

University of Mumbai



No. UG/138 of 2019-20

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, the Head of the University Departments and Directors of the recognized Institutions in Science & Technology Faculty is invited to syllabus uploaded by Academic Authority Unit which was accepted by the Academic Council at its meeting held on 27th February, 2013 vide item No. 4.39 relating to the revised syllabus as per the (CBSGS) for the M.Sc. Programme Course of Zoology-Biotechnology-Oceanography and Fishery Science (Sem. III & IV).

They are hereby informed that the recommendations made by the Board of Studies in Zoology at its meeting held on 21st February, 2019 have been accepted by the Academic Council at its meeting held on 15th April, 2019 vide item No. 4.39 and that in accordance therewith, the additional credits may be permitted for Sindhu Swadhyay Sanstha's (SSS) students pursuing M.Sc. in Zoology by suitably amending oceanography syllabus if required and/or by allowing an additional component such as project or research component or assignments or placements (Summer or otherwise) etc. on the time and as per the ordinances/rules/regulations/norms applicable to research project envisaged in T.Y.B.Sc. syllabus and to weigh these additional credits for granting Honour status to the students by conferring M.Sc. (Honours) on compliance of such additional credits and those credits should be reflected in the marksheet of those students. (The same is available on the University's website www.mu.ac.in).

MUMBAI - 400 032

To 19th October, 2019
NOV.

(Dr. Ajay Deshmukh)
REGISTRAR

The Principals of the affiliated Colleges, the Head of the University Departments and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C./4.39/15/04/2019

No. UG/138 -A of 2019

MUMBAI-400 032

19th NOV.
October, 2019

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Zoology,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-ordinator, University Computerization Centre,

(Dr. Ajay Deshmukh)
REGISTRAR

AC 27/2/13
Item no. 4.39

UNIVERSITY OF MUMBAI



Syllabus for Sem III and Sem IV

Program: M.Sc.

**Course: Zoology-Biotechnology -
Oceanography and Fishery Science**

(Credit Based Semester and Grading System with
effect from the academic year 2013–2014)

UNIVERSITY OF MUMBAI

M.Sc. in Zoology: SEMESTER III and IV

Credit Based Semester and Grading System

to be implemented from the Academic Year 2013-2014.

PREAMBLE

BOS in Zoology during its meeting constituted a pyramid committee, to revise the syllabi in Zoology, with Dr. M. K. Pejaver as the Chairperson and Senior Teachers from affiliated Colleges as Jt. Chairperson, one each for UG and PG programmes. The class-wise syllabus committees were constituted in accordance with inclusive policy of the BOS with an aim to provide faculty at large hands on training and exposure to work on syllabus committees which will go a long way in taking our subject ahead in future when these experienced staff members would shape the subject after a decade. With the introduction of Credit Based Semester and Grading System and continuous evaluation consisting of components of internal assessment and external assessment by the esteemed University, the syllabus in Zoology was revised for M.Sc. Sem I and II to be implemented with effect from 2012-13, after approval by concerned authorities of the University.

Vide University Circular No. APD/Misc.-01/407/of 2011 dated 12/12/2011, contents of letter from K. P. Singh, Joint Secretary, UGC No. D.O.F1-1/2009-(CPP-II) dated 29/11/2011 were notified to the faculty in Zoology. As per the letter an expert committee was constituted by the UGC to look into the issue of discontinuation of dissection of live animals in the laboratory experiments in Zoology/ Life Sciences at UG and PG levels. The guidelines prepared by the expert committee and approved by UGC were notified with a viewpoint to ensure compliance of the guidelines.

A special meeting of Heads of Zoology Departments of all the Colleges affiliated to the University was convened on 17th August 2012 for deliberation on recommendation of expert committee appointed by the UGC regarding the discontinuation of dissection of live animals in laboratory experiments in Zoology / Life Sciences at UG and PG level.

In accordance with the deliberations in the above meeting, draft syllabus for M.Sc. SEMESTER-III and IV in Zoology, suitably revised, to be implemented in the Credit Based Semester and Grading System was prepared by the committee under the guidance of pyramid committee. The draft was circulated among the heads and senior teachers of the Department of Zoology of various colleges for approval and suggestions.

In meeting of the BOS held on 12th December, the draft was approved and it was resolved to implement the revised syllabus of Zoology at M.Sc. SEMESTER-III and IV and make it effective from the Academic Year 2013-2014 after approval from concerned authorities of the University.

Chairman
Board of Studies in Zoology
University of Mumbai

M.Sc. Semester III and IV
Zoology- Biotechnology--Oceanography and Fishery Science
 Credit Based Semester and Grading System.
 To Be Implemented from the Academic Year 2013-2014.

Semester –III

Theory				
Course	Unit	TOPIC	Credits	L / Week
PSZOBT301	I	The implications of recombinant DNA technology of commercial products and microbial synthesis	4	1
	II	Large scale culture & production from recombinant microorganisms & genetically engineered animal cells		1
	III	Medical Biotechnology		1
	IV	Environmental Biotechnology I		1
PSZOBT302	I	Genome management and analysis	4	1
	II	Manipulation of gene expression in prokaryotes		1
	III	Bioinformatics		1
	IV	Animal biotechnology and Human therapies		1
PSZOOCN303	I	General Oceanography	4	1
	II	Physical Oceanography		1
	III	Chemical Oceanography		1
	IV	Biological Oceanography		1
PSZOOCN304	I	Planktology	4	1
	II	Fish and Fishery Science		1
	III	Biotechnology in Fishery and Biometric Studies		1
	IV	Aquaculture		1
			16	16
Practicals				
PSZOBT3P1		Practicals based on PSZOBT 301	2	4
PSZOBT3P2		Practicals based on PSZOBT 302	2	4
PSZOOCN3P3		Practicals based on PSZOOCN 303	2	4
PSZOOCN3P4		Practicals based on PSZOOCN 304	2	4
Total			08	16
TOTAL			24	32

SEMESTER –IV

Theory				
Course	Unit	TOPIC	Credits	L / Week
PSZOBT401	I	Microbial synthesis of commercial products	4	1
	II	Large scale culture & production for industrial biotechnology		1
	III	Agricultural Biotechnology		1
	IV	Environmental Biotechnology II		1
PSZOBT402	I	Genome management	4	1
	II	Manipulation of gene expression in eukaryotes		1
	III	The human genome project		1
	IV	Regulations and patents in biotechnology		1
PSZOOCN403	I	General Oceanography	4	1
	II	Physical Oceanography		1
	III	Chemical Oceanography		1
	IV	Biological Oceanography		1
PSZOOCN404	I	Planktology	4	1
	II	Fish and Fishery Science		1
	III	Biotechnology in Fishery and Biometric Studies		1
	IV	Aquaculture		1
			16	16
Practicals				
PSZOBT4P1		Practicals based on PSZOBT4P1	2	4
PSZOBT4P2		Practicals based on PSZOBT4P2	2	4
PSZOOCN4P3		Practicals based on PSZOOCN 403	2	4
PSZOOCN4P4		Practicals based on PSZOOCN 404	2	4
Total			08	16
TOTAL			24	32

M.Sc. Semester III and IV
Zoology- Biotechnology--Oceanography and Fishery Science
Credit Based Semester and Grading System.
To Be Implemented from the Academic Year 2013-2014.

SEMETER – III

THEORY

PSZOBT301

PSZOBT301: Basics of Industrial & Environmental Biotechnology I

Unit I: The implications of recombinant DNA technology of commercial products and microbial synthesis **15**

- 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 15 & 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

15

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

15

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**

PSZOBT302

PSZOBT302: GENETIC ENGINEERING TECHNIQUES AND ITS APPLICATIONS

Unit I: Genome management and analysis

15

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

15

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

15

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

15

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**

PSZOCN303- GENERAL, PHYSICAL, CHEMICAL AND BIOLOGICAL OCEANOGRAPHY

UNIT I: GENERAL OCEANOGRAPHY 15 L

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 15 L

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 15 L

- * **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 15 L

***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**

SEMESTER III

PSZOOCN304- PLANKTOLOGY, FISH, FISHERY SCIENCE AND AQUACULTURE

UNIT I: PLANKTOLOGY 15L

- 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 15L

- 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 15L

- 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 15L

- 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

Course Code PSZOBT3P1 & PSZOBT3P2
(Based on PSZOBT301 and PSZOBT302)

- 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.

PSZOOCN3P3

1) Physical and chemical oceanography:

(Uniform methods for all colleges to be followed)

Determination of physico-chemical parameters:

- 1) Salinity (Argentometric and conductivity method)
- 2) Dissolved oxygen,
- 3) Carbon dioxide.
- 4) Nitrates-nitrites.
- 5) Silicates.
- 6) 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, Umbonium, Oliva, Pea crab, Fiddler crab, Molluscan shells, Star fish and Balanoglossus.
- c) Muddy shore: Lingula, Chaetopterus, Arenicola, Tubiculus worm and Mud skipper.

PSZOOCN3P4

- 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 toloo*
11. Family- Stromatidae
Pampus chinensis, *Pampus argenteus*
12. Family- Scombridae
Rastrelliger kanagurta, *Cybium 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 experiment

SEMESTER -IV

Zoology-Biotechnology--Oceanography and Fishery Science

Credit Based Semester and Grading System.

To Be Implemented from the Academic Year 2013-2014.

PSZOBT401: Basics of Industrial & Environmental Biotechnology II

Unit I: Microbial synthesis of commercial products 15

- 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 **15**

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 **15**

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 thuringiotoxin 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 **15**

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**

PSZOB402: Genome management, manipulation, regulations and patents in biotechnology

Unit I: Genome management

15

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

15

- 2.1 Eukaryotic gene expression
- 2.2 *Introduction of DNA into fungi-yeast and filamentous fungi
(fungal transformation)
- 2.3 Heterologous proteins production in yeasts

- 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

15

- 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

15

- 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**

PSZOOCN403: GENERAL, PHYSICAL, CHEMICAL AND BIOLOGICAL
OCEANOGRAPHY

UNIT I: GENERAL OCEANOGRAPHY 15 L

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 15 L

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 15 L

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 15 L

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**

SEMETER – IV

PSZOOCN404: PLANKTOLOGY, FISH, FISHERY SCIENCE AND AQUACULTURE

UNIT I: PLANKTOLOGY

15L

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

15L

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

15L

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

15L

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 PRACTICALS

SEMESTER IV Practicals

**Course Code PSZOB4P1 & PSZOB4P2
Based on PSZOB401 and PSZOB402**

- 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).

PSZOOCN4P3

Based on PSZOOCN403

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.

PSZOOCN4P4

Based on PSZOOCN4P4

- 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 kempii*,
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., Atextbook 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. Rilcy 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 plasias, 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.

N.B :

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees :

- 1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
- 2) A Dissection Monitoring Committee (DMC)

Composition of DMC shall be as follows :

- i) Head of the Concerned Department (Convener/Chairperson)
 - ii) Two Senior Faculty Members of the concerned Department
 - iii) One Faculty of related department from the same College
- One or two members of related department from neighboring colleges

Practicals paper pattern

Semester III

Zoology- Biotechnology-Physiology

Course Code PSZOB3P1

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

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)
MARKS

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)
MARKS

Q3) Viva (05)
MARKS

Q4) Journal (05)
MARKS

Practical

Course Code PSZOB3P2

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

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

Q3) Viva (05)
MARKS

Q4) Journal (05)
MARKS

PRACTICAL EXAMINATION PSZOOCN3P3

1. (A) Determination of Physio-chemical parameter salinity/D.O./CO ₂ /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

PRACTICAL EXAMINATION PSZOOCN3P4

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 |

Course Code PSZOBT4P1

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

OR

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

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

Q3) Viva (05) MARKS

Q4) Journal (05) MARKS

Practical
Course Code PSZOBT4P2

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

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) MARKS

OR

Q2) Demonstrate the western blotting technique for the given sample of protein.

(DAY 2) (15) MARKS

Q3) Viva (05) MARKS

Q4) Journal (05) MARKS

Semester IV

PRACTICAL EXAMINATION PSZOO CN4P3

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

PRACTICAL EXAMINATION PSZOO CN4P4

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
