AC 27/2/13
Item no. 4.40

UNIVERSITY OF MUMBAI

Syllabus for Sem III and Sem IV
Program: M.Sc.
Course: Zoology-Biotechnology-Animal Physiology

(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 2012-2013, 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 geld 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 and Physiology
Credit Based Semester and Grading System.
To Be Implemented from the Academic Year 2013-2014.
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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
PSZOPHY303	I	Level of response and Nutritional Physiology	4	1
	II	Dynamics of physiological fluids		1
	III	Physiological of mobility & Continuity of Life		1
	IV	Neuroendocrine regulation, sensory & effecter physiology		1
PSZOPHY304	I	Stress, Water and pressure as environmental factors	4	1
	II	Oxygen and Temperature as environmental factors		1
	III	Environmental Radiation, physiology of Biological Timing		1
	IV	Physiological Tools for clinical diagnostics		1
			16	**16**
Practicals				
PSZOBT3P1		Practicals based on PSZOBT 301	2	4
PSZOBT3P2		Practicals based on PSZOBT 302	2	4
PSZOPHY3P3		Practicals based on PSZOPHY303	2	4
PSZOPHY3P4		Practicals based on PSZOPHY304	**2**	**4**
Total			**8**	**16**
Grand 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
PSZOPHY403	I	Level of response and Nutritional Physiology	4	1
	II	Dynamics of physiological fluids		1
	III	Physiological of mobility & Continuity of Life		1
	IV	Neuroendocrine regulation, sensory & effecter physiology		1
PSZOPHY404	I	Stress, Water and pressure as environmental factors	4	1
	II	Oxygen and Temperature as environmental factors		1
	III	Environmental Radiation, physiology of Biological Timing		1
	IV	Physiological Tools for clinical diagnostics		1
			16	**16**
Practicals				
PSZOBT4P1		Practicals based on PSZOBT4P1	2	4
PSZOBT4P2		Practicals based on PSZOBT4P2	2	4
PSZOPHY4P3		Practicals based on PSZOPHY4P3	2	4
PSZOPHY4P4		Practicals based on PSZOPHY4P4	**2**	**4**
Total			**8**	**16**
Grand Total			**24**	**32**

SEMESTER III

THEORY

PSZOBT301

Zoology– Biotechnology Animal Physiology

PSZOBT301: Basics of Industrial & Environmental Biotechnology I

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

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 **15 L**

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 L**

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 L**

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 xenobiotic 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**

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PSZOBT302

PSZOBT302: GENETIC ENGINEERING TECHNIQUES AND ITS APPLICATONS

Unit I: Genome management and analysis **15 L**

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 L**

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 L**

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 L**

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**

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Course Code: PSZOPHY303
PSZOPHY303: Comprehensive Physiology-I.

UNIT I: Levels of response and Nutritional Physiology. **15 L**

1.1. Levels of Physiological response- Molecular, Membrane, Organ and Organism.
1.1.1 A brief idea of physiological response at molecular level
1.1.2 Membrane physiology- Functional consequences of molecular composition and arrangement.
1.1.3 Transport across cell membrane-* Diffusion ***** active transport, pump; uniports, symports and antiport, co-transport by symporters and anitporters.

1.2. Physiology of Food Capture and Processing:
1.2.1 Nutritive Patterns: Origin of nutritive types.
1.2.2 Feeding patterns:
a) Large particle feeding
b) Surface nutrient absorption
1.2.3 Digestion:
a) Bulk movement and peristalsis
b) Comparative biochemistry of digestion

c) Neural and hormonal regulation of secretion of digestive enzymes.

1.2.4 Regulation of nutritional intake:

a) Hunger drive, Glucostatic and Hepatostatic theories of hunger drive

b) Adaptation of gut to metabolic rate and diet.

c) *Balanced diet: A human perspective

UNIT II: Dynamics of physiological fluids-circulation. **15 L**

2.1. Circulation of body fluids:

2.1.1 a) Circulating fluids-Cytoplasm, Hydrolymph, hemolymph, lymph and Blood

b) Circulatory mechanisms and Fluid compartments, movement of body fluids by somatic muscles. Hemolymph and open systems

2.1.2 Pressure and flow in vertebrate circulatory system

2.1.3 Physiological types of hearts with special reference to arthropods, annelids, mollusca, tunicates and vertebrates.

2.1.4 Pacemakers and specialized conducting fibers.

2.1.5 Selective distribution of blood flow.

2.2 Cardiac Physiology:

2.2.1 Neurohormonal regulation of cardiac amplitude and frequency.

2.2.2 *Effects of exercise on cardiac vascular physiology - A human perspective.

UNIT III: Physiology of motility. **15 L**

3.1. Physiology of movement and locomotion:

3.1.1 *Biochemistry of contractile proteins.

3.1.2 Physiology of non-muscular contractile elements: Axoplasmic movement, Chromosome involvement

3.1.3 Physiology of skeletal muscle fibre:

a) Actomyosin complex

b) Source of energy for muscle contraction

c) *Sliding filament theory

d) Excitation of contraction and mechanism of regulation of contraction by calcium

e) Mechanism of relaxation

3.1.4 Comparative physiology of invertebrate muscle:

a) Polyneural innervation in anthropod muscle

b) Insect non-oscillatory postural muscle

c) Resonant flight and tymbal muscle in insects

d) Catch muscle and delayed relaxation

UNIT IV: Neurotransmission Physiology. **15 L**

4.1. Physiology of neuronal system:

4.1.1 Excitable membranes:

a) Membranes potential

b) Ions as current carriers - Protons, calcium, potassium, structure of cation-permeable channels and chloride channels

4.1.2 Synaptic transmission:

a) Electrical transmission

b) Chemical transmitters- Neuropeptide, FMRF-amide family, Gastrin, CCK family, Hypothalamic pituitary factors

4.1.3 Integrative Neurophysiology: Neurons, Interneurons, neural Circuits, Networks, Primitive Nervous Systems, Nerve nets, Central pattern Generators in Invertebrates,
Chordate Nervous System, Central Nervous System processing

* Memory and Learning.
* Indicate topics for learners to present seminars on.

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Course Code: PSZOPHY304

PSZOPHY304: Environmental and Applied physiology-I.

Unit I: Stress, Water as an environmental factor. **15 L**

1.1. Environmental Stress, Homeostasis and strategies of biochemical adaptations:
- 1.1.1 Basic concept of environmental stress
  - a) Plastic and elastic strain
  - b) Stress resistance, stress avoidance and stress tolerance* – Seminar topics
- 1.1.2 Homeostasis and biochemical adaptation:
  - a) External and internal environment
  - b) Multiple control system
  - c) Strategies of biochemical adaptations

1.2. Water and Solute problem:
- 1.2.1 Preservation of intracellular solvent capacity
- 1.2.2 Strategies and degrees of ionic regulation
- 1.2.3 ATPase the model regulatory enzyme
- 1.2.5 Key role of GDH reaction
- 1.2.6 *Salt glands in animal kingdom.

Unit II: Oxygen as environmental factor. **15 L**

2.1. Oxygen as an environmental factor:
- 2.1.1 *Oxygen and Origin of life
- 2.1.2 Oxygen dependencies in living organism
- 2.1.3 Anoxia adaptations in invertebrates
- 2.1.4 Adaptations of vertebrates during prolonged diving
- 2.1.5 Oxygen debt in vertebrate muscle

Unit III: Environmental Radiation. **15 L**

3.1. Radiation as an environmental parameter:
- 3.1.1 The solar spectrum
- 3.1.2 Biomolecules involved in perception and trapping of solar radiations: Chlorophyll, Bacterio-rhodospin, Rhodospin and Vitamin A. Adaptations of animals to absence of solar radiations
- 3.1.3 Effects of Ionizing radiations at the cellular and molecular level Phenomenon of radioprotection
- 3.1.4 Effects of Ionization radiations at cellular and molecular level
- 3.1.5 Phenomenon of radioprotection.

Unit IV: Enzymes and Body Fluids as Clinical Diagnostic Tools. **15 L**

4.1. Enzymes as diagnostic tools :
- 4.1.1 Plasma specific and non-plasma specific enzymes
- 4.1.2 Diagnostic importance of LDH
- 4.1.3 Enzyme in diagnosis of myocardial infarction
- 4.1.4 Enzymes in Liver diseases and toxicity
- 4.1.5 Enzymes in muscle disease

4.1.6 *Enzymes in cancer

4.2. Body fluid parameters as diagnostic tools:

4.2.1 Physiological fluids as diagnostic tools:
Routine Blood tests, plasma composition- changes in disease
Serum: Urea-N, Creatinine, Uric acid, proteins, bicarbonates, Na^+ K^+ Cl^-

4.2.2 Glucose tolerance test, glycosylated Haemoglobin

4.2.3 Lymph and cerebro-spinal-fluid: Changes in composition in disease –

4.2.4 * Urine composition/ constituents as a diagnostic tool-Routine Urine tests, Urea-N, Creatinine, Uric acid, tests for proteinurea, albuminurea, Glucosurea, chyluria (for filariasis)

* Indicate topics for learners to present seminars on.

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PRACTICAL

Semester III

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, petridishes) 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.

Course Code: PSZOPHY3P3 and PSZOPHY3P4
Based on PSZOPHY303 and PSZOPHY304

1) Determination of activities of digestive enzymes viz. Amylase, Pepsin, Trypsin, Lipase etc. in different animals (Cockroach)
2) Study of effect on activity of any enzyme of various factors like pH, Temperature, Activator, Inhibitor
3) Determination of Km of a given enzyme
4) Total RBC, WBC and Different WBC count- A comparative study of fish, goat and human
5) Routine human blood tests like RBC, WBC, DWBC, Hb content, blood sugar. prepare a report as required by a pathological laboratory (goat blood)
6) Observation of decreasing PO_2 of water on the respiratory rate of a fish
7) Effect of decreasing PO2 of water on Lactic acid in the muscle.
8) Estimation of salt loss and gain in an aquatic animal when it is transferred to a salt-free medium and to natural medium.
9) Preparation of glycerinated muscle fibre and study of its properties.

10) Effect of different concentrations of sodium chloride on the diameter of RBCs and determination of concentration isotonic to blood.

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Semester -IV

PSZOBT401: Basics of Industrial & Environmental Biotechnology II

Unit I: Microbial synthesis of commercial products 15 L

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 L

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 L

3.1. Agricultural Biotechnology:

3.1.1 *****Nitrogen fixation

3.1.2 Nitogenase-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 L**

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 and 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**

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PSZOBT402: Genome management, manipulation, regulations and patents in biotechnology

Unit I: Genome management **15 L**

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 L**

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 L**

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 L**

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 P*seudomonas 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**

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Course Code: PSZOPHY403-Comprehensive Physiology-II

UNIT I: Physiology of Respiration and Nitrogen Metabolism . **15 L**

1.3. Respiration:

1.1.1 *Transition from water to land- Vertebrates and invertebrates

1.1.2 O2 consumption, RQ and modifying agents:
Activity, Temperature, Salinity, Photoperiod, Development,
Hibernation, Animal size and metabolism.

1.1.3 Respiratory functions of blood:
*Respiratory pigments,
respiratory acidosis and alkalosis, Alkali reserve

1.1.4 Control and co-ordination of respiration

1.4. Nitrogen Metabolism:

1.2.1 Amino-N Metabolism, Nucleic acid metabolism, Nitrogenous waste products.

1.2.2 Ammonia toxicity and detoxification pathways-
* Ammonotely, Ureotely, Purinotely, uricotely, Storage excretion.

1.2.3 Patterns of detoxification pathways in eggs and during metamorphosis,
Phylogenetic patterns.

UNIT II: Dynamics of physiological fluids-composition. **15 L**

2.1. Dynamics of fluid composition:

2.1.1 Body fluid composition- water, solute and Intracellular regulation.

2.1.2 Cutaneous evaporation, Respiratory evaporation,

2.1.3 Integrated functioning for nitrogen excretion and osmoregulation
Contractile vacuole, Coelomoducts, Flame cells, Green gland,
Malpighian Tubules, Invertebrate Nephredia and Vertebrate Nephron

2.1.4 Comparative physiology of vertebrate kidney

2.1.5 *Kidney stones and kidney transplants - a human perspective.

2.2. Transfusion, Blood Replacement- A human perspective.

2.3. Haemodialysis and peritoneal dialysis- A human perspective.

UNIT III: Physiology of Continuity of Life. **15 L**

3.1 Physiology of Reproduction:

3.1.1 Selfish gene, evolution of gametes, maternal DNA

3.1.2 Endocrine regulation of reproduction in invertebrates,
Molluscs, Crustaceans, Insects

3.1.3 Comparative account of vertebrate gonadotropins, gonadal steroids,

3.1.4 * Interaction of steroid hormones and nervous tissue.

3.1.5 Human intervention in Reproduction
Contraceptives, MTP, Treatment of Infertility.
Assisted Reproduction Techniques- IFV, GIFT, ICSI, ZIFT, DI, AID

UNIT – IV : Endocrine regulation, sensory & effecter physiology. **15 L**

4.1. Physiology of Endocrine Regulation:

4.1.1 Specificity, Membrane bound receptor system, Cytosolic receptor system

4.1.2 *Invertebrate Endocrine System

Lower invertebrates, Annelids, Molluscs, Crustaceans, Insects

4.1.3 Regulated supply of hormones: Feedback: Direct and Indirect

Hypothalamo- Hypophysical axis, Pineal- Pituitary gland, Thyroid and Adrenal gland, G-E-P (Gastro-entero-pancreatic) cells, Renal hormones Cardiac hormones, Prostaglandins.

4.2. Sensory and Effecter physiology

4.2.1 Sensory Physiology- Structural and Functional Classification, Modality Intensity, Sensory coding

4.2.2 Various receptors- Chemoreception, Mechanoreception , Electroreception Thermoreception, *Photoreception.

4.2.3 * Physiological effectors: Cnidoblasts, Bioluminescent systems Chromatophores, electric organs

* Indicate topics for learners to present seminars on.

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Course Code: PSZOPHY404: Environmental and Applied physiology-II.

Unit I: Pressure as an environmental factor. **15 L**

1.1 Pressure as an environmental factor :

.1.1 Fundamental effects of pressure on biological system

1.1.2 Rate of enzyme action with respect to pressure

1.1.3 Effect of pressure on weak bonds and the consequences for higher orders of Protein structure.

1.1.4 Effects of pressure on cellular processes viz. transcription, translation and gene regulation

1.1.5 Strategies of enzyme adaptations to pressure in marine organisms: FDPase and PK

UNIT II: Temperature as environmental factor. **15 L**

2.1. Temperature Regulation/ Response to temperature fluctuations:

2.1.1 Thermal limits of survival

2.1.2 Temperature and Structural effects with response to Biological molecules and biological membranes

2.1.3 Temperature and rate effects: Temperature dependent E~S affinity, Lipoprotein enzymes

2.1.4 Thermal resistance of dormant and active cells

2.1.5 Ectothermy and endothermy

2.1.6 Endothermy in invertebrates

2.1.7 Biochemical adaptations of Ectothermy: Antifreeze substances, Heat shock

proteins

UNIT III : Radiation and Physiology of Biological Rhythms . **15 L**

3.1. Physiology of Biological Rhythms and timings:

3.1.1 Temporal organization of the cells

3.1.2 Circadian Rhythms. Synchronization of circadian rhythms

3.1.3 Dormancy in fresh water and terrestrial animals
Preparatory phases, Induction of dormancy, Arousal from dormancy
Entrainment and dormancy

3.1.4 Diapause in insects- Induction, Factors affecting and termination of Diapause, Diapause and endocrine functions

3.1.5 *Photoperiodism

3.1.6 *Biological clocks

UNIT IV: Physiological Tools for clinical diagnostics. 1**5 L**

4.1. Antibodies as diagnostic tools:

4.1.1 RIA- of GnRH, Gonadotropins, T3, T4, TSH, HCG, Insulin

4.1.2 * ELISA- for detection of HCG, diagnosis of Amoebiasis, Typhoid, HIV

4.1.3 Monoclonal antibodies as diagnostic tools: Detection of HCG, Diagnostic of STD, Streptococcal throat infections, Herpes and Cancer

4.2. Organ Function Tests as diagnostic tools:

4.2.1 *Liver function tests and toxicity tests

4.2.2 Pancreatic function tests

4.2.3 Gastric function tests

4.2.4 Kidney function tests

* Indicate topics for learners to present seminars on.

SEMESTER IV

Practicals

Course Code PSZOBT4P1 & PSZOBT4P2
Based on PSZOBT401 and PSZOBT402

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).

Course Code: PSZOPHY4P3 and PSZOPHY4P3
Based on PSZOPHY403 and PSZOPHY403

1. Determination of Urea, Creatinine in blood -Human/goat
2. Determination of serum content of uric acid, cholesterol – Human/goat
3. Effect of injection of insulin/ glucagon on the blood sugar and liver glycogen in rat/ mouse
4. Routine urine tests and preparation of report as per pathological laboratory (treatment as in "Fundamentals of Practical clinical biochemistry pp 34-38, 40-43)
5. Performance of Ouchterlony technique to demonstrate immunodiffusion
6. Demonstration of single radical immunodiffusion of antibody and antigen
7. Influence of sub lethal (50-60ppm) ammonia (as liquor ammonia/ ammonium hydroxide/ ammonium chloride) on a suitable fish exposed to ammonia stress for
8. 3/7/15 days with reference to the following parameters:
    a. Level of excretory ammonia
    b. Level of activity of hepatic and brain glutamate dehydrogenase
    c. Level of amino acid content of muscle, gill, brain and liver
9. A survey based project to study physiological diagnostic tools with the help of local pathological laboratory/ hospital.
10. Effect of administration of carbon tetra chloride in rat/mice with reference to following parameters
    a) Total lipid and free fatty acid content of liver
    b) Free fatty acid content of plasma
    c) Level of activity of the following enzymes: AspAT, AlaAT, AICP, ACP, LDH, SDH and ATPase

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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
IV) One or two members of related department from neighboring colleges

Practicals paper pattern

Semester III

Zoology- Biotechnology-Physiology

Course Code PSZOBT3P1

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 PSZOBT3P2

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

Course Code: PSZOPHY3P3

Q.1 Major Question: 25

Prepare an extract of salivary gland/ stomatch/ intestine/ liver. Using this extract as an enzyme source, determine the activity of amylase/ trypsin/ pepsin/ lipase. Submit a report to the examiner.

OR

Demonstrate the effect of pH/ temperature/ activator/ inhibitor on the activity of salivary amylase.

OR

Calculate and compare total RBC/ total WBC/ Differential WBC of any two animals (human/ goat /fish).

Q.2 Minor Question: 15

Determine the Km of given enzyme with the help of suitable graph.

OR

Demonstrate the effect of ATP and Mn^{++}/ ATP and Mg^{++}/ATP and KCl/ATP and $CaCl_2$ and NaCl on glycerinated fiber. Submit a report.

Q.3 Viva-voce **05**

Q.4 Journal **05**

Course Code: PSZOPHY3P4

Q.1 Major Question: 25

Set up an experiment to demonstrate the effect of decreasing PO_2 on lactic acid content of the fish muscle. Compare it with control fish and submit the report**.**

OR

Estimate the salt loss and salt gain in fish when it is transferred to salt free medium and natural medium.

OR

Demonstrate the effect of different concentrations of sodium chloride on the diameter of RBCs and determine the isotonic concentration for the blood cells, with help of occulometer.

Q.2 Minor Question: 15

Prepare a report from the given parameters of routine blood test. Interpret the result and submit the report.

OR

Set up an experiment to demonstrate the effect of decreasing PO_2 of water on respiratory rate of fish by counting opercula movement and estimation of oxygen in water.

Q.3 Viva-voce **05**

Q.4 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

Course Code: PSZOPHY4P3

Q.1 Major Question: 25

Demonstrate the effect of insulin/ glucagon on the blood sugar/ liver glycogen in the given rat/ mouse. Submit a report.

OR

Estimate the content of urea/ uric acid/ creatinine/ bilirubin/ cholesterol from the given blood sample (any two).

Q.2 Minor Question: 15

Demonstrate Ouchterlony technique to show immunodiffusion. Show the result to the examiner.

(Result to be observed on the subsequent day)

OR

Demonstrate Single radial immunodiffusion of antigen and antibody. Plot the graph and show the results to the examiner.

Q.3 Viva-voce **05**

Q.4 Journal **05**

ourse Code: PSZOPHY4P4

Q.1 Major Question: **25**

Show the influence of sublethal dose of ammonia (50-60ppm) on the suitable fish exposed to ammonia stress for 3/7/15 days with reference to the following parameters:

a) Level of excretory ammonia and
b) Activity of hepatic and brain glutamate dehydrogenase

OR

c) Level of amino acid content of muscle/ gill/ brain/ liver.

OR

Report the effect of administration of carbon tetrachloride on rat/ mouse with reference to following parameters:

a) Total lipid and free fatty acid content of liver.
b) Free fatty acid from plasma.
c) Level of hepatic AST and ALT.
d) Level of hepatic LDH and SDH.

Q.2 Project **15**

Q.3 Viva-voce **05**

Q.4 Journal **05**