction of B and T cell epitopes for vaccine drug design
- Comparative and structural genomics.
- Proteomics (Expasy) and Interprotein Scan- pattern/motiof detection in proteins
- Protein-Protein interaction

REFERENCES :

1) Practical Bioinformatics (2006) J. Bajnieci (Ed)
2) Bioinformatics (1995). A Practical guide to analysis of genes and protein.

MBL 114: LAB IN PLANT TISSUE CULTURE

- Sterilization of explants and callus induction.
- Regeneration of plantlet from callus.
- Single cell suspension and protoplast isolation.
- Axenic culture & tissue culture of seaweeds.
- Somatic embryogenesis.
- *Agrobacterium* gene transfer.

REFERENCES:

1. Plant Biotechnology: methods in tissue culture and gene transfer (2006). R. Keshavachandra and K.V. Peter.
2. Plant tissue culture: theory and practice- revised editions. Bhojwani and M. Rajdan.

SEMESTER III

MBT 221 : BIOPROCESS & INDUSTRIAL BIOTECHNOLOGY

Module I

Basic Principles of Biochemical Engineering and Fermentation Processes:

Isolation, screening, and preservation of industrially important microbes

Bioreactor designs

Types of fermenters

Concepts of basic modes of fermentation: batch, fed-batch and continuous

Scale up fermentation processes

Media formulation

Air and media sterilization.

Aeration & agitation in bioprocess.

Measurement and control of bioprocess parameters.

Module II

Industrial production of chemicals :

Strain improvement for increased field & other desirable characteristics

alcohol (beer)

organic acids (citric acid)

antibiotics (Penicillin)

amino acids (lysine)

Application of microbes in food processing: manufacture of cheese and monosodium glutamate

Module III

Downstream Processing:

introduction, removal of microbal cells & solids

bioseparation, filtration, centrifugation sedimentation.

flocculation, cell disruption, liquid-liquid extraction,

Purification by chromatographic techniques

Drying, crystallization.

Storage & Packaging

Effluent treatment & disposal.

Immobilization of microbial cells & their applications

Bioprocess for the production of biomass: yeast and mushrooms

Single cell proteins

REFERENCES :

1. Encyclopedia of bioprocess technology. Vol 1-5. (1999). Flickinger, M.C. & Drew, S.W.(Ed).
2. Fermentation technology. (1994). Cassida.
3. Bioprocess engineering: Down stream processing & recovery of bioproducts, safety in biotechnology and regulations. (1990). Behrens, D. & Kramer, P.(Ed).
4. Fundamentals of biotechnology. (1987). Prave, P., Fanst, V., Sitting, W. & Sukatesh, D.A. (Ed.)
5. Comprehensive biotechnology. Vol 2-4. (1985). &Young, M. (Ed)
6. Chemical engineering. (1984). Coulson, J.M. & Richardson, J.F.
7. Principles of fermentation technology. (1984). Stanbury, F. & Whitaker,A.
8. Immobilized enzymes: An introduction & application in biotechnology. (1980). Trevan, M.D.
9. Topics in enzyme & fermentation technology. (1984). Wiseman, A. (Ed).

MBT 222 : RECOMBINANT DNA TECHNOLOGY

Module I

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

Module II

Cloning vectors and their applications a) Plasmids of Gram +ve & Gram –ve bacteria b) Phages – Lambda and M13 vectors c) Cosmids d) Phagemids 3. Specialized vectors & their uses a) Expression vectors for prokaryotes & Eukaryotes b) Gene fusion vectors c) Yeast vector. d) Drosophila genetic element based vectors. DNA cloning a) Sticky ends b) Blunt ends c) Homopolymeric tailing d) Use of adapters & linkers. Construction of genomic libraries (shotgun cloning) Construction of cDNA libraries. Preparation of radiolabelled/non radiolabelled DNA & RNA probes.

Module III

Screening of genomic libraries with oligoprobe & antibodies. Technique of DNA and plasmid isolation with special reference to commercial kits, Equilibrium density gradient centrifugation, DNA finger printing, Foot printing, Northern/Southern/Western blot, dot/zoo blot Chromosome jumping, Chromosome walking, DNA sequencing. Site directed mutagenesis.

REFERENCES :

1. Biotechnology. (1998). Singh, B.D.
2. Genetic engineering: principles & practice (1996). Mitra, S.
3. Principles of gene manipulations (1996) Old,R.W. & Primrose,S.B.
4. The basic principles of gene cloning (1996). Brown, T.A.
5. An introduction to Genetic engineering.(1994). Nicholl,D.S.T.
6. Recombinant DNA. (1992). Watson et al.
7. Genetic engineering fundamentals: An introduction to principles & applications. (1989). Kammermeyer,K. & Virginica,C.
8. From Genes to Clones: Introduction to Gene Technology. (1987). Winnacker, E.L.
9. Genetic engineering Vol I-VI Setlow and Halander.
10. Genetic engineering Vol I-IV (1981). Williamson, R.(Ed.).

MBT 223: ANIMAL CELL CULTURE

Module I

1. INTRODUCTION

   Introduction to tissue culture

   History and concepts of Animal cell culture

   Applications and limitations

2. DESIGNING AND EQUIPPING THE TISSUE CULTURE LAB :

   Laboratory design

   Equipment needed and used

   Glassware and plasticware - tissue culture vessels

3. ASEPTIC TECHNIQUES

4. TYPES OF TISSUE CULTURE

   Primary Cultures : explant culture

   Cell cultures: sources, types-adherent/suspension, kinetics of cell growth, rodent and human cell cultures, techniques for isolation , methods for cell separation.

   Organ cultures – techniques for organ culture, histotypic, organotypic, organoids and 3D cultures.

   Stem cell cultures.

   Embryo cultures and IVF.

Module II

1. CULTURE OF CELL LINES

   Basic techniques of culturing mammalian cells, initiation, selection and evolution of cell lines, maintenance of cell lines, phases of cell cycle, growth curve of cells, protocols for subculturing of cells: monolayer and suspension cultures, setting up replicate cultures, established cell lines. Large scale culturing of animal cells.

2. CULTURE ENVIRONMENT

   Atmosphere, media- types, components, natural and artificial substrate material

3. PRESERVATION AND CHARACTERISATION OF THE ANIMAL CELL

   Maintenance, cryopreservation and storage of cell cultures, culture banks, sources for seed cultures.

4. BIOLOGY OF THE CULTURED CELL AND CELL COUNTING

   Transformation, differentiation, deadaptation and dedifferentiation

   Cell Counting: hemocytometer, coulter counter, Flow cytometry and Cytofluorometry

5. APPLICATIONS OF ANIMAL CELL CULTURES

REFERENCES:

1. In Vitro Cultivation of Animal Cells (1995) Butterworth – Heinemann
2. Animal Cell Culture (2000) – A Practical Approach John R.W. Masters
3. Culture of Animal Cells – A manual of Basic technique (2005) R.I. Freshney

MBT 224 : ENZYMOLOGY

Module I

Classification and nomenclature of enzymes.

Effect of pH, temperature, ions, etc. on enzyme activity.

Enzyme extraction and assay.

Enzyme purification: principles and techniques of salting in and out, molecular sieving, ion exchange and affinity chromatography, gel electrophoresis, isoelectric focusing, 2-D electrophoresis.

Module II

Isozymes ; *in situ* localization of enzymes in gels.

Catalytic mechanisms: mechanism of action of lysozyme, chymotrypsin etc.

Cofactors and Coenzymes.

Allosteric enzymes.

Reaction kinetics, order and molecularity; steady state kinetics; analysis of kinetic data; enzyme inhibition.

Multisubstrate reactions.

Enzyme activation.

Biological regulation of enzyme activity.

Module III

Enzyme modification.

Clinical and industrial applications of enzymes; enzyme immobilization.

Ribozymes, catalytic antibodies and their applications.

Enzyme fusion.

Biosensors.

REFERENCES:

1. Enzymes. (1979). Dixon M. & Webb E.C.
2. Methods in Enzymology (relevant volumes of the series)
3. Fundamentals of Biochemistry. (1999). Voet, D., Voet, J.G & Pratt,C.W.
4. Genes VII. (2000). Lewin, B.
5. Biological Chemistry. (1986). Mahler, H.R. and Cordes E.
6. Bioseparations: Principles & Techniques (2005). Sivasankar B.
7. Enzymes- a practical introduction to structure mechanism and data analysis (2000). Copeland, R.A.
8. Enzymes: Biochemistry, Biotechnology & clinical chemistry (2004). Palmer, T.

MBT 225 : MOLECULAR IMMUNOLOGY

Module I

Recognition of antigens

1. The major histocompatibility complex:

   i. Discovery and its role in immune response
   ii. Structure of MHC molecules
   iii. Binding of peptides to MHC molecules
   iv. Genomic organization of the MHC

2. Recognition of antigens by T Lymphocytes

i) Antigen processing and presentation to $CD4^+$ and $CD8^+$ T Lymphocytes.

ii) Antigen receptors and accessory molecules of T Lymphocytes

iii) Effector molecules of T lymphocytes

Maturation, activation and regulation of Lymphocytes

1. Maturation of Lymphocytes

i. General features of Lymphocyte maturation
ii. Formation of functional antigen receptor genes in B & T lymphocytes.
iii. Maturation of B lymphocytes.
iv. Maturation of T lymphocytes.

Module II

2. Activation of T lymphocytes

i) Signal transduction by the T lymphocyte receptor complex – Ras and Rac,

Calcineurin and Protein Kinase C signaling.

ii) Activation of transcription factors in T cells

3. Activation of B cells

i. Signal transduction by the B cell antigen receptor complex

ii. CD40 and it's role in T-B cooperation

iii. Bidirectional molecular interactions between T-B cells

4. Immunologic tolerance

    i. General features & mechanisms of immunologic tolerance
    ii. T Lymphocyte tolerance
    iii. B Lymphocyte tolerance
    iv. Homeostasis in the immune system: termination of normal immune response

Effector mechanisms of immune responses

i. Cytokines – regulating innate and adaptive immunity and stimulate hematopoiesis
ii. Cell mediated immunity
iii. Humoral immunity

Module III

Immunity in defense and disease

1. Immunity to Microbes –

    Immunity to extracellular and intracellular bacteria: Innate and adaptive response,

    evasion of mechanisms by bacteria

    Immunity to fungi, viruses and parasites

    Strategies for vaccine development

2. Immunity to tumors

    i) Tumor antigens

    ii) Immune responses to tumors

    iii) Evasion of immune responses by tumors

    iv) Immunotherapy for tumours

3. Diseases caused by immune responses: hypersensitivity and autoimmunity

    i. Mechanisms of autoimmunity
    ii. Types of hypersensitivity diseases
    iii. Therapeutic approaches for immunologic diseases
    iv. Immunosuppression
    v. Bone marrow transplantation immunology

REFERENCES:

1. Cellular and Molecular Immunlogy (2000) Abbas A.K., Lichtman A.H. & Pober, J.S.

2. Practical Immunology (2003) Frank C. Hay & O.M.R. Westwood

3. Immunology (2007) Goldsby R.A., Kindt T.J., Osbrne B.A. and Kuby J.
4. Essential Immunology (2005) Roitt I.M. and Delves P.J.
5. Immunology – Roitt I, Bostoff J. Male D.
6. Immunology (2006) Luttmann M, Bratke K, Kupper M & Myrtek D.
7. Manual of Molecular and Clinical Laboratory Immunology (2006)
8. Detrick B, Hamilton R.G. & Folds J.D.

MBL 221: LAB IN FERMENTATION TECHNOLOGY

- Microbial production of ethanol using yeast sp.
- Estimating ethanol concentration by Cerric Ammonium nitrate method.
- Microbial production and estimation of organic acids: Citric acid using *Aspergillus* sp.
- Microbial production of antibiotics.
- Immobilization of microbial cells: use of alginate.
- Use of fermenter with special reference to scale-up operations.
- Batch and continuous culture.
- Manufacture of ginger ale.
- Mushroom cultivation.

REFERENCES:

1. Practical Fermentation Technology (2008) Brian Mcneil and Linda Harvey. Wiley

MBL 222: LAB IN RECOMBINANT DNA TECHNOLOGY

Plasmid isolation by alkaline lysis and boiling method. Ethidium bromide/CsCl density gradient centrifugation. Transformation of plasmid using competent bacterial cells. Restriction mapping. Cloning a) Restriction of plasmid and alkaline phosphatase treatment. b) Ligation of insert. c) Selection/screening for recombinant. Transfection and preparation of ssDNA. PCR. RT-PCR. Western blotting. Southern blotting. DNA sequencing.

REFERENCES :

a. Molecular cloning (1989) Maniatis,T. *et al*
b. Recombinant DNA methodology. (1985). Dillon, R.G., Nasim, A. & Nestmann. E.R.

MBL 121: LAB IN ANIMAL CELL CULTURE

1. Sterilization and preparation of glassware, preparation of tissue culture medium and membrane filtration.

2. Preparation of single cell suspension from spleen or thymus
3. Cell counting and cell viability
4. Setting up of macrophage monolayer and use of inverted microscope
5. Preparation of goat serum
6. Setting up monolayer of tilapia hepatocytes
7. Staining and preparation of permanent slides

REFERENCES :

1. Animal cell culture (2000)-A Practical Approach John R.W. Masters
2. Culture of animal cells – A manfual of Basic techniques (2005) R.I. Freshney

MBL 223 : LAB IN ENZYME CHARACTERIZATION

1. Enzyme isolation – preparation of cell-free lysates
2. Ammonium sulphate precipitation
3. Dialysis
4. Gel filtration
5. Ion exchange chromatography
6. Affinity chromatography

7. Enzyme kinetic parameters
8. Assessing protein purity by native polyacrylamide gel electrophoresis
9. Molecular weight determination by SDS-PAGE

REFERENCES:

1. Modern Experimental Biochemistry (2003). Boyer, R

2. Fundamentals of Biochemistry. (1999). Voet, D., Voet, J.G & Pratt,C.W.

3. Bioseparations: Principles & Techniques (2005). Sivasankar B.

SEMESTER IV

MBT 331 : POTENTIAL APPLICATIONS OF MARINE ORGANISMS

Module I

Microorganisms :

Marine viruses

Bacteria and their significance : unculturable bacteria : occurrence, characteristics and exploitation, chemosynthetic and giant bacteria, the Superbug.

Macroorganisms :

Hydrothermal vents : biodiversity of organisms

Barophilic organisms & their applications

Module II

Important Marine Products:

Bioactive compounds from marine organisms

GFP, RFP characteristics and their applications

Green mussel adhesive protein

Chitosan and its applications

Module III

Marine Processes and control:

Biofouling ,biofilms, corrosion and antifouling treatment

Ballast water : consequences & management

Red tides : causative organisms and control

Marine pollution & its control ; Seaweeds for removal of metal pollutants

Techniques for identification of bacterial & viral pathogens in aquaculture and

Remedies.

Probiotic bacteria and their importance in aquaculture

Vaccines in aquaculture: Fish ,shrimps & prawns

Marine food analysis-spoilage, quality control

ISO standards taking export into consideration

REFERENCES:

1. Drugs from sea. (2000). Fusetani, N.
2. Microbiology of deep sea hydrothermal vents. (1995). Karl, D.M.
3. The search from bioactive compounds from microorganisms. (1992). Omum, S.
4. Biotechnology and Biodegradation (1990). Kamely, D. Chakraborty, A. & Omenn, G.S.
5. Recent Advances in Marine Biotechnology. Vol.2 (1998) Fingerman, M., Nagabushanam, R., Thompson, M.

6. Biotechnology in the marine sciences: Proceedings of the first annual MIT sea grant lecture & seminar. (1984). Colwell, R.D.(Ed)Recent articles from various journals such as Journal of Marine Biotechnology, Nature and Science will be covered.
7. Environmental Biotechnology: Theory and Application Gareth G. Evans, Judy Furlong John Wiley and Sons, 2011
8. Recent Advances in Marine Biotechnology Volume 3 – Milton fingerman et al., 1999.
9. Cynobacterial and Algal Metabolisms and Environment Biotechnology – Tasneem Fatma, 1999.
10. Environmental Biotechnology Theory and applications – Evans et al., 2000.
11. Environmental Biotechnology – Gareth M.Evams et al., 2003
12. Biotechnology, Recombinant DNA Technology, Environmental Biotechnology – S.Mahesh et al., 2003.

MBT 231 : AQUACULTURE TECHNOLOGY & MARINE PHARMACOLOGY

Module I

Culture systems and Hatchery techniques

Importance of coastal aquaculture; Aqua farms; Design and construction; Criteria for selecting cultivable species; Culture systems and management practices – extensive, semi intensive and intensive culture practices

Seed production in controlled condition; Types; Design and management of hatchery –induced spawning;

Mass production of seeds; Live feed culture technique and feed formulation; Artificial insemination - *in vitro* fertilization.

Module II

Introduction to marine pharmacology

Terms and definitions; Medicinal compounds from marine flora and fauna - marine toxins, antiviral and antimicrobial agents.

Manipulation Techniques

Chromosome manipulation in aquaculture – hybridization; Ploidy induction; Gynogenesis, Androgenesis and sex reversal in commercially important fishes.

Module III

Microbial techniques

Application of microbial biotechnology in culture ponds; Bioaugmentation; Bioremediation for soil and water quality improvement - nutrient cycling; bio-fertilization;

Diseases diagnosis

Tools for disease diagnosis in cultivable organisms; Enzyme immunoassays; Dot immune-binding assay; Western blotting; Latex agglutination test; Monoclonal antibodies; DNA based diagnosis; Cryopreservation.

REFERENCES :

1. Mime, PH., Fish and shellfish farming in coastal waters, Fishing News Ltd., London, 1972.

2. Bradach, J.E., H.H. Ryther and W.D. MC Larney, Aquaculture, farming and husbandry

and fresh and marine organisms, Wiley lnterscience, New York. 1972.

3. Iverson, E.S., Farming the edge of the sea, Fishing News Ltd., London. 1976.

4. Fingerman M., Recent advances in Marine Biotechnology, Science Publishers, 2000.

5. Aquaculture, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

6. Kenneth, B.D., 2000. Environmental impacts of Aquaculture. CRC. pp. 214.

7. Stickney, R.R., 2000. Encyclopedia of Aquaculture. John Wiley Sons Inc. pp. 1063.

8. Rautenstraub, B. and T. Liehr, 2002. Fish technology, 494pp.

MBT 332 : APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY

Module I

PCR, types and their applications in clinical diagnosis, mutagenesis, monitoring of GEMS phylogenetic analysis, genetic markers assisted screening, pathogen detection and biodiversity. Metagenomic studies, Studying large genomes: Plasmid/marker rescue techniques & Tn-tagging for isolation of genes., Physical maps by PFGE., Ordering cosmids., Binary finger printing using oligo probes., Linking cosmids with cosmid contigs., Ordering cosmids & YACS along chromosome using *in situ* hybridization.

Module II

DNA microarrays and applications. Gene therapy, viral and non-viral strategies and application. Transgenic plants: Terminator gene technology, RNAi, Metabolic Engineering – Modification of plant Nutritional content – Amino acids and lipids as Bioreactor- polymers and foreign proteins in seeds. Selectable Markers, reporter genes- Promoters used in Plant vectors genetic engineering for- heat, drought and saline tolerance (Osmogenes)- Virus resistance.- Pest resistance- Herbicide resistance- Herbicide tolerance- Delayed fruit ripening- Fungal and bacterial resistance- Secondary metabolite production., Production of therapeutic proteins- antibodies- vaccines edible Vaccines- hormones- Golden Rice- Biolistic in transgenic plants. Marker free transgenic plants. Co-transformation- Transgenic silencing & their applications, Transgenic animals and their applications. Genetic engineering & pharmaceutical proteins, Restriction enzymes, Bioplastic and other commercial products.

Module III

Molecular markers**:** use of nucleic acid probes and antibodies, In clinical diagnosis and tissue typing - Mapping of human genome-RFLP and applications. Animal cloning. Biotechnology of silkworms, transgenic silk production - Baculo viruses vector and foreign gene expression. Microbes in oil recovery & mining. Management and Commercialization aspects of Biotechnology & Enterpreneurship in Biotechnology.

REFERENCES:

1. Pharmaceutical biotechnology: concepts and applications Gary Walsh. John Wiley and Sons, 2007
2. Biotechnology: expanding horizons B. D. Singh Kalyani, 2008.
3. Molecular Biotechnology: Principles and applications of recombinant DNA. (2009) Glick, B.R., Pasternak, J.J, Patten C.L. ASM press.
4. Principles of gene manipulation and genomics. S. B. Primrose, Richard M. Twyman. Wiley-Blackwell, 2006.
5. From genes to genomes: concepts and applications of DNA technology Jeremy Dale, Malcolm von Schantz. Wiley-Interscience, 2007
6. Biotechnology: The science and business (1999). Moses, V. & D.G. Springham. Harwood Academic.
7. Biotechnology and Genetic Engineering reviews (1988). Russel, G.E.
8. Biotechnology: applying the genetic revolution David P. Clark, Nanette Jean Pazdernik Elsevier, 2008.

MBT 232 : BIOSAFETY AND IPR

Module I

Introduction to Intellectual Property

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP

IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS

Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.);

Module II

Basics of Patents

Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application

Patent filing and Infringement

Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes; Publication of patents-gazette of India, status in Europe and US

Patenting by research students, lecturers and scientists-University/organizational rules in India and abroad, credit sharing by workers, financial incentives

Patent infringement- meaning, scope, litigation, case studies and examples

Module III

Biosafety

Introduction; Historical Backround; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines – Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and

communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

REFERENCES :

1. Intellectual property rights in Biotechnology. A status report (1993). Singh, K.
2. Biotechnology and Patent laws:patenting living beings (2008) Sreenivasulu, N.S. and Raju C.B. Manupatra Publishers.
3. Patents for Chemicals, Pharmaceuticals a nd Biotechnology:Fundamentals of Global Law, Practice and Strategy (2010) Grubb P. W. Grubb, P. L. Thomsen, P. R. Oxford University Press.
4. Patent law in Biotechnology, chemicals & pharmaceuticals. (1994) Harold C. Wegner Stockton Press
5. A User's Guide to Patents (2007) Trevor M. Cook. Tottel Publishing.
6. Intellectual property law (2008) Lionel Bently, Brad Sherman. Oxford University Press.
7. Biosafety and bioethics (2006) Rajmohan Joshi. Gyan Publishing House.
8. Laboratory biosafety manual. (2004). World Health Organization. WHO press, 2004.
9. Biological safety: principles and practices (2000) Diane O. Fleming, Debra Long Hunt. ASM Press.
10. CRC handbook of laboratory safety. (2000)A. Keith Furr. CRC Press.

MBT 131: CELLULAR BIOPHYSICS

Module I

Ohm's law, diffusion, electric fields, potentials and charge

1) Overview of the Cellular organization of the nervous system:

Typical nerve cell
Types of cells: Neuronal, Glial cells, ependymal cells and Schwann cells.

Role of meninges and CSF.

Classification and types of neurons , cytons and axons

function of nerve cells

2) Ion Channels

Sodium channels

Potassium channels

Calcium channels

Chlorine channels

Ligand-gated channels

Ionic basis of resting membrane potential: Donann's equilibrium experiments, Nernst's potential ,Goldman's equation, Sodium –Potassium pump.

3) Biophysics of neurons

Electrical properties of the axon, ion fluxes, potentials of nerve cell membrane
Resting membrane potential
Chemical –to- electrical transduction
Signal summation

Action Potential and propagation (a) Hodgkin and Huxley's model, voltage clamp experiment and the derivation and propagation of Action Potential

Compound Action potential

Sodium and Potassium ionic currents

4) Electrical- to- chemical Transduction (a) Graded potential (b) Synaptic potential and synaptic integration [Electrical and Chemical Synaptic Potential, Excitatory Post Synaptic Potential (EPSP) Inhibitory Post Synaptic Potential (IPSP), Neuro-muscular junctions

5) Transmission of nerve impulse

Module II

1) Communication between neurons **:**

Types of synapses and synaptic transmission (electrical and chemical)

Synaptic transmission at central synapse (Type of receptors)

Synaptic transmission through second messenger (including mechanism of signal transduction, Neuromodulation and synaptic inhibition

Neurotransmitter –physiological role, pharmacological significance, (example of one agonist and one antagonist for a neurotransmitter)
Acetylcholine(Nicotinic and muscarinic receptors)

2) Muscle- structure and electro-physiology of contraction.

3) Sensory system :

Introduction – sensory systems and mediation of 4 attributes of a stimulus

i. modality; ii. Location; iii. Intensity; iv. Timing.

Common plan of sensory system. General idea of a receptor and transduction of specific types of energy into electrical signals.

4) Visual system: Vertebrate eye and retina.

Morphology and arrangement of photoreceptors.

Electrical response to light.

Concept of receptive fields.

Colour vision.

Visual pathway, lateral geniculate nucleus and visual cortex.

Visul perception as a creative process.

Perception of motion, depth, form and colour.

Visual attention and conscious awareness.

Module III

Organisation of the nervous system in Marine organisms:

Structure of nerve net, neural plexus, an ganglionated nervous system e.g. hydra, starfish, aplysia and Zebrafish

Development of behavioral paradigms :

Type study of behavior of Aplysia: elementary behavior, neuroendocrine reflexes, complex behavior; higher grade and learned behavior.

Molecular basis of neuronal development and degeneration: Type model: Zebrafish

REFERENCES :

1. Introductory Biophysics , V. Pattabhi & N. Gautham, Narosa Publications
2. Ionic Channels of Excitable Membranes, Third Edition. Bertil Hille. Sinauer Associates. Sunderland, MA. 2001.
3. Physical Biology of the Cell by Rob Phillips, Jane Kondev and Julie Theriot, Garland Science, Taylor & Francis Group, New York, 2009.
4. Handbook of Molecular Biophysics- Methods and applications by H.G. Bohr Wiley-VCH Verlag GmbH & Co, KGaA, Weinheim (2009)
5. The Physiology of Excitable Cells, Aidley, D. J. (1998). Cambridge University Press.
6. Principles of Neural Sciences Ed: E. Kandel, J. Schwarts and T. Jessel. 4th edition (2000) McGraw Hill
7. Textbook of Medical Physiology Ed: Guyton and Hall 9th edition (1998) W. B. Saunders Company
8. Molecular Neurobiology Ed: J.B.Martin (1998) Scientific American
9. Elements Of Molecular Neurobiology C.U.M. Smith,J Wiley and Sons Publishers, N.Y.

10. An Introduction to Molecular Neurobiology Z.W. Hall Sinauer Associates Inc. Publishers

MBT 333: GENOMICS AND PROTEOMICS

Module I

Introduction

Structural organization of genome in Prokaryotes and Eukaryotes; Organelle DNA-mitochondrial, chloroplast; DNA sequencing-principles and translation to large scale projects; Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree analysis-physical and genetic mapping.

Module II

Genome sequencing projects

Microbes, plants and animals; Accessing and retrieving genome project information from web; Comparative genomics, Identification and classification using molecular markers-16S rRNA typing/sequencing, ESTs and SNPs.

Pharmacogenetics

High throughput screening in genome for drug discovery-identification of gene targets, Pharmacogenetics and drug development

Module III

Proteomics

Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Microscale solution isoelectricfocusing; Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid system.

Functional genomics and proteomics

Analysis of microarray data; Protein and peptide microarray-based technology; PCR-directed protein *in situ* arrays; Structural proteomics

REFERENCES :

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006

2. Brown TA, Genomes, 3rd Edition. Garland Science 2006

3. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007

4. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.

5. Bioinformatics, genomics, and proteomics: getting the big picture. Ann Batiza. Infobase Publishing, 2005

6. Genomics and proteomics: functional and computational aspects Sándor Suhai Springer, 2000

7. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998

MBM 131 : SCUBA DIVING

(This is an entry-level to give students the necessary skills to conduct open water dives in conditions similar to their training).

The course includes underwater environment, physics and physiology, Scuba equipment, skill development, dive planning, safety & first aid, CPR/AED/oxygen first aid, self and buddy assists rescues. (This course is a prerequisite for Research Diving.)

This will provide the theoretical aspects and practical training to assess the biological, physical, geological and archaeological characteristics of the nearshore marine environment. Lectures will focus on data gathering techniques, collecting common biota, installation of scientific apparatus, site location, scientific dive planning, etc. This will provide the theoretical aspects and practical training to assess the biological, physical, geological and archaeological characteristics of the near shore marine environment.

PREREQUISITES: Diving medical clearance, and successful completion of a water proficiency test consisting of the following skills:

* Swim underwater without swim aids for a distance of 25 yards without surfacing;

* Swim 400 yards in less than 12 minutes without swim aids;

* Tread water for 10 minutes, or 2 minutes without the use of hands, without swim aids;

* Without the use of swim aids, transport another person of equal size a distance of 25 yards in the water.

REQUIRED EQUIPMENT:

* Students to purchase: Mask, snorkel, fins, gloves, hood, booties, dive bag, weights & belt

* Students to rent: Cylinder; BCD; regulator with 2 secondary stages, pressure gauge, depth gauge & compass; and wetsuit.

GENERAL OBJECTIVES: Educate and train students with minimal entry knowledge and skills, in Scuba Diving, First Aid, Cardio-Pulmonary Resuscitation, Automatic External Defibrillation and Oxygen First Aid. Knowledge, skill performance and safety awareness levels will be equal to or exceed national training standards. Students are instructed using a multi-media approach, which includes: lectures, discussions, small group activities, guided and individual practice on mannequins and with classmates, DVD and live demonstrations, text readings and

discussions, written assignments and self-quizzes. Evaluations will be accomplished through instructor, peer and self-assessments and standardized tests and other activities.

Practical :

Once the student completes, he/she must proceed to Gulf of mannar or Lakshadweep for practicals, combined with theory or validation classes. Here following can be demonstrated. 1. Coral reef status survey methods (Two days) 2. Health of corals (One day) 3. Diseases of corals (One day) 4. Biodiversity & Symbiosis (One day) 5. Sample collection for the microbial associations (one day). Six days are planned because one dive is planned for a diver per day. Here the expenses to travel to GoM or Lakshadweep has to be born by the student (Rs 10,000 for a week).

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