

Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College of Arts, Science and Commerce

(Autonomous College)

Affiliated to University of Mumbai



Syllabus for M.Sc. II

Semester III & IV

Program: M.Sc.

Course: Zoology

Biotechnology and Oceanography & Fishery Sciences

SEMESTER –III

TOPIC

Course	Unit		Credits
RJSPZOBT305 Basics of industrial & environmental biotechnology I	I	The implications of recombinant DNA technology of commercial products and microbial synthesis	4
	II	Large scale culture & production from recombinant microorganisms & genetically engineered animal cells	
	III	Medical Biotechnology	
	IV	Environmental Biotechnology I	
RJSPZOBT306 Genetic engineering techniques and its applicatons	I	Genome management and analysis	4
	II	Manipulation of gene expression in prokaryotes	
	III	Bioinformatics	
	IV	Animal biotechnology and human therapies	
RJSPZOOC307 General, physical, chemical and biological oceanography	I	General Oceanography	4
	II	Physical Oceanography	
	III	Chemical Oceanography	
	IV	Biological Oceanography	
RJSPZOOC308 Planktology, fish, fishery science and aquaculture	I	Planktology	4
	II	Fish and Fishery Science	
	III	Biotechnology in Fishery and Biometric Studies	
	IV	Aquaculture	
RJSPZOBT305	Practicals based on RJSPZOBT305		2
RJSPZOBT306	Practicals based on RJSPZOBT306		2
RJSPZOOC307	Practicals based on RJSPZOOC307		2
RJSPZOOC308	Practicals based on RJSPZOOC308		2

SEMESTER –IV

Theory			
Course	Unit	TOPIC	
RJSPZOBT405 Basics of industrial & environmental biotechnology II	I	Microbial synthesis of commercial products	4
	II	Large scale culture & production for industrial biotechnology	
	III	Agricultural Biotechnology	
	IV	Environmental Biotechnology II	
RJSPZOBT406 Genome management, manipulation, regulations and patents in biotechnology	I	Genome management	4
	II	Manipulation of gene expression in eukaryotes	
	III	The human genome project	
	IV	Regulations and patents in biotechnology	
RJSPZOOC407 General, physical, chemical and biological oceanography	I	General Oceanography	4
	II	Physical Oceanography	
	III	Chemical Oceanography	
	IV	Biological Oceanography	
RJSPZOOC408 Planktology, fish, fishery science and aquaculture	I	Planktology	4
	II	Fish and Fishery Science	
	III	Biotechnology in Fishery and Biometric Studies	
	IV	Aquaculture	

Practical

RJSPZOBT405	Practicals based on RJSPZOBT405	2
RJSPZOBT406	Practicals based on RJSPZOBT406	2
RJSPZOOC407	Practicals based on RJSPZOOC407	2
RJSPZOOC408	Practicals based on RJSPZOOC408	2

SEMESTER – III
Zoology-Biotechnology--Oceanography and Fishery Science
Biotechnology Paper V

RJSPZOOBT305 : Basics of Industrial & Environmental Biotechnology I

Unit I: The implications of recombinant DNA technology of commercial products and microbial synthesis

- 1.1. The implications of recombinant DNA technology
 - 1.1.1 *General account on applications of biotechnology
 - 1.1.2 *Commercialization of biotechnology & biotech companies
 - 1.1.3 Prospects of novel food technology
 - 1.1.4 Economics of microbial biotechnology
 - 1.1.5 Areas of significant public concern: Antibiotic resistance marker gene, transfer of allergies, pollen transfer from GM plants, social, moral & ethical issues associated with GMOs.
- 1.2 Amino acids & their commercial use – production strain, process of L-glutamate, L-aspartate, L-phenylalanine, L-tryptophan.

Unit II: Large scale culture & production from recombinant microorganisms & genetically engineered animal cells

- 2.1. Large scale culture & production from recombinant microorganisms:
 - 2.1.1 Batch fermentation
 - 2.1.2 Fed batch fermentation
 - 2.1.3 Continuous fermentation
 - 2.1.4 *Maximizing the efficiency of fermentation process
 - 2.1.5 Harvesting, disrupting & downstream processing
- 2.2. Large scale culture & production from genetically engineered animal cell cultures:
 - 2.2.1 Design of bioreactors for large scale animal cell culture-Batch, Fed batch
 - 2.2.2 Mammalian cell lines & their characteristics
 - 2.2.3 Media for the cultivation of mammalian cells
 - 2.2.4 *Commercial products produced with mammalian cell culture

Unit III: Medical Biotechnology

- 3.1. Sub-unit vaccines
 - 3.1.1 *Sub-unit Vaccine production against viruses-Herpes simplex, Bovine foot & mouth disease virus
 - 3.1.2 Peptide vaccines-synthetic drugs (engineered proteins)
 - 3.1.3 Genetic immunization-DNA vaccines, Antisense DNA, Therapeutic ribozymes
 - 3.1.4 *Live recombinant vaccines
 - 3.1.5 *Attenuated vaccines against Cholera, Salmonella sp.

3.1.6 Vector vaccines-Vaccine directed against viruses- Rabies virus G-protein, Hepatitis B surface antigen

3.1.7 Anti-idiotypic vaccine for cancer treatment

3.2. Monoclonal antibodies (mAbs) & therapeutic applications:

3.2.1 mAbs for prevention of rejection of transplanted organs

3.2.2 Treatment of bacterial blood infection

3.2.3 Human monoclonal antibodies

3.2.4 Hybrid human-mouse monoclonal antibodies

3.2.5 HIV therapeutic agents

3.2.6 Anti-tumour antibodies

Unit IV: Environmental Biotechnology I

4.1. Biomass utilization

4.1.1 Microorganisms in lignocellulose degradation

4.1.2 Isolation of prokaryotic & eukaryotic cellulase gene

4.1.3 Manipulation of cellulase gene

4.1.4 Production of single cell proteins by using biomass as raw material

4.1.5 Commercial production of fructose and alcohol from biomass

4.1.6 Improvements of fructose and alcohol production

4.1.7 Fuel ethanol from biomass

4.2. Bioremediation of aerobic compounds

4.2.1 Characteristics of xenobiotics in the environment

4.2.2 Characteristics of aerobic microorganisms for degradation of organic pollutants

4.2.3 Genetic engineering of biodegradative pathways-

Manipulation by transfer of plasmid, manipulation by gene alteration

4.2.4*Degradation of xenobiotic compounds-petroleum products, n-alkanes, alkenes, cycloaliphatic compounds, aromatic hydrocarbons, polyaromatic hydrocarbons, chlorinated organic compounds (aliphatic & aromatic)

***marked topics are to be taken for seminar**

Biotechnology Paper VI

RJSPZOOBT306: GENETIC ENGINEERING TECHNIQUES AND ITS APPLICATIONS

Unit I: Genome management and analysis

1.1 The Basic tools of genetic engineering

- 1.1.1 Chemical Synthesis of DNA-Oligonucleotide synthesis by Phosphoramidite method, Synthesis of genes
- 1.1.2 *DNA Sequencing -- Maxam-Gilbert method, Sanger's dideoxynucleotide method, By using bacteriophage M13 by Primer walking
- 1.1.3 Polymerase chain reaction and its advantages

1.2 Cloning Vectors

- 1.2.1 *General purpose plasmid vectors (pUC19, pBR322) (Bacterial Vectors)
- 1.2.2 Bacteriophage and cosmid vectors
- 1.2.3 Yeast artificial chromosomes (YACs)

1.3 Analysis of genome/proteome

- 1.3.1 DNA fingerprinting/physical mapping/pulsed field gel electrophoresis
- 1.3.2 Analysis of the proteome
- 1.3.3 Analysis of mRNA transcripts

Unit II: Manipulation of gene expression in prokaryotes

2.1 Promoters of gene expression in prokaryotes

- 2.1.1 Prokaryotic gene expression
- 2.1.2 Isolation of functional promoters
- 2.1.3 Promoter selection with E.coli plasmid pBR316
- 2.1.4 *Promoter selection with plasmid pKO1
- 2.1.5 Gene expression from strong and regulatable promoters

2.2 Expression of cloned genes in prokaryotes

- 2.2.1 Increasing protein production and secretion
- 2.2.2 *Inclusion bodies and fusion proteins
- 2.2.3 Unidirectional tandem gene arrays
- 2.2.4 Translation expression vectors
- 2.2.5 Increasing protein stability

Unit III: Bioinformatics

- 3.1 Uses and application of computers in biological sciences
- 3.2 *DNA profiling: cDNA and EST's (expressed sequence tags)
- 3.3 Basic research with DNA microarrays and its application in healthcare.
- 3.4 Biomedical genome research and pharmaco genomics
- 3.5 *Random amplified polymorphic DNA (RAPD)
- 3.6 Human genomic variation-SNP's (single nucleotide polymorphisms, SNP's and disease; QTL (quantitative trait loci) and its relation to SNP's
- 3.7 Satellite DNA and its types

Unit IV: Animal biotechnology and Human therapies

4.1 Animal Biotechnology

- 4.1.1 *Transgenic animals and their applications:
Mice as model system for human diseases and as test case model, Cows, pigs, sheep, goats as biopharmaceuticals, Transgenic insects and birds
- 4.1.2 Recombinant DNA technology to prevent animal diseases
- 4.1.3 Conservation biology-Embryo transfer
- 4.1.4 Regulation of transgenic animals and patenting genetically engineered animals

4.2 Human therapies

- 4.2.1 Tissue engineering: Skin, liver, pancreas
- 4.2.2 *Xenotransplantation
- 4.2.3 Antibody engineering
- 4.2.4 Cell adhesion based therapies: Integrins, Inflammation, Cancer and metastasis
- 4.2.5 Targeted gene replacement for correcting a mutated gene
- 4.2.6 Site directed mutagenesis

***marked topics are to be taken for seminar**

Oceanography Paper VII

RJSPZOOOC307- GENERAL, PHYSICAL, CHEMICAL AND BIOLOGICAL OCEANOGRAPHY

UNIT I: General Oceanography

- 1.1 Terminology of submarine topography
Continental shelf, continental slope, submarine canyons, submarine mountain ranges, Guyots and trenches with special reference to the Indian Ocean and adjacent seas.
- * 1.2 A general knowledge of typical oceanographic research vessel and its equipments, oceanographic labs and stations of the world and India.

UNIT II: Physical Oceanography

- 2.1 Physical properties of sea water:
Salinity, Chlorinity, Temperature, Light, Density, Pressure, Salinity-Temperature-Density relationship (STD) .
- 2.2 Oceanographic circulation:
Ekman spiral, geotropic current, westward intensification with dynamic topography.

UNIT III: Chemical Oceanography

- * 3.1 Composition of sea water- constancy of its composition and factors affecting the composition, major and minor constituents, trace elements and their biological role.
- 3.2 Dissolved gases in the sea water and their role in the environment, CO₂ system, dissolved O₂ and oxygen profile, hydrogen sulphide.
- 3.3 Nutrients in the ocean, their cycles and factors influencing their distribution
a) Nitrogen b) Phosphorus c) Silicon.

Unit IV: Biological Oceanography

- *4.1 Sea as a biological environment.
- *4.2 Division of marine environment.
- 4.3 a) Marine biotic diversity: Plankton, Nekton, Benthos- brief account
Implications of species richness, measuring diversity, quadrants of species diversity, models explaining diversity gradient.
*b) Intertidal organisms and their zonation.
- 4.4 Effect of physical factors on marine life
a) Light: photosynthesis, colouration, structural adaptations, bioluminescence
b) Temperature: tolerance, geographical distribution, size, calcium precipitation, metabolism, bipolarity, tropical submergence and periodicity.
c) Salinity: tolerance and distribution, size, buoyancy and osmoregulation. d)
Currents: role in nutrition, transportation and propagation.
*e) Marine bacteria and their role.

***marked topics are to be taken for seminar**

Oceanography Paper VIII

RJSPZOOOC308-- PLANKTOLOGY, FISH, FISHERY SCIENCE AND AQUACULTURE

UNIT I: Planktology

- 1.1. Classification of Plankton.
Adaptation to planktonic life.
Factors influencing the distribution and abundance, plankton bloom, patchiness, vertical distribution and red tide.
- 1.2. *Diurnal migration of zooplankton.
Inter-relationship between phyto and zooplankton.

UNIT II: Fish and Fisheries Science

- 2.1. An overview of fish classification as per Francis Day and FAO.
- 2.2. a) Major commercial fisheries: Elasmobranchs (shark and ray)
Teleosts: Sciaenoids, Indian salmon, Seer fish, Mackerel, Sardine, Carangids, Tuna, Sole fish, Harpodon, Ribbon fish fisheries.
b) *Crustacean fisheries: Prawns (penaeid and non penaeid), Shrimps, Lobster and Crab.
c) *Molluscan fisheries.

UNIT III: Biotechnology in Fishery and Biometric Studies

- 3.1. Fish stock improvement through selective hybridization.
- 3.2. Gene transfer technology in fish: General steps for developing transgenic fishes.
Gene transfer by microinjection, electroporation, transfer of transgenes by injection with pantropic retroviral viruses, fish antifreeze protein gene, promoter in the production of growth hormone.
*Characterization of transgenic fish. (Identification of transgenic fish and expression of transgenes). Gene transfer in common carp and channel fish.

UNIT IV: Aquaculture

- 4.1. *History, scope and importance of aquaculture.
Aquaculture practices in India.
Cultivable organisms for aquaculture and criterion for their selection.
- 4.2. Different systems of aquaculture such as Pond Culture, Cage Culture, Pen Culture, Running Water Aquaculture, Raft Culture, Aquaranching.
- 4.3. Impact of aquaculture on environment.

***marked topics are to be taken for seminar**

SEMESTER III- PRACTICALS

Biotechnology

Course Code- RJSPZOOBTP305, RJSPZOOBTP306

- 1) Demonstration of aseptic technique: Work place for aseptic handling, packing glassware (flasks, test tubes, pipettes, petridish) for sterilization, aseptic transfer of liquids (pipetting from flask to test tube)
- 2) Preparation of LB agar plate, slant, butt & demonstration of streaking technique using bacterial culture to obtain isolated colonies.
- 3) Determination of viable cell count in the given culture of bacteria by dilution & spreading technique.
- 4) Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing agarose gel electrophoresis.
- 5) To estimate the number of bacteria in the given culture by nephelometry.

Oceanography Practical VII

Course code- RJSPZOOOCP307

1) Physical and chemical oceanography:

Determination of physico-chemical parameters:

- a) Salinity (Argentometric and conductivity method)
- b) Dissolved oxygen,
- c) Carbon dioxide.
- d) Nitrates-nitrites.
- e) Silicates.
- f) Phosphate-phosphorus.

2) Textural features:

Sediment analysis- size fraction (sand, silt, clay)

3) Identification of foraminiferans and radiolarians from sand.

4) Estimation of primary productivity by light and dark bottle.

5) Identification of intertidal organisms:

- a) Rocky shore- Patella, Chiton, Fissurella, Mytilus species, *Perna viridis*, Cardium, Balanus, Gorgonids, Littorina and Corals.
- b) Sandy shore: Solen, Umbo, Oliva, Pea crab, Fiddler crab, Molluscan shells, Star fish and Balanoglossus.
- c) Muddy shore: Lingula, Chaetopterus, Arenicola, Tubiculus worm and Mud skipper.

Oceanography Practical VIII

Course code- RJSPZOOOCP308

- 1) Laboratory procedure for quantitative estimation of plankton settling method, wet weight method, weight displacement method, counting method.
- 2) Identification of Zooplankton permanent slides (Noctiluca, Obelia medusa, Zoea, Zoea porcelina, Copepods, Mysids, Echinoderm larvae, Nauplius, Sagitta, Doliolum, Salpa, Fish eggs and larvae, Jelly fish, Physalia, Porpita)
- 3) Study of fecundity-maturation studies.
- 4) Plotting the frequency polygon by ova diameter measurement.
- 5) Identification and classification of Marine fishes

List of Marine fishes

Elasmobranchs

1. Family- Carcharidae
Carcharias sps. *Zygaena malleus*

2. Family- Rhinobatidae
Rhynchobatus djeddensis

3. Family- Trygonidae *Trygon uarnak* **Teleost**

4. Family- Percidae
Lutianus johnii, *Therapon* sps., *Pristipoma maculatum*, *Synagris japonicus*, *Gerres filamentosus*

5. Family- Squamipinnes
Scatophagus argus

6. Family – Mullidae
Upenoides vittatus

7. Family- Polynemidae
Polynemus tetradactylus

8. Family- Sciaenidae
Pseudosciaena diacanthus, *Sciaena* sps.

9. Family- Trichuridae
Trichurus savala/ haumela

10. Family- Carangidae
Caranx rottleri, *Chorinemus tolool*

11. Family- Stromatidae
Pampus chinensis, *Pampus argenteus*

12. Family- Scombridae
Rastrelliger kanagurta, *Cybbium guttatum*

13. Family- Trachinidae
Sillago sihama

14. Family- Cottidae
Platycephalus punctatus
15. Family- Gobidae
Periophthalmus sps., *Boleophthalmus* sps.
16. Family- Sphyraenidae
Sphyraena acutippinis
17. Family- Mugillidae
Mugil sps.
18. Family- Gadidae
Bregmaceros sps.
19. Family- Pleuronectidae
Psettodes erumei, *Cynoglossus elongatus*
20. Family- Siluridae
Arius dussumieri
21. Family- Scopelidae
Saurida tumbil, *Harpodon nehereus*
22. Family- Sombresocidae
Belone stongylurus, *Hemiramphus* sps.
23. Family- Clupeidae
Pellona feligera, *Clupea longiceps*
24. Family- Chirocentridae
Chirocentrus dorab
25. Family- Muraenesox
Muraenesox sps.

Note: Minimum number of animals to be used for experiments

SEMESTER -IV
Zoology-Biotechnology--Oceanography and Fishery Science

Biotechnology Paper V

RJSPZOOBT405: Basics of Industrial & Environmental Biotechnology II

Unit I: Microbial synthesis of commercial products

1.1. Microbial synthesis of commercial products

1.1.1 Organic acids & their commercial applications – Citric acid, gluconic acid, lactic acid.

1.1.2 Antibiotics – Cloning antibiotic biosynthetic gene by complementation & other methods. Synthesis of novel antibiotics & improving antibiotic production.
*Aminoglycosides & their uses

1.1.3 Polysaccharides:

Bacterial polysaccharides: General properties & their commercial applications-
Dextran, Xanthan, Alginate

Genetic engineering for the large scale production of Xanthan gum & its modification.

*Marine polysaccharides: General properties & their commercial application-
Agar & agarose, Chitosan

1.1.4 Polyesters: Polyhydroxyalkanoates (PHA)-Biosynthesis of PHA, Biopol-
commercial biodegradable plastic.

Unit II: Large scale culture & production for industrial biotechnology

2.1. Biotransformations

2.1.1 Selection of biocatalyst-screening & use of novel existing biocatalyst

2.1.2 Genetic modification of existing biocatalyst (Indigo biosynthesis)

2.1.3 Biocatalyst immobilization-

Methods of immobilization- Cross linking, supported immobilization,
adsorption & ionic binding, covalent coupling, lattice entrapment

2.1.4 Immobilized soluble enzymes & suspended cells

2.1.5 Immobilization of multi-enzyme systems & cells

2.1.6 *Immobilized enzyme reactors- Batch reactors, continuous reactors

2.1.7 Analytical enzymes-

Enzymes in diagnostic assays: Test strip systems & Biosensors-Electrochemical & optical type

Unit III: Agricultural Biotechnology

3.1. Agricultural Biotechnology:

3.1.1 *Nitrogen fixation

3.1.2 Nitrogenase-Component of nitrogenase; Genetic engineering of nitrogenase cluster

3.1.3 Hydrogenase-Hydrogen metabolism

3.1.4 Genetic engineering of hydrogenase gene

3.1.5 Nodulation-Competition among nodulation organisms, genetic engineering of nodulation gene

3.1.6 Microbial insecticides-Toxins of *Bacillus thuringiensis*, mode of action & use of thuringiensis toxins, thuringiensis toxin gene isolation, genetic engineering of *Bacillus thuringiensis* strains & cloning of thuringio toxin gene.

3.1.7*Developing insect resistant, virus resistant & herbicide resistant plant

3.1.8 Algal products: Fuels from algae, marine natural products & their medical potential-anticancer, antiviral compounds, antibacterial agents.

Unit IV: Environmental Biotechnology II

4.1. Bioabsorption of metals (Recovery from effluents)

4.1.1 *Bioabsorption by fungi, algae, moss & bacteria

4.1.2 Mechanism of bacterial metal resistance & genetic engineering for specific proteins

4.1.3 Bioreactors for bioabsorption-packed bed, fluidized bed, rotating disc, single blanket, sequential reactors

4.1.4 Phytoremediation & its use in biotechnology

4.2. Bioleaching of metals

4.2.1 Biochemical mechanism of bioleaching

4.2.2 Extraction from mixtures

4.2.3 Types of bioleaching

4.2.4 Methods for bioleaching-Tank & heap bioleaching

4.2.5*Microorganisms used for bioleaching

***marked topics are to be taken for seminar**

Biotechnology Paper VI

RJSPZOOBT406: Genome management, manipulation, regulations and patents in biotechnology

Unit I: Genome management

1.1 The Basic tools of genetic engineering

- 1.1.1 Gene transfer techniques: Protoplast fusion, calcium phosphate, precipitation, electroporation, liposome, ligand mediated, gene gun or biolistic approach, viral mediated
- 1.1.2 Selection and screening of recombinants
- 1.1.3 *Nucleic acid probes and hybridization, Southern blotting and Northern blotting
- 1.1.4 Immunological assays for identification of gene product, Western blot

1.2 Cloning Vectors

- 1.2.1 *Retrovirus and SV40 vectors
- 1.2.2 Special purpose vectors- Expression vectors, Secretion vectors, Shuttle or bi-functional vectors, single stranded phage and phagemids

Unit II: Manipulation of gene expression in eukaryotes

- 2.1 Eukaryotic gene expression
- 2.2 *Introduction of DNA into fungi-yeast and filamentous fungi (fungal transformation)
- 2.3 Heterologous proteins production in yeast
- 2.4 Heterologous proteins production in filamentous fungi
- 2.5 Cultured insect cells expression systems- Baculovirus transfer vector
- 2.6 *Mammalian cell expression systems- Human Papova BK virus shuttle vector

Unit III: The human genome project

- 3.1 *The human genome, scope and goals of the project
- 3.2 Genetic linkage maps, chromosome walking, restriction mapping
- 3.3 Polymorphic DNA markers
- 3.4 Restriction fragment length polymorphism (RFLP) and its uses
- 3.5 Physical maps, Sequence tagged sites
- 3.6 Integrating genetic linkage and physical maps
- 3.7 *Mapping human diseases
- 3.8 Positional cloning: Getting closer to a disease causing gene
- 3.9 Testing for exons
- 3.10 Limitations of positional cloning

Unit IV: Regulations and patents in biotechnology

- 4.1 Regulating recombinant DNA technology
- 4.2 *Regulatory requirements – safety of genetically engineered foods
Chymosin, tryptophan, bovine somatotropin
- 4.3 Regulation environmental release of genetically engineered organism (GEO).
Ice minus *Pseudomonas syringae*
- 4.4 Regulatory agencies and laws for product regulation
- 4.5 Risk assessment: How much risk?
- 4.6 *Open field tests of GEO
- 4.7 Development of policy for Human gene therapy
- 4.8 Patenting biotechnology inventions
 - a) What constitutes the patent?
 - b) The patent process
 - c) The conditions to be satisfied for an invention to be patentable
:Novelty, Inventiveness, Usefulness
 - d) Patenting in different countries, types of inventions that are not patentable in India
 - e) What is Paris convention? Principal features of Paris convention f) Patenting multicellular organisms
 - g) Patenting and fundamental research

***marked topics are to be taken for seminar**

Oceanography Paper VII

RJSPZOOOC407: GENERAL, PHYSICAL, CHEMICAL AND BIOLOGICAL OCEANOGRAPHY

UNIT I: General Oceanography

1.1 Oceanographic instruments:

Grab (Peterson and Van veen) for benthos collection, naturalist's dredge (Ekman Sanders deep sea anchor dredge), trawl, plankton nets and continuous plankton sampling system, Reversing Nansen bottles, Reversing thermometer, Salinometer, Secchi disc, Stempel's pipette and dilution jar, underwater photography, remote sensing and satellite imaging, SCUBA apparatus.

*1.2 Oceanographic Expeditions: Challenger, Indian Ocean and Antarctic.

1.3 Law of sea.

UNIT II: Physical Oceanography

2.1 Vertical circulation: wind induced circulation, Thermohaline circulation and upwelling of water.

2.2 Waves: Characteristics of waves, deep water and shallow water waves, transitional waves, wind generated waves, internal waves and Tsunami

*2.3 Tides: Tides generating forces, equilibrium theory of tides, dynamic theory of tides, tides as a source of power.

* 2.4 Currents: Types of currents, major currents of the world, Coriolis effect and El Nino effect.

UNIT III: Chemical Oceanography

3.1 Impact of anthropogenic activities:

A) a) Pollution- Domestic sewage, industrial/heavy metals.

Agricultural- fertilizers and pesticides.

b) Oil pollution.

c) Ocean dumping.

d) Radioactive and Thermal waste.

B) Reclamation.

UNIT IV: Biological Oceanography

4.1 Resources from the sea:

A) Mineral resources:

a) Continental margin.

b) Deep sea mud oozes and manganese nodules.

c) Oil, gas and sulphur deposits and role of ONGC.

B) Bioactive compounds from the sea.

C) Scientific and economical aspect of seabed exploration and mining.

***marked topics are to be taken for seminar**

Oceanography Paper VIII

RJSPZOOOC408: PLANKTOLOGY, FISH, FISHERY SCIENCE AND AQUACULTURE

UNIT I: Planktology

- 1.1. Marine algae and plankton in relation to fisheries. Indicator species
- 1.2. Methods of collection, preservation and analysis of plankton.
- 1.3. *Marine Bio-deterioration: Fouling and Boring organisms.

UNIT II: Fish and Fisheries Science

- 2.1. Population Dynamics
Abundance in population and fishery. Fishery catches and fluctuation.
M.S.Y., Optimum Yield, Age Composition, Population Growth, Population Models.
- 2.2. *Socio-economics of fishermen.

UNIT III: Biotechnology in Fishery and Biometric Studies

- 3.1. Statistical methods:
Collection of data, Sampling methods, Presentation data, Measurement of central tendency and dispersion, Frequency distribution, Analysis of variance and co-variance, Correlation regression, Theory of probability, Tests of significance, Chi-square test.
- 3.2. * Measurement of fish:
 - a) Measurement of length and weight
 - b) Morphometric measurements
 - c) Merestic counts
 - d) Biometric index

UNIT IV: Aquaculture

- 4.1. Hatchery and grow out practices for cultivable species of freshwater fishes (Indian major carps and exotic carps) and prawns (*Macrobrachium rosenbergii*), Culture of Air breathing fishes.
- 4.2. Integrated aquaculture and sewage fed fishery Hatchery and growout practices for the culture of brackish water fishes (*Chanos chanos* and *Lates calcarifer*), Prawns (*Penaeus monodon* and *Penaeus indicus*).
- 4.3. *Present status of sea farming in India
Culture of molluscs, clams, oyster (edible and pearl) and Mussels, Echinoderms (sea cucumber), sea weeds.

***marked topics are to be taken for seminar**

SEMESTER IV - Biotechnology Practicals

Course Code RJSPZOOBTP405 & RJSPZOOBTP406

- 1) Immobilize Yeast cells in calcium alginate & prepare a bioreactor column to demonstrate Invertase activity in the bioreactor column.
- 2) Restriction-digest the given DNA sample & demonstrate the separation of fragments by performing agarose gel electrophoresis. Interpret the results by comparing with the standard digests provided.
- 3) Demonstrate the western blotting technique for the given sample of protein.
- 4) To plot a growth curve for the microorganisms provided.
- 5) Demonstrate the effect of medium on growth curves of given microorganism, using two different media (minimal & enriched)

Oceanography & Fishery Science Practicals

Course Code RJSPZOOOCP407

1) Oceanographic instruments:

- a) Nansen reversing bottle.
- b) Deep sea reversing thermometer.
- c) Bathythermometer.
- d) Drift bottle.
- e) Ekman's current meter.
- f) Secchi disc.
- g) Plankton nets: Standard net, Hensen net and Clarke Bumpus net.
- h) Stemple pipette and counting slide.
- i) Nekton sampling device-trawls.
- j) Benthic sampling devices-dredges, grabs and corers.

2) Detection of heavy metals:

- a) Zinc
- b) Lead
- c) Copper.

3) Food and feeding in fish.

4) Identification of crafts and gears.

Course Code RJSPZOOOCP408

- 1) Preparation of Zooplankton mountings.
- 2) Collection of marine algae and preparation of herbaria (at least five different forms).
- 3) Biometric studies of fish/ prawn
 - A. Study of relationship between total length and standard length/head length/body depth length/body weight.
 - B. Calculate correlation (standard length and total length, head length and total length, body depth and total length). Calculate the index values for various relationships.
- 4) Identification of fouling and boring organisms
(*Limnoria* sps., *Lepas*, *Balanus*, *Caprella*, *Teredo*, *Littorina*, *Crassostrea*, *Pellaria*/
Sertularia).
- 5) Identification and classification of fresh water fishes
(Rohu, Catla, Mrigal, Tilapia, Gourami) and fresh water giant prawn (*Macrobrachium rosenbergii*).
- 6) Crustacean fishery
(*Penaeus monodon*, *P. indicus*, *M. monoceros*, *P. stylifera*, *Solenocera indica*,
Nematopaleomon, *Acetes indicus*).
- 7) Molluscan fishery
(*Meretrix*, *Perna viridis*, *Katelysia* sps., *Crassostrea* sps., *Xancus pyrum*, *Solen kemp*i, *Cuttle fish* and gastropods).
- 8) Visit to aquaculture centres, boat building yards, processing plants and marine biological institutions (Excursions or study tours)
Students Activity
 - a. Collection of molluscan shells
 - b. Preparing herbaria from marine algae (atleast 5)
 - c. Preparation of shrimp pickle

Note: Minimum number of animals to be used for experiment

REFERENCES: Semester III & IV Biotechnology

1. Johan E. Smith, Biotechnology, 3rd Edition, Cambridge Univ. Press
2. Colin Rateledge and Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge Univ. Press
3. Susan R. Barnum, Biotechnology – An Introduction, Vikas Publishing House
4. Bernard R. Glick and Jack J. Pasternack, Molecular Biotechnology – Principles and applications of recombinant DNA, ASM Press, Washington DC.
5. Alexander N. Glazer and Hiroshi Nikaido, Microbial Biotechnology – Fundamentals of applied microbiology, W. H. Freeman and Co, New York
6. InduShekar Thakur, Environmental Biotechnology – Basic concepts and applications, I. K. International Pvt. Ltd, Mumbai, New Delhi
7. John A. Thomas (Ed.), Biotechnology and safety assessments, 2nd Edition, Taylor and Francis
8. S. S. Purohit, Biotechnology – Fundamentals and applications, 3rd Edition, Agrobios, India
9. Patent Facility Centre (PTC) Technology information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology, New Delhi
10. R. S. Crespi; Patents – a basic guide to patenting biotechnology, Cambridge Univ. Press
11. R. E. Speir, J. B. Griffiths, W. Berthold (Ed), Animal Cell Technology – Products of today, prospects of tomorrow, Butterworth –Heinman Publishers
12. Martin Fransman, GerdJunne, AnnemiekeRoobeek (Ed), The Biotechnology revolution?, Blackwell Scientific Publishers
13. Terence Cartwright, Animal Cells as Bioreactors, Cambridge Univ. Press
14. A. Rosevear, John F. Kennedy, Joaquim M. S. Cabral, Immobilized enzymes and cells, Adam Hilger Publishers, Bristol and Philadelphia
15. Micheal P. Tombs and Stepan E. Harding, An Introduction to polysaccharide biotechnology
16. T. A. Brown, Gene Cloning – An Introduction, 3rd Edition, Nelson Thornes
17. Bob Old and S. B. Primrose, Principles of Gene Manipulation, 5th Edition, Wiley Blackwell Publishers
18. U. Satyanarayan, Biotechnology, 2007 Reprint, Uppala Author Publisher Interlink

REFERENCES: Oceanography and Fishery Science Semester III & IV

1. Svedrup et al., The Oceans.
2. Nair N.B. and Thampi D.H., A text book of marine ecology, T-M-H.
3. Harold Thurman, Introductory oceanography, Prentice Hall. London.
4. Qasim S.Z., Glimpses of Indian Ocean, Sangum Bodes Ltd. London. Navya Printers, Hyderabad.
5. Michael King, Fisheries Biology assessment and management, Fishing News Publishers, 1995.
6. R. Gordob Pirje, Oceanography.
7. Newell and Newell, Marine Plankton.
8. Jhingran, Fish and fisheries
9. P. Michal, Ecological methods for field and laboratory investigations.
10. R.V. Tait, Marine zoology, Oxford press.
11. David Ross, Introduction to Oceanography.
12. Carl Schlipper, Research method in marine biology.
13. B.F. Chapgar, Sea Shore life of India, SIDGWICK and JACKSON, London
14. D.V. Bal and K.V. Rao, Marine fisheries of India, T-M-H.
15. Russel and Young, The Seas
16. Kurian and Sebastian, Prawn and prawn fisheries of India.
17. M. Krishna Pillai. Introduction to Planktology, Himalaya Publishing
18. A.A. Fincham. Basic marine biology, British Museum Natural History.
19. Latha Shenoy. Course manual in fishing technology, CIFE, Versova, Mumbai.
20. Jefferey F. Raymond, Plankton and productivity, Vol. I and II.
21. J.S. Levington, Marine Biology, Function, biodiversity, ecology. Oxford University Press.
22. Wealth of India, Vol. IV, CSIR Publications.
23. S.P. Biswas, Manual of methods in fish biology, South Asian publishers private Ltd., New Delhi.
24. J.P. Riley and R. Chester, Introduction to marine chemistry, Academic Press, London and New Delhi.
25. American Public Health Association-2000.
26. J.V.R. Pillai, Aquaculture principles and practice, Blackwell Scientific pub.
27. Das P. and Jhingran A.C.G., Fish genetics in India.
28. Colin E. Purdon, Genetics and Fish breeding, Chapman and Hall.
29. Schroder J.J., Genetics and Mutagenesis of fish, Chapman and Hall.
30. P. Bensam. Development of marine fishery sciences in India, Daya publishing House.

Practicals paper pattern

Semester III- Biotechnology Practical V

Total marks- 50

Q1) Determination of viable cell count in the given culture of bacteria by dilution & spreading technique. (DAY 1) (25)

OR

Q1) Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing agarose gel electrophoresis. (DAY 1) (25)

Q2) To estimate the Demonstration of aseptic technique: Work place for aseptic handling, packing glassware (flasks, test tubes, pipettes, petridish) for sterilization, aseptic transfer of liquids (pipetting from flask to test tube. (DAY 2) (15)

Q3) Viva (05)

Q4) Journal (05)

Biotechnology Practical VI

Total- 50 marks

Q1) Preparation of LB agar plate, slant, butt & demonstration of streaking technique using bacterial culture to obtain isolated colonies. (DAY 1) (25)

Q2) Estimate number of bacteria in given culture of nephelometry. (15)
(DAY 2)

Q3) Viva (05)

Q4) Journal (05)

Oceanography and Fisheries Practical VII

Total- 50 marks

1. (A) Determination of Physio-chemical parameter salinity/D.O./CO₂ /Nitrates-Nitrites/Silicates/Phosphate-Phosphorus. 10
OR
A) Estimation of primary productivity by light and dark bottle. 10
(B) Foraminiferan and radiolarian shells (any four) 05
2. Minor – Sediment analysis 07
3. Identify and describe (any 6 Intertidal Organism) (6 X 3) 18
4. Viva voce 05
5. Journal 05

Oceanography and Fisheries Practical VIII

Total- 50 marks

1. Major
(A) Fish identification (1 from Elasmobranch, 4 from Teleost) 15
(B) Fish identification as per Francis day volume 05
2. Minor
(A) Study of maturity, Plankton settling method/ weight method/ weight displacement method/ counting method and study of fecundity and maturation studies 08
Or
Plotting the frequency polygon by ova diameter measurement 08
3. Identification (4 identification 3 marks each) 12
4. Viva voce 05
5. Journal 05

Semester IV

Biotechnology Practical V

Total- 50 marks

Q1) Demonstrate the effect of medium on growth curves of given microorganism, using enriched media. (DAY 1) (25)

OR

Q1) Demonstrate the effect of medium on growth curves of given microorganism, using minimal media. (DAY 1) (25)

Q2) Immobilize Yeast cells in calcium alginate, prepare beads & keep them overnight in activation medium (DAY 1) (15)

Q3) Viva (05)

Q4) Journal (05)

Biotechnology Practical VI

Total- 50 marks

Q1) Prepare a bioreactor column to demonstrate Invertase activity in the bioreactor column. (DAY 2) (25)

Q2) Restriction-digest the given DNA sample & demonstrate the separation of fragments by performing agarose gel electrophoresis. Interpret the results by comparing with the standard digests provided. (DAY 2) (15)

OR

Q2) Demonstrate the western blotting technique for the given sample of protein. (DAY 2) (15)

Q3) Viva (05)

Q4) Journal (05)

Semester IV

Oceanography & Fisheries Practical VII

Total Marks: 50

- | | |
|---|----|
| 1. Major Experiment | |
| Identification of Oceanographic instrument (3 identification 4 marks each) | 12 |
| 2. (A) Detection of heavy metals – zinc/ Lead/ Copper | 10 |
| (B) Food and feeding in fish | 06 |
| 3. Identification (4 identification 3 marks each 2 from crafts & 2 from gears) | 12 |
| 4. Viva voce | 05 |
| 5. Journal | 05 |

Oceanography & Fisheries Practical VIII

Total Marks: 50

- | | |
|--|----|
| 1. Biometric study of fish | |
| (A) Study of relationship between total length and standard length / head length / body depth length / body weight | 04 |
| (B) Calculate correlation (standard length and total length / head length and total length | 03 |
| 2. Preparation of zooplankton mounting (5 different mounting of zooplankton) | 10 |
| 3. Identification (1 from fouling and boring organism, 1 from fresh water fish & fresh water prawn – 1 from crustacean fishery, 1 from molluscan fishery) (4 X 2 marks each) | 08 |
| 4. (A) Herbarium | 05 |
| (B) Field report (visit to aquaculture centre, boat building yards, processing plants, marine biological Institutions) (Excursion or Study tours) | 04 |
| (C) Collection molluscan shells (5 shells) | 04 |
| (D) Report on shrimp prawn pickle | 02 |
| 5. Viva voce | 05 |
| 6. Journal | 05 |