VIMALA COLLEGE
(AUTONOMOUS), THRISSUR

SYLLABUS

FOR

POST GRADUATE PROGRAMME IN

ZOOLOGY

Effective from 2016 admission

FIRST SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY I - BIOCHEMISTRY
Code: VPZO1C01
(90 Hours)

SECTION A: CHEMISTRY AND FUNCTIONS OF BIOMOLECULES (36 hrs)

1. Introduction (2 hrs)

1.1 Macromolecules and their subunits

1.2 Chemical bonds of biomolecules

2. Carbohydrates (12 hrs)

2.1 Monosaccharides

Classification with examples

Structure of glucose, fructose, galactose, mannose and ribose

Methods of representation of sugars (Ball & stick, projection formula & perspective formula)

Isomerism - structural isomerism (functional group isomerism) and stereo isomerism (optical isomerism), mention epimer, anomer and enantiomer with examples

Mutarotation

Reactions - Oxidation (by acids, metal hydroxides and H_2O_2), dehydration (by acid) and reduction (by alkali), reactions with alanine and phenyl hydrazine

Derivatives - ascorbic acid, acetal and hemiacetal, ketal and hemiketal, glycocosides, glycosidic bond and deoxyribose

Biological roles of monosaccharides

2.2 Disaccharides

Structure and biological roles of Maltose, Sucrose, Lactose, Cellobiose and Trehalose

Biosynthesis of trehalose and lactose

2.3 Polysaccharides

Homopolysaccharides - Structure and biological roles of cellulose, starch, glycogen, inulin and chitin

Mode of action of amylase on homopolysaccharides (starch and glycogen)

Heteropolysaccharide - Structure and biological roles of hyaluronic acid, chondroitin, chondroitin sulphate, keratin sulphate, heparin and agar- agar

3. Proteins (9 hrs)

3.1 Amino acids

Classification on the basis of

(a) number of amino and carboxyl group

(b) the chemical composition of side chain

(c) the polarity of side chain (R)

Amphoteric properties of amino acids

pK value and isoelectric point (pI) of amino acids

Peptide bond and peptides (di, tri, tetra, oligo and polypeptide)

3.2 Structure of protein

Primary structure, secondary structure (α-helix - parallel & antiparallel and β pleated sheet), random coil conformation, tertiary structure, quarternary structure

Brief note on protein domains, motifs, folds and Ramachandran plot

Biological roles of proteins

4. Lipids (8 hrs)

4.1 Classification of lipids
Simple lipids (fats, oils and waxes)
Compound lipids (phospholipids, glycolipids, lipoproteins and sulpholipids)
Derived lipids
4.2 Brief account of the chemistry of sterols, terpenes and carotenoids
4.3 Acid number, saponification number, Iodine number, Polenske number and Reichert-Meissl number of lipids
4.4 Biological roles of lipids - as food reserves (storage lipids), structural lipids in membrane, as signals, as co-factors, as pigments, as insulators, as vitamin carriers etc
4.5 Prostaglandins - Chemical nature and functions
4.6 Fatty acids – definition, essential fatty acids
Classification with examples– Saturated, unsaturated, hydroxyl and cyclic fatty acids
Nomenclature of fatty acids – Genevan system

5. Nucleic acids (5 hrs)

5.1 Structure of nitrogen bases and nucleotides
5.2 Structural organization of DNA (Watson –Crick model)
5.3 Characteristic features of A, B, C and ZDNA
5.4 Structural organization of t-RNA,
5.5 Brief note on micro-RNA
5.6 Biological roles of nucleotides and nucleic acids

SECTION B: ENZYMES (15 hrs)

1. Classification- (I.U.B. system)
2. Specificity of enzyme action
3. Mechanism of enzyme action- Formation of enzyme substrate complex- Gibbs free energy of activation, Michaelis-Menten theory, Fischer‟s template theory and Koshland‟s induced fit theory, electrostatic, hydrogen and Van der Waal‟s bonds in enzyme-substrate complex
4. Enzyme kinetics - Michaelis-Menten equation, derivation, significance of K_m and V_{max} values
5. Lineweaver-Burk equation and double reciprocal plot of enzyme reaction
6.Enzyme inhibition – competitive, non-competitive and uncompetitive inhibition (distinguish kinetically), suicide inhibition and feedback inhibition
7. Allosteric enzymes – positive and negative modulators
8. Iso-enzyme and ribozyme
9. Vitamins as conenzymes
10.Factors influencing enzyme action

SECTION C: BIOENERGETICS (5 hrs)

1. Laws of thermodynamics and biological system, enthalpy, entropy, free energy concept
2. Energy of activation, standard free energy change
3. Role of ATP as a free energy carrier in the biological system

SECTION D: METABOLISM AND BIOSYNTHESIS OF BIOMOLECULES (34 hrs)

1. Carbohydrate metabolism (15 hrs)

1.1 Glycolysis, PFK as pacemaker, Hexokinase conformation and change by glucose, fate of

pyruvic acid

1.2 Metabolism of 2, 3 DPG as regulator of oxygen transport
1.3 Citric acid cycle, pyruvate dehydrogenase complex and ketoglutarate dehydrogenase complex
1.4 Electron transport system and oxidative phosphorylation, redox potential, chemiosmotic Hypothesis, inhibitors of electron transport chain
1.5 Gluconeogenesis, Glycogenesis, Glycogenolysis, regulation of glycogen synthesis breakdown- Cori `s cycle
1.6 Pentosephosphate pathway (HMP pathway)

2. Amino acid metabolism (5 hrs)
2.1 Biosynthesis and degradation of amino acids – glutamic acid, phenyl alanine, methionine, tryptophan, isoleucine, histidine

3. Lipid metabolism (8 hrs)
3.1 Oxidation of fatty acids
3.2 Biosynthesis of fatty acids
3.3 Biosynthesis of cholesterol
3.4 Disorders related to defect in lipid metabolism

4. Nucleic acid metabolism (5 hrs)
4.1 Biosynthesis and degradation of purines and pyramidines

5. Interrelation between lipid, amino acid & carbohydrate metabolism (1 hr)

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3. Lubert Stryer (2010) Biochemistry, 7th edition, W.H. Freeman & Co. New York.
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FIRST SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY II- BIOPHYSICS AND BIOSTATISTICS
Code: VPZO1C02
(90 Hours)

SECTION A: BIOPHYSICS (55 hrs)

1. Matter and mechanics of cells (3 hrs)
1.1 Colloids, properties of colloids, forms of colloids, Brownian movement and Tyndall Phenomena

2. Diffusion and Osmosis (5 hrs)
2.1 Fick‟s law and diffusion coefficient
2.2 Gibb‟s Donnan equilibrium
2.3 Application of diffusion processes in biology, haemolysis
2.4 Vant Hoff‟s laws
2.5 Osmotic concentration, osmotic pressure and osmotic gradient
2.6 Electrosmosis
2.7 Electrolytic and ionic balance in biological fluid
2.8 Adsorption

3. pH (2 hrs)
3.1 Dissociation of water
3.2 Dissociation of a weak acid
3.3 Henderson Hasselbalch equation
3.4 Buffers
3.5 pH meter
3.6 pH value calculation

4. Bioacoustics (5 hrs)
4.1 Characteristics of sound
4.2 Physical basis of hearing
4.3 Physical organization of ear
4.4 Physical aspects of sound transmission in the ear
4.5 Audible sound frequency
4.6 Pitch reception and theories
4.7 Infrasonic and ultrasonic sounds

5. Radiation Biology (9 hrs)
5.1 Properties of different types of radio isotopes normally used in biology, their detection and measurement, incorporation of radioisotopes in biological tissues and cells
5.2 Molecular imaging of radioactive material, safety guidelines
5.3 Biological effects of radiations
5.4 Radiation protection and therapy, nuclear medicine
5.5 Applications of tracer techniques- radiation dosimetry, radioactive isotopes, ionizing radiations, radiation detectors (GM Counter, Liquid Scintillation Counter)
5.6 Autoradiography

6. Biophysical methods (Brief account) (5 hrs)
6.1 Analysis of biomolecules- using UV / visible fluorescence, circular dichroism

6.2 NMR and Electron Spin Resonance (ESR) spectroscopy
6.3 Structure determination using X-ray diffraction and NMR, analysis using light scattering
6.4 Different types of mass spectrometry and surface plasma resonance methods

7. Electrophysiological methods (Brief) (3 hrs)
7.1 Single neuron recording
7.2 Patch clamp recording
7.3 ECG
7.4 Brain activity recording
7.5 Lesion and stimulation of brain
7.6 Pharmacological testing
7.7 PET (Positron Emission Tomography), MRI, f MRI, CAT

8. Principles and applications (8 hrs)
8.1 Microscopy (Fluorescent, interference , confocal -scanning and transmission electron microscopes), resolving powers of different microscopes
8.2 Different fixation and staining techniques for EM (freeze-etch & freeze fracture methods)
8.3 Image processing methods in microscopy
8.4 Laser and its applications in biology

9. Separation Techniques (10 hrs)
9.1 Chromatography (adsorption, partition and ion-exchange chromatography, column, paper, thin- layer, gel-filtration, gas chromatography, affinity chromatography, HPLC)
9.2 Electrophoresis (paper, disc, PAGE, two dimensional PAGE, high voltage and Immunoelectrophoresis)
9.3 Isoelectric focusing
9.4 Flow cytometry

10. Influence of gravity (3 hrs)
10.1 Human body posture in the gravitational field
10.2 Influence of G force
10.3 Force of centrifugal acceleration, importance in aviation and space travel
10.4 Effect of positive G force & negative G forces
10.5 Protection against G force
10.6 Influence of linear acceleration on the body

11. Nanotechnology (2 hrs)
11.1 Definition
11.2 Nanotechnology and its applications in the field of health care
11.3 Roles of nanotechnology in environmental management

SECTION B: BIOSTATISTICS (35 hrs)

1. Introduction (2 hrs)
1.1 Biostatistics- definition, terms, applications
1.2 Role of biostatistics in modern research.

2. Data collection (7 hrs)
2.1Types of data- Primary, secondary, qualitative, quantitative
2.2 Methods of data collection and classification- types of sampling methods, advantages and

disadvantages of census and sampling method
2.3 Classification of data- tabulation, methods of classification, class intervals (exclusive and inclusive method)
2.4 Diagrammatic and graphical presentation of data- Bar diagram (types), pie diagram, histograms, frequency polygon, frequency curve (skewness, kurtosis, ogive)

3. Statistical Methods (8 hrs)
3.1 Measures of central tendency and dispersal - mean, median, mode, quartile
3.2 Range, mean deviation, Quartiles deviation, variance, standard deviation, standard error, degree of freedom

4. Statistical Inference (7 hrs)
4.1 Difference between parametric and non-parametric statistics
4.2 Testing of hypothesis
4.3 Errors
4.4 Confidence interval, levels of significance, critical region
4.5 Normality test
4.6 t-test, chi-square test, F-test, ANOVA
4.7 Kruskal-Wallis, Mann-Whitney

5. Correlation and Regression (7 hrs)
5.1 Types of correlation
5.2 Methods to measure correlation- scatter diagram, Karlpearson‟s coefficient of correlation, Spearman‟s correlation
5.3 Types of regression analysis
5.4 Regression equations
5.5 Difference between regression and correlation analysis

6. Probability distributions (4 hrs)
6.1 Basic concepts and definition:
6.2 Laws of probability
6.3 Probability distribution (Binomial, poisson and normal)

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Biostatistics

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FIRST SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY III- SYSTEMATICS AND EVOLUTION
Code: VPZO1C03
(90 Hours)

SECTION A: SYSTEMATICS (45 hours)

1. Definition and basic concepts in Systematics and Taxonomy (4 hrs)

1.1 Historical resume of systematics
1.2 Levels of taxonomy - Alpha, Beta, Gamma
1.3 Importance and application of Taxonomy
1.4 Goals of taxonomy

2. Classification (4 hrs)

2.1 Practice of classification, purpose of classification
2.2 Use of classification- storage of data, recovery of data
2.3 Theories of biological classification, hierarchy of categories
2.4 Types of classification- evolutionary & phylogenetic classification, typological classification, phonetic classification, omnispective classification, horizontal and vertical classification
2.5 Components of classification

3. Taxonomic procedure (8 hrs)

3.1 Taxonomic collections- types of collections, value of collections, types of Museum collections
3.2 Curation- preservation of collection in field and laboratory
3.3 Recording of field data, storage of collection, labelling and cataloguing of collections
3.4 Identification- methods of identification, use of keys, kinds of keys, their merits and demerits
3.5 Taxonomic descriptions, presentation of findings
3.6 Kinds of taxonomic publications, ecological publication and their difference

4. Species concepts (7 hrs)

4.1 Species category- different species concepts- typological, Nominalistic, biological, evolutionary, recognition, ontological (theoretical) and operational (epistemological species concepts)
4.2 Taxonomic diversity within species, different kinds of species, sub species and other infra specific categories, hybrids

5. Taxonomic character (4 hrs)

5.1 Different kinds of taxonomic characters
5.2 Functions of taxonomic characters
5.3 Taxonomic characters and classification
5.4 Taxonomic characters and evolution

6. Zoological nomenclature (5 hrs)

6.1 International Code of Zoological Nomenclature, development of Code of Zoological Nomenclature: its operative principles, interpretation and application of important rules in the formation of scientific names of various taxa
6.2 Principle of priority, homonymy and synonymy

6.3 Type method and its significance, different kinds of types in descriptive taxonomy

7. Newer trends in systematic (4 hrs)

7.1 Chemo and serotaxonomy
7.2 Cytotaxonomy
7.3 Numerical taxonomy
7.4 Cladistics
7.5 Molecular systematic
7.6 DNA bar coding vs traditional taxonomy

8. Ethics in taxonomy (5 hrs)

8.1 Ethics related to collections
Credit
Lending and borrowing of specimens
Loan of material
Exchange of materials
Collaboration and co-operation with co-workers
Use of language
8.2 Ethics related to taxonomic publications
Authorship of taxonomic papers
Correspondence
Suppression of data
Undesirable features of taxonomic papers
8.3 Taxonomists and user communities

9. Taxonomic impediments (4 hrs)

9.1 Impediments to build up taxonomic collections and maintenance
9.2 Shortage of man power
9.3 Lack of funding for taxonomic research
9.4 Lack of training in taxonomy
9.5 Lack of library facilities
9.6 Impediments in publishing taxonomic work
9.7 Solutions to overcome the impediments
International co-operation, development of taxonomic centres
9.8 Need for efficient international networking
9.9 The desired end product

SECTION B: EVOLUTION (45 hrs)

1. Natural Selection (7 hrs)

1.1 Mechanism of natural selection - directional, disruptive and stabilizing selection
1.2 Natural selection in Islands
1.3 Sexual selection- Intrasexual and intersexual selection, secondary sex characteristics, sexy son hypothesis, good genes hypothesis

2. The Mechanisms (10 hrs)

2.1 Population genetics – populations, gene pool, gene frequency, Hardy-Weinberg law, founder principle, bottleneck effect and genetic drift as factors in speciation.
2.2 Isolating mechanisms- Prezygotic and Postzygotic isolating mechanisms
2.3 Speciation-allopatric, peripartric, parapatric, heteropatric, sympatric speciation, ecotypes

2.4 Co-evolution, Microevolution, Macroevolution, convergent (homoplasy), divergent and parallel evolution

3. Tempo of evolution (8 hrs)

3.1 Gradualism vs punctuated equilibrium

3.2 Anagenesis vs Cladogenesis

4. Molecular evolution (10 hrs)

4.1 Neutral theory of molecular evolution, molecular divergence, molecular drive

4. 2 Molecular clocks, genetic equidistance, human mitochondrial molecular clock

4.3 Phylogenetic relationships- homology, orthogous, paralogous, parsimony, homologous sequences of protein and DNA analysis, nucleotide sequence analysis, DNA bar coding vs traditional taxonomy

5. Evolutionary trends (10 hrs)

5.1 Biochemical evolution- RNA world hypothesis, collapse of Orthogenesis, Evo-Devo, heterochrony, heterotopy, heterometry and heterotypy

5.2 Stages in primate evolution- *Homo*, dry and wet nosed primates, prosimians and simians, humans, African origin for modern humans. Y-chromosomal Adam- mitochondrial Eve

5.3 Communication, speech, language and self awareness in primates

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Systematics

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Evolution

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SECOND SEMESTER M.Sc. ZOOLOGY
PROGRAMME THEORY IV- PHYSIOLOGY
Code: VPZO2C04
(90 Hours)

1. Nutrition (12 hrs)

1.1 Constituents of normal diet and their daily requirements
1.2 Physiological calorie value of food stuffs
1.3 Antioxidant nutrients
1.4 Digestion of carbohydrate, protein & lipids, brief note on the role of salivary glands, liver, pancreas and intestinal glands in digestion
1.5 Absorption of carbohydrates, lipids, amino acids, water, electrolytes, vitamins & minerals
1.6 Movements of GI tract: deglutition, gastric motility and emptying, intestinal motility and defecation
1.7 The role of hormones and neurotransmitters in the control of gastrointestinal motility
1.8 Energy balance and obesity, causes and consequences
1.9 BMR and its significance

2. Excretory system (12 hrs)

2.1 Introduction- brief description of different types of excretory organs in different animal groups
2.2 Functional anatomy of mammalian kidney, nephron and juxtaglomerular apparatus- structure, parts and function
2.3 Urine formation (glomerular filtration, tubular re-absorption and tubular secretion)
2.4 Regulation of water balance - mechanism of concentration of urine, counter current system (counter current multiplier and counter current exchanger)
2.5 Renal regulation of acid base balance
2.6 Composition (normal & abnormal) and characteristics of urine
2.7 Physiology of micturition
2.8 Renal clearance – definition, concept and significance, clearance value of urea, creatinine, phosphate, potassium, chloride and sodium

3. Respiratory system (13 hrs)

3.1 Introduction- brief description of major respiratory organs (tracheal system, book lungs, gills and ctenidia)
3.2 Physiological anatomy and histology of respiratory passage and lungs
3.3 Mechanism of pulmonary ventilation (inspiration & expiration)
3.4 Alveolar ventilation, dead space and its effect on alveolar ventilation
3.5 Role of surfactant in alveolar expansion
3.6 Pulmonary volumes and capacities – definition, normal values (tidal volume, inspiratory reserve volume, expiratory reserve volume, residual volume, functional residual capacity, inspiratory capacity, vital capacity, total lung capacity)
3.7 Exchange of gases
3.8 Transport of gases -transport of oxygen and carbon dioxide
Oxygen dissociation curve - factors affecting binding of oxygen to haemoglobin (PO_2, PCO_2, CO, pH, body temperature, diphosphoglyceric acid level, foetal haemoglobin and also myoglobin)
3.9 Neural and chemical regulation of respiration

4. Nervous system (18 hrs)

4.1 Introduction- basic details of neurons and action potential

4.2 Gross neuroanatomy of the brain (histology & neural pathway not expected)

Cerebral cortex -motor cortex, mention functional areas (including specialized areas) and their motor functions

Cerebral cortex- Association areas, their sub areas and their functions, Wernicke‟s area and its intellectual function

Memory – definition, types of memory (positive and negative memory), brief note on the mechanism of short term, intermediate long term and long term memory, consolidation of memory

Brain stem – list the components (medulla, pons, mesencephalon, reticular and vestibular nuclei) and functions

Cerebellum- mention parts and functions

Basal ganglia – mention components and functions

Limbic system; structure and functions (emotion and motivation)

4.3 Gross neuroanatomy of the spinal cord

Spinal cord - structural organization

Reflex action – reflex arc, muscle spindle, golgi tendon organ

Types of reflexes- monosynaptic reflex (Muscle stretch reflex, negative stretch reflex), polysynaptic reflex (withdrawal reflex)

4.4 Diseased states of brain – brief description of epilepsy, depression, schizophrenia, Alzheimer‟s disease, senile dementia & Parkinson‟s disease

5. Special senses (13 hrs)

5.1 Vision

Structure of eyeball

Fluid systems of the eye

Layers of Retina and photoreceptors (rods & cones)

Brief notes on the neuronal cell types and neural circuitary of the retina and visual pathways from retina to visual cortex

Image formation, formation of image on the retina, brief general account of electrophysiology of vision, photochemistry of vision & colour vision, problems related to vision

5.2 Taste, primary sensations of taste (agents and site of sensation)

Taste buds (location, structure, receptors and nerve supply)

Physiology of taste (receptor stimulation, generation of nerve impulse by taste buds and its transmission to CNS)

5.3 Smell, olfactory membrane and receptor cells

Physiology of olfaction (stimulation of olfactory cells and transmission of smell signals to CNS)

6. Tactile response (brief note) (4 hrs)

6.1 Mechanoreceptors and their stimulation

6.2 Pain receptors and their stimulation

6.3Thermal receptors and their stimulation

7. Cardiovascular system (8 hrs)

7.1 Introduction- brief description of vertebrate hearts

7.2 Structural organization of myogenic heart (in human beings)

7.3 Physiological anatomy of cardiac muscle - specialized tissue

7.4 Heart as a pump
7.5 Cardiac cycle
7.6 ECG – Principle and application
7.7 Neural and chemical regulation of heart function
7.8 Blood volume and blood pressure
7.9 Physiological anatomy of coronary blood flow, coronary blood flow and its control
7.10 Ischemic heart disease – mention causes and example

8. Lymphatic system (5hrs)
8.1 Lymph channels of the body
8.2 Composition and formation of lymph
8.3 Functions of lymph and lymphatic system including role in controlling interstitial fluid, protein concentration, interstitial fluid volume and interstitial fluid pressure

9. Environmental physiology (5hrs)
9.1 Thermoregulation
Comfort zone, normal body temperatures (oral, skin & core), heat production & heat loss, factors affecting body temperature, lethal temperature
9.2 Temperature regulating mechanisms (hot & cold), mention the role of hypothalamus, thyroid and adrenal glands
9.3 Acclimatization

REFERENCES

1. Arthur C. Guyton & John E. Hall (2003) Textbook of Medical Physiology, Saunders (An imprint of Elsevier).
2. William F. Ganong (1999) Review of Medical Physiology, Lange Medical Publications (Appleton & Lange).
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SECOND SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY V: ECOLOGY AND ETHOLOGY
Code: VPZO2C05
(90 Hours)

SECTION A: ECOLOGY (65 hrs)

1. Natural history of Indian subcontinent (3 hrs)

1.1 Major habitat types of the subcontinent
1.2 Geographic origin and migration of species
1.3 Seasonality of the subcontinent
1.4 Resistance and resilience stability
1.5 Gaia hypothesis

2. Habitat and niche (3 hrs)

2.1 Concept of habitat and niche
2.2 Niche width and overlap
2.3 Fundamental and realized niche
2.4 Resource partitioning
2.5 Character displacement

3. Ecosystem (9 hrs)

3.1 Structure and function
3.2 Ecosystem energetics
3.3 Primary production
3.4 Energy flow models
3.5 Mineral cycling (CNP)
3.6 Trophic levels, food chain, food web and secondary production.
3.7 Decomposers and detritivores
3.8 Structure and function of some Indian ecosystems-
Terrestrial- major forest types in India with their features, grassland, desert
Fresh water, marine, coral reef, estuarine, wetland and mangrove ecosystems

4. Population Ecology (7 hrs)

4.1 Characteristics of a population
4.2 Methods of estimating population density of animals, ranging patterns through direct, indirect and remote observations
4.3 Sampling methods in the study of behaviour, habitat characterization
4.4 Ground and remote sensing methods
4.5 Population growth curves, life tables, survivorship curves, population regulation, life history strategies, r and k selection, demes and dispersal, interdemic extinctions, age structure of populations
4.6 Growth and regulation of human population

5. Species interaction (6 hrs)

5.1 Types of interactions, interspecific competition
5.2 Herbivory, carnivory, pollination, symbiosis, mutualism, commensalisms and protoco-operation

6. Community Ecology (7 hrs)

6.1 Nature of communities
6.2 Characteristics of a biotic community
6.3 Species diversity and its measurements
Alpha diversity- Simpson's Diversity Index -Shannon index -Fisher's Alpha- Rarefaction,
Beta diversity –Sorensen‟s similarity index-Whittaker's measure
Gamma diversity –Guild and its functioning in the community
6.4 Latitudinal gradients in diversity
6.5 Edges and ecotones

7. Ecological succession (4 hrs)
7.1 Types, mechanisms
7.2 Changes involved in succession
7.3 Concept of climax

8. Biogeography (6 hrs)
8.1 Major terrestrial biomes:
Tropical rain Forest, grassland, desert, chaparral, temperate deciduous forest, temperate boreal forest, tundra, savanna

9. Theory of island biogeography (4 hrs)
9.1 Theory, influencing factors
9.2 Applications in conservation biology
9.3 Species-area relationship -single large or several small (SLOSS)
9.4 Development of habitat corridors

10. Biogeographical zones of India (4 hrs)
10.1 Trans Himalayan zone
10.2 Himalayan zone
10.3 Desert zone
10.4 Semiarid zone
10.5 Western Ghats zone
10.6 Deccan plateau zone
10.7 Gangetic plain zone
10.8 North east zone
10.9 Coastal zone
10.10 Islands present near the shore line

11. Applied ecology (8 hrs)
11.1 Environmental pollution (air, water, terrestrial and noise pollution)- causes and consequences
11.2 Global environmental change (global warming and ozone layer depletion), climate change
11.3 Biodiversity with special reference to India, status monitoring and documentation, major drivers of biodiversity change
11.4 Biodiversity management approaches- *Ex situ* and *in situ* conservation strategies

12. Conservation Biology (4 hrs)
12.1 Principles of conservation

12.2 Major approaches to management with reference to Indian case studies on conservation & management strategy (concepts of project tiger, biosphere reserves)

SECTION B: ETHOLOGY (25 hrs)

1. Introduction (4 hrs)

1.1 Ethology as different from the other schools studying animal behaviour like behaviourism
Behaviour as a reaction to stimuli - sign stimuli, social releasers
1.2 Ethograms, super normal stimuli, stimulus filtering

2. Motivating factors (5 hrs)

2.1 General factors in motivation, studies of motivation in guppies
2.2 Mating systems-parental investment and reproductive success

3. Conflict behaviour (3 hrs)

3.1 Stress-displacement activities, ritualization

4. Instinct behaviour and reflex action (2 hrs)

Neural basis of sleep and arousal

5. Adaptiveness of behavior (2 hrs)

J.P.Scotts categories of behaviour

6. External stimulus - circadian rhythms (3 hrs)

7. Parental care -Social behaviour (3 hrs)

Termites
Primates (Macaque, Langurs)

8. Evolution of behaviour (3 hrs)

Altruism, kin selection, inclusive fitness**,** selfish gene theory, cultural transmission of behaviour, domestication and behavioural changes

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SECOND SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY VI: DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY
Code : VPZO2C06
(90 Hours)

SECTION A: DEVELOPMENTAL BIOLOGY (55 hrs)

1. Introduction- Basic concepts of development (7 hrs)

1.1 Potency
1.2 Commitment
1.3 Specification - autonomous, conditional
1.4 Induction
1.5 Competence
1.6 Determination and differentiation
1.7 Morphogenetic gradients

2. Gametogenesis, fertilization and early development (10 hrs)

2.1 Production of gametes
2.2 Cell surface molecules in sperm-egg recognition in animals
2.3 Zygote formation
2.4 Cleavage and blastula formation
2.5 Embryonic fields
2.6 Gastrulation and formation of germ layers in amphibia

3. Embryogenesis and Organogenesis (10 hrs)

3.1 Axis formation in amphibians - primary embryonic induction
3.2 Anterior posterior patterning in Amphibians - Hox code hypothesis
3.3 Anterior posterior patterning in Drosophila - gap genes, bicoid gradient, segmentation genes, pair rule genes, homeotic selector genes, realistor genes
3.4 Dorsoventral patterning and left right patterning - dorsal protein gradient in Drosophila
3.6 Limb development in chick
3.7 Insect wings and legs
3.8 Vulva formation in *Caenorhabditis elegans*

4. Cellular and Molecular basis of development (10 hrs)

4.1 Cellular interactions during development
Epithelial - mesenchymal interactions, paracrine factors, RTK pathway, JAK-STAT pathway, cell death pathways
4.2 Cellular interactions concerned in fertilization
4.3 Cellular changes during blastulation and gastrulation
4.4 Cellular interactions in organogenesis
4.5 Molecular basis of cellular differentiation - cadherins

5. Genetic basis of development (7 hrs)

5.1 Differential gene expression
Promoters, transcription factors, silencers, DNA methylation, insulators, dosage compensation, differential RNA processing
5.2 Models of cell differentiation
5.3 Reversibility of patterns of gene activity

6. Metamorphosis, Regeneration and Aging (7 hrs)

6.1 Metamorphosis in amphibians and insects and their hormonal control

6.2 Types of regeneration - super, hetero, epimorphic, morphallactic and compensatory regeneration, histological process during regeneration

6.3 Ageing – cellular and extra cellular aging, causes, wear and tear, oxidative damage, mitochondrial genome damage, genetically programmed aging

7. Environmental regulation of animal development (4 hrs)

7.1 Environmental regulation of normal development – types of polyphenism

sex determination in Bonellia, primary and secondary sex determination, environmental sex determination

7.2 Environmental disruptions of normal development (Teratogenesis)

Teratogenic agents - Alcohol, retinoic acid, bisphenol, heavy metals, pathogen

7.3 Environmental oestrogens

SECTION B: ENDOCRINOLOGY (35 hrs)

1. Endocrine glands and their hormones (Brief account) (3 hrs)

1.1 Hormone secreting tissues –skin, liver, kidney, heart

1.2 General classes of chemical messengers- peptide, thyroid, steroid hormones, neurotransmitters and pheromones

1.3 Synthesis and delivery of hormones- storage, secretion and transportation

1.4 Physiological roles of hormones

1.5 Control of hormone secretion

2. General mechanisms of Hormonal action (5 hrs)

2.1 Cell signalling

2.2 Receptors and transducers, types of receptors, regulation of receptor number, receptor activation

2.3 Second messengers of hormone action, receptor signal transduction

2.4 Eicosanoids and hormone action

3. Endocrine glands (15 hrs)

Structure, physiological functions and control of secretion of their hormones and pathophysiology of

3.1 Hypothalamus

3.2 Hypophysis

3.3 Thyroid

3.4 Parathyroid

3.5 Adrenal

3.6 Pancreas

4. Hormones and male reproductive physiology (3 hrs)

4.1 Synthesis, chemistry, and metabolism of androgens

4.2 Endocrine control of testicular function

4.3 Physiological roles of androgens and estrogens

4.4 Pathophysiology

5. Hormones and female reproductive physiology (6 hrs)

5.1 Synthesis, chemistry, and metabolism of ovarian steroid hormones

5.2 Physiological roles of ovarian steroid hormones
5.3 Hormonal regulation of female monthly rhythm
5.4 Hormonal factors in pregnancy, parturition and lactation

6. Neurohormones (3 hrs)
6.1 Gases as neural messengers
6.2 Endorphins- physiological roles, mechanism of action and pathophysiology
6.3 Brain hormones and behaviour
6.4 Neuroendocrine pathophysiology

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Endocrinology

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THIRD SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY VII- CELL AND MOLECULAR BIOLOGY
Code: VPZO3C07
(90 Hours)

1. DNA replication (11 hrs)

1.1 Semi-discontinuous synthesis- Okazaki fragments
1.2 Replication origin and replication fork
1.3 Unit of replication, extra chromosomal replicons
1.4 Enzymes/proteins of replication- primase, replisomes, helicase, DNA polymerases, single strand binding proteins, topoisomerases and ligase, fidelity of replication
1.5 Replication of the ends of eukaryotic chromosome – role of telomerase
1.6 Models of DNA replication –Rolling circle model and looped rolling circle model, D-loop model, θ-model
1.7 Inhibitors of DNA replication – Methotrexate and Fluorodeoxyuridylate

2. Safeguard systems of DNA (5 hrs)

2.1 Restriction - significance, role and features of Type I, II & III restriction enzymes
2.2 Modification- enzymes and significance
2.3 Repair - major kinds of damage to DNA and causes
Repair mechanisms: direct reversal, mismatch repair, excision repair, recombination repair, SOS response

3. Transcription of mRNA in prokaryotes and eukaryotes (9 hrs)

3.1 Structural organisation and life span of mRNA, monocistronic and polycistronic mRNA
3.2 Initiation, elongation and termination of transcription
3.3 Promoter (mention Pribnow, TATA, CAAT and GC box), enhancer and silencer sites
3.4 Transcription factors - Transcription activators and repressors
3.5 Characteristic features of RNA polymerases of phages, prokaryotes and eukaryotes and their functions
3.6 Post transcriptional modification of RNA
Capping, polyadenylation, splicing
3.7 RNA editing - site specific deamination and role of gRNAs
3.8 mRNA transport

4. Genetic code (5 hrs)

4.1 Characteristics of genetic code
4.2 Start codons and stop codons
4.3 Degeneracy of the code - Wobble hypothesis and isoacceptor tRNAs
4.4 Special features of the genetic code in mitochondria, mitochondrial tRNA
4.5 Variations in the genetic code in *Mycoplasma* and *Tetrahymena*
4.6 Point mutations that alter genetic code (missense, nonsense & frameshift)
4.7 Suppressor mutation, suppressor genes & suppressor tRNA

5. Ribosome (5 hrs)

5.1 Composition, topography, active centres and biogenesis of ribosome
5.2 Experiments to understand composition, topography, active centres and biogenesis of ribosome
Composition - Reconstitution experiments, r-protein mutants

Topography, methods to study ribosome structure - Immune electron microscopy, cross linking
5.3 Active centres, affinity labelling
5.4 Biogenesis, anucleolate mutants in *Xenopus laevis*

6. Translation in prokaryotes and eukaryotes (8 hrs)
6.1 Aminoacylation of tRNA, initiation, elongation and termination of protein synthesis
6.2 Aminoacyl tRNA synthetases & initiation, elongation and termination factors
6.3 Translational proof-reading
6.4 Differences in protein synthesis between prokaryotes and eukaryotes
6.5 Translational inhibitors in prokaryotes and eukaryotes – role of tetracycline, streptomycin, neomycin, chloramphenicol, erythromycin, puromycin and diphtheria toxin
6.6 Post- translational modification of proteins - protein folding (role of chaperones) and biochemical modifications

7. Control of gene expression at transcription and translation level (8 hrs)
7.1 Regulation of gene expression in Phages – alternate patterns of gene expression for control of lytic and lysogenic cycle in λ phage
7.2 Regulation of gene expression in bacteria – basic features of tryptophan, arabinose and galactose operons, riboswitches
7.3 Regulation of gene expression in eukaryotes –
Role of chromatin in regulating gene expression
Activation and repression of transcription
Regulation of translation by gene arrangement
Regulation of translation by alternate pathways of transcript splicing
Antisense RNA strategies for regulating gene expression
si RNA and mi RNA in regulation

8. Eukaryotic genome: (5 hrs)
8.1 Special features of eukaryotic genome
8.2 Features, components and reassociation kinetics of unique, moderately repetitive and highly repetitive DNA
8.3 Junk DNA, satellite DNA and selfish DNA
8.4 Cot value and complexity of genome
8.5 Organisation of human genome (brief account)

9. Interrupted genes (4 hrs)
9.1 Definition and explanation
9.2 Organisation and special features of interrupted genes
9.3 Evolution of interrupted genes

10. Gene families (6 hrs)
10.1 Definition and concept
10.2 Classification with example
Simple multigene family - organisation of rRNA gene in *Xenopus*
Complex multigene family - organisation of histone genes in sea urchin and tRNA genes in *Drosophila*
Developmentally controlled complex multigene family e.g. globin gene
Globin genes and its products, organisation of globin genes and its expression in man,
Evolution of globin genes

10.3 Concept of an evolutionary clock
10.4 Pseudogenes

11. Transposable genetic elements - Transposons (6 hrs)
11.1 Definition, features and types
11.2 Transposition and mechanism
11.3 Transposons in bacteria
IS elements, Tn family
μ phage as a transposable element
11.4 Transposons in eukaryotes
SINE, Alu family, LINE, L1
P elements in *Drosophila*
Transposons in Maize
11.5 Retroviruses and transposition

12. Molecular mechanisms involved in recombination of DNA (4 hrs)
12.1 Genetic recombination – types with example
Site specific recombination, non-homologous recombination, homologous recombination
12.2 Molecular mechanism involved in homologous recombination of DNA in eukaryotes- Holliday model, Holliday intermediate, heteroduplex DNA, gene conversion
12.3 Role of Rec A protein in genetic recombination

13. Microbial genetics (5 hrs)
13.1 Prokaryotic genome- structural organisation of *Escherichia coli*
13.2 Methods of genetic transfers in bacteria– transformation (in *Streptococcus pneumonia*), conjugation and sexduction, transduction
13.3 Brief note on mapping genes by interrupted mating (in bacteria)

14. Organelle genome (4 hrs)
14.1 Extra nuclear genes and maternal inheritance
14.2 Chloroplast genome: special features
14.3 Mitochondrial genome
Special features of yeast mitochondrial genome, petite mutants
Special features of human mitochondrial genome

15. Cancer (5 hrs)
15.1 Genetic rearrangements in progenitor cells
15.2 Oncogenes, protooncogenes and tumour suppressor genes
15.3 Virus-induced cancer
15.4 Cancer and the cell cycle
15.5 Cancer and apoptosis
15.6 Interaction of cancer cells with normal cells
15.7 New therapeutic interventions of uncontrolled cell growth (immunotherapy and gene therapy)

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THIRD SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY VIII- ELECTIVE
FISHERY BIOLOGY-I
TAXONOMY, BIOLOGY, PHYSIOLOGY & ECOLOGY
Code: VPZO3E11
(90 Hours)

SECTION A: TAXONOMY (5 hrs)

1. Fish Taxonomy (5 hrs)

1.1 Classification and distribution of economically important fin fishes

SECTION B: FISH BIOLOGY (20 hrs)

1. Integument (10 hrs)

1.1 Exoskeleton
1.2 Skin and scales
1.3 Colouration
1.4 Chromatophores and pigments
1.5 Structure, function and modification of fins

2. Locomotion (5 hr)

2.1 Body shape and musculature
2.2 Mechanism of propulsion- forces
2.3 Types of locomotion

3. Life history of fishes (5 hrs)

3.1 Reproduction, reproductive hormones, reproductive behaviour, oviparity, ovoviviparity
3.2 Age and growth
3.3 Migration

SECTION C: PHYSIOLOGY (40 hrs)

1. Digestive physiology (10 hrs)

1.1 Food and feeding
1.2 Feeding behaviour
1.3 Feeding mechanism
1.4 Digestive enzymes
1.5 Absorption

2. Circulatory physiology (6 hrs)

2.1 Heart
2.2 Blood, blood cells, blood pigments and functions of blood
2.3 Circulation

3. Respiratory physiology (6 hrs)

3.1 Gills and accessory respiratory organs
3.2 Gas transport

4. Excretory and osmoregulatory physiology (6 hrs)

4.1 Excretory organs
4.2 Osmoregulation in marine, brackish water and fresh water fishes

5. Endocrine physiology (6 hrs)

5.1 Endocrine glands – structure and function

5.2 Regulation of endocrine secretion

5.3 Crustacean neurosecretory system and their role in reproduction

6. Adaptive physiology (6 hrs)

6.1 Deep sea fishes

6.2 Cave dwelling fishes

6.3 Hill stream fishes

SECTION D: ECOLOGY (25 hrs)

1. Oceanography (15 hrs)

1.1 Ecological subdivisions of the sea

1.2 Major topographic features of continental shelf, continental slope and ocean floor

1.3 Physico-chemical properties of sea water

1.4 Ocean currents

1.5 Ocean productivity

1.6 Coral reefs

2. Brackish water ecology (5 hrs)

2.1 Characteristics of brackish and estuarine waters

2.2 Estuarine productivity

3. Limnology (5 hrs)

3.1 Classification of inland waters – ponds, lakes, rivers and reservoirs

3.2 Physico-chemical properties of inland waters

THIRD SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY IX- ELECTIVE
FISHERY BIOLOGY- II
CAPTURE AND CULTURE FISHERIES
Code: VPZO3E21
(90 Hours)

1. Introduction to capture and culture fisheries (10 hrs)

1.1 Marine fisheries –

Crustaceans, molluscs, fin fishes, shrimps, crabs, lobsters, mussels, oysters cephalopods, sardine, mackerel, Bombay duck, pomfrets, ribbon fishes and Tuna

2. Freshwater fisheries (5 hrs)

2.1 Major river systems and fisheries

2.2 Lakes and reservoir fisheries

3. Estuarine fisheries (6 hrs)

3.1 Major estuaries and fisheries

4. Aquaculture (5 hrs)

4.1 History of aquaculture, scope and definition

4.2 Importance of aquaculture, present state of aquaculture, future prospectus

4.3 Classification of aquaculture practices

5. Design and construction of aqua farms and hatcheries (7 hrs)

5.1 Pond design and construction

5.2 Farm design and layout

5.3 Pond preparation

5.4 Cage farms

5.5 Pens and enclosures

5.6 Design and construction of hatcheries

6. Transportation and acclimatization (3 hrs)

7. Nutrition and feeds (3 hrs)

7.1 Feeding habits and food utilization

7.2 Live feeds

7.3 Artificial feeds

8. Water quality management (3 hrs)

8.1 Water quality parameters

8.2 Techniques for monitoring

8.3 Strategies for monitoring

9. Fertilizers and chemicals in aquaculture (2 hrs)

10. Reproduction and genetic selection (11 hrs)

10.1 Reproductive cycles

10.2 Control of reproduction

10.3 Induced breeding
10.4 Use of hormone analogues
10.5 Cryo-preservation of gamates
10.6 Sex reversal
10.7 Genetic selection and hybridization

11. Control of weeds, pests and predators in aquaculture (2 hrs)

12. Aquaculture practices (21 hrs)

12.1 Integrated fish farming –
Paddy cum fish culture, duck cum fish culture, pig cum fish culture
12.2 Polyculture
12.3 Culture of shrimps
12.4 Culture of prawns
12.5 Culture of crabs
12.6 Culture of edible oysters, pearl oysters and mussels
12.7 Culture of sea weeds
12.8 Culture of fresh water fishes – Indian major carps and exotic carps
12.9 Culture of cold water fishes – trout and mahaseer
12.10 Culture of brackish water fishes – mullets, milk fish and *Etroplus*
12.11 Culture of Holothuria

13. Preparation and maintenance of aquarium (5 hrs)

13.1 Types of aquaria
13.2 Preparation and maintenance
13.3 Equipments
13.4 Water Chemistry
13.5 Aquarium fishes and plants

14. Pathology (7 hrs)

14.1 Major fish diseases - viral, bacterial, fungal
14.2 Protozoan infections
14.3 Control and treatment

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Kumar Santosh and Tembhre Manju (2010

FOURTH SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY X- IMMUNOLOGY
Code: VPZO4C08
(90 Hours)

1. Introduction (6 hrs)

1.1 Innate and adaptive immunity
1.2 Cells and organs of the immune system
1.3 Antigens, antigenecity, immunogenecity and haptens
1.4 Factors influencing immunogenicity

2. Antibodies (14 hrs)

2.1 Structure and functions of antibody molecules
2.2 Generation of antibody diversity
2.3 Monoclonal antibodies - Hybridoma technology and applications
2.4 Antibody engineering

3. Antigen-Antibody Interactions (16 hrs)

3.1 Strength of antigen antibody interactions
3.2 Cross reactivity, precipitation reactions, agglutination reactions
3.3 Immunotechniques - ELISA, RIA, Western Blot, Immunoprecipitaion, Immunofluorence microscopy, Flow cytometry

4. Generation of B cell & T cell response (12 hrs)

4.1 Humoral & cell mediated response
4.2 B & T cell receptors and CD3 Complex
4.3 Properties of B cell & T cell epitopes
4.4 Activation and differentiation of B and T cells

5. Immune effector mechanisms (12 hrs)

5.1 Cytokines & antagonists
5.2 Complement System- components & functions
5.3 Complement activation and regulations (classical, alternate and lectin pathways)
5.4 Toll –like receptors
5.5 Cell mediated effector functions
5.6 Inflammation & hypersensitivity

6. Major Histocompatability Complex (MHC) (10 hrs)

6.1 General organisation and inheritance of MHC
6.2 MHC genes & molecules
6.3 Cellular distribution of MHC molecules
6.4 MHC and immune response
6.5 Antigen processing and presentation –Endogenous and Exogenous pathways
Presentation of non peptide bacterial antigens

7. Immune system in health and diseases (20 hrs)

7.1 Immune responses in bacterial (tuberculosis) parasitic (malaria) and viral (HIV) infections

7.2 Autoimmune diseases (organ specific and systemic)
7.3 Primary Immunodeficiency diseases -Bruton‟s disease, Di-george Syndrome & Severe combined immunodeficiency (SCID)
7.4 Secondary immunodeficiency diseases -AIDS (origin, means of infection, course of infection, structure and types of HIV, viral multiplication, mutation, diagnosis, antiretroviral therapy and AIDS vaccine)
7.5 Vaccines –Recombinant , DNA vaccines, synthetic peptide vaccines and multivalent vaccines

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FOURTH SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY XI- MICROBIOLOGY & BIOTECHNOLOGY
Code: VPZO4C09
(90 Hours)

SECTION A: MICROBIOLOGY (45 Hours)

1. Introduction (3 hrs)

1.1 History and scope of microbiology
1.2 Spontaneous generation concept
1.3 Recognition of the role of microbes in diseases
1.4 Composition of the microbial world
1.5 Turning points in microbial research
1.6 Microorganisms and the evolution of the earth
1.7 Modern age of microbiology

2. Microbial taxonomy and phylogeny (4 hrs)

2.1 Major characteristics (classic and molecular)
2.2 Numerical taxonomy
2.3 Taxonomic ranks
2.4 Phylogenetic studies
2.5 Phenetic classification
2.6 Bergey‟s Manuel (mention major groups)

3. Bacterial cell structure and function (6 hrs)

3.1 Plasma membrane and internal system - cytometrix, inclusions, ribosomes, nucleoid
3.2 Bacterial cell wall –peptidoglycan, structure
3.3 Gram positive and gram negative cell wall- mechanism of gram staining
3.4 Components external to cell wall- pili and fimbriae, capsule and slime layers
3.5 Flagella and motility

4. Microbial nutrition (3 hrs)

4.1 Nutritional requirements
4.2 Nutritional types (auto, hetero, chemo, phototrophs & obligate parasites)
4.3 Culture media and types of media
4.4 Mixed microbial population and pure cultures

5. Microbial growth (5 hrs)

5.1 Growth curve -synchronous growth
5.2 Continuous culture
5.3 Influence of environmental factors on growth
5.4 Measurement of growth
5.5 Measurement of cell numbers-
Petroff, Hassuer counting Chamber, Spread plate and pour plate techniques
5.6 Measurement of cell mass-turbidity and microbial mass measurements

6. Utilization of energy (4 hrs)

6.1 Biosynthetic process-
Peptidoglycan synthesis, amino acid synthesis, non synthetic processes

6.2 Bacterial motility and transport of nutrients

7. Viruses (4 hrs)
7.1 General structural properties
7.2 Types- DNA viruses, RNA viruses, and enveloped viruses

8. Microbial diseases (4 hrs)
8.1 Human diseases caused by bacteria- *Streptococcal* diseases, typhoid, cholera, tetanus, leprosy, tuberculosis and Pneumonia
8.2 Human diseases caused by viruses - AIDS, small pox, rabies, measles, swine flu, bird flu, SARS
8.3 Fungal diseases- candidiasis

9. Control of microorganisms (5 hrs)
9.1 Disinfectants-
Physical- heat, filtration and radiation
Chemical agents - phenol and phenolic compounds, alcohols, halogens and aldehydes
9.2 Antibiotics- Penicillin‟s, Cephalosporins, Chloramphenicol, Tetracyclines
9.3 Microbial drug resistance

10. Microbial fermentation (4 hrs)
10.1 Lactic fermentation - homolactic and heterolactic fermenters
10.2 Dairy products cheese, Yogurt, kefir (brief)
10.2 Alcoholic fermentation- alcoholic beverages

11. Environmental microbiology (3 hrs)
11.1 Aquatic microbes
11.2 Microbiological analysis of drinking water
11.3 Waste water- microbial characteristics and treatment
11.4 Microbial Bioremediation- microbial fouling and corrosion
11.5 Biogas plants

SECTION B: BIOTECHNOLOGY (45 hrs)

1. Introduction (1 hr)
1.1 Definition, scope and importance
1.2 Branches

2. Genetic engineering (4 hrs)
2.1 Cloning vectors – properties of a good cloning vector
2.2 Types of vectors -
Plasmids - pBR322, pBR327, pUC
Phages - lambda phage, M13
Cosmids, Phagemids, viruses, BAC, YAC and MAC
2.3 Shuttle vectors and expression vectors
2.4 Enzymes for r DNA technology- restriction enzymes and ligases

3. Different steps involved in *in vivo* cloning (3 hrs)
3.1 Construction of chimeric DNA (blunt end ligation, cohesive end ligation, homopolymer tailing, use of linkers)

3.2 Selection of transformed cells –blue white selection method, colony hybridization, Plaque hybridization
3.3 Amplification – multiplication, expression and integration of the DNA insert in host genome

4. Molecular probes (2 hrs)
4.1 Production
4.2 Labelling
4.3 Applications

5. Genomic and cDNA library (4 hrs)
5.1 Construction
5.2 Screening by - DNA hybridization, immunological assay, protein activity
5.3 Blotting techniques - Southern blot, northern blot, western blot, dot blot and slot blot
5.4 FISH and GISH, chromosome walking

6. Polymerase Chain Reaction (2 hrs)
6.1 Basic PCR – raw materials and steps involved
6.2 Inverse PCR, anchored PCR, asymmetric PCR, PCR for mutagenesis and real time PCR
6.3 Applications of PCR in biotechnology and genetic engineering

7. Molecular markers (brief notes) (3 hrs)
7.1 RFLP
7.2 AFLP
7.3 RAPD
7.4 Minisatellites (VNTR)
7.5 Microsatellites (SSR)
7.6 SNPs

8. Isolation, sequencing and synthesis of genes (4 hrs)
8.1 Isolation (for specific proteins and tissue specific proteins)
8.2.DNA sequencing – Maxam and Gilbert‟s chemical degradation method, Sanger‟s dideoxynucleotide synthetic method
8.3 Synthesis of gene- chemical synthesis of tRNA gene, synthesis of gene from mRNA, gene synthesis machines

9. Transfection methods and transgenic animals (3 hrs)
9.1 Definition, methods of transfection - Electroporation, DNA micro injection, Calcium phosphate precipitation, Dextran mediated transfer, shot gun method, virus mediated, lipofection method, engineered embryonic stem cell method
9.2 Transgenic animals for human welfare

10. Biotechnology - animal and human health care (3 hrs)
10.1 Vaccines
10.2 Disease diagnosis
10.3 Gene therapy
10.4 Transplantation of bone marrow, artificial skin
10.5 Antenatal diagnosis
10.6 DNA finger printing
10.7 Forensic medicine

11. *In vitro* fertilization (2 hrs)

11.1 *In vitro* fertilization and embryo transfer in human

11.2 *In vitro* fertilization and embryo transfer in live stock

12. Animal cell and tissue culture (3 hrs)

12.1 Culture media – natural and artificial

12.2 Culture methods – primary explantation techniques, various methods of cell and tissue culture

12.3 Tissue and organ culture

13. Gene Silencing techniques (2 hrs)

13.1 Antisense RNA

13.2 RNAi

14. Cloning (2 hrs)

14.1 Cloning procedures (adult DNA cloning, therapeutic cloning, embryo cloning) –

14.2 Advantages and disadvantages of cloning

15. Environmental biotechnology (3 hrs)

15.1 Pollution control – cleaner technologies, toxic site reclamation, removal of oil spill, reducing of pesticides and fertilizers, biosensors, biomonitoring

15.2 Restoration of degraded lands - reforestation using micro propagation, development of stress tolerant plants

16. Intellectual property rights (2 hr)

16.1 Intellectual property protection

16.2 Patents, copy right, trade secrets, trademarks

16.3 GATT and TRIPS, patenting of biological materials, Geographical indicators

16.4 International co-operation, obligation with patent applications, implications of patenting-current issues

17. Ethical and social implications (2 hrs)

17.1 Ethics of Genetic engineering - social impacts, human safety, virus resistant plants, animals and ethics

17.2 Release of GEOs-Use of herbicide resistant plants

17.3 Human genome alterations by biotechnology

17.4 Social acceptance of biotechnology-

Transgenic crops

Social acceptance of medical biotechnology

Acceptance of GM crops for food and pharmaceutical production

Social acceptance of industrial biotechnology

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Screening by - DNA hybridization, immunological assay, protein activity (Refer unit 4-Molecular Biotechnology by Glick and Pasternak-ASM press)
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FOURTH SEMESTER M.Sc ZOOLOGY PROGRAMME
THEORY XII- ELECTIVE
FISHERY BIOLOGY-III
HARVESTING, POST HARVESTING TECHNOLOGY AND MARKETING
Code: VPZO4E31
(90 Hours)

SECTIONA: HARVESTING & POST HARVESTING TECHNOLOGY (84 hrs)

1. Commercial fishing method (2 hr)

1.1 Brief history of commercial fishing

1.2 Introduction to materials for construction of nets and ropes

2. Crafts and gears for harvesting (21 hrs)

2.1 Towed or dragged gear
Bottom trawling
Beam trawl
Otter trawl
Side trawling
Stern trawling
Bottom pair trawling
Mid water (pelagic) trawling
Targeted and selective trawling
Turtle excluder device (TED)
Dredging
2.2 Encircling gear
Beach seining
Purse seining
Seine nesting
2.3 Static gear
Gill nets
Trap nets
Long lines
Pots and traps
2.4 Other gears
Squid jigging
Net fishing
Harpooning
2.5 Fish aggregating devices (FAD)
2.6 Echo-sounder and sonar
2.7 Catch per unit effort and economic consideration of vessel operations

3. Chemical composition of fish (2 hrs)

3.1 Chemical composition of fish muscle

3.2 Significance of proteins and lipids

3.3 Nutritive value of fish muscle over red meat

4. Post-mortem changes in fish muscle (4 hrs)

4.1 Pre-rigor mortis and post mortem changes

4.2 Physical and biochemical changes associated with the post mortem changes

4.3 Importance of post mortem changes in fish processing
4.4 Problems associated with post mortem changes and solutions

5. Fish spoilage mechanisms (4 hrs)
5.1 Microbial spoilage
5.2 Enzymatic spoilage
5.3 Biochemical spoilage

6. Handling of fresh fish (3 hrs)
6.1 Icing and icing methods
6.2 Different types of ice - block ice, flake ice and dry ice
6.3 Handling - on board chilling and use of refrigerated sea water (RSW)
6.4 Fish landing platforms
6.5 Hygienic handling of fish on board and on shore

7. Preservation and processing techniques (10 hrs)
7.1 Drying
7.2 Salting
7.3 Smoking
7.4 Freezing - plate freezers, blast freezers and individual quick freezing (IQF)
7.5 Battered and breaded products
7.6 Accelerated freeze drying (AFD)
7.7 Immersion freezing and cryogenic freezing
7.8 Canning
7.9 Irradiation
7.10 Assessment of capacity of plate, blast and IQF freezers

8. Processing of shrimps (3 hrs)
8.1 Commercially important prawns and shrimps of India
8.2 Pre-processing of prawns and shrimps into different varieties - peeled and deveined (PD), peeled and undeveined (PUD), head-less shrimps (HI), head on shrimps (HON)
8.3 Grades of shrimps
8.4 Cooked shrimps
8.5 IQF shrimp

9. Processing of lobsters (3 hrs)
9.1 Commercially important lobsters of India
9.2 Processing lobsters into different varieties of products
9.3 Grades of packing

10. Processing of cephalopods (3 hrs)
10.1 Commercially important cephalopods of India (squids and cuttlefish)
10.2 Pre-processing of cephalopods into different varieties
10.3 Grades of packing

11. Processing of fish (4 hrs)
11.1 Commercially important fishes of India
11.2 Fish filleting
11.3 Surimi
11.4 IWP products, grades for fish products

12. Fishery by-products (9 hrs)
12.1 Body oil, liver oil and sauces
12.2 Shark fins, fin rays, fish maws/isinglass
12.3 Fish silage, chitin and chitosan
12.4 Fermented fishery products

13. Fish processing plant and cold storage (2 hrs)
13.1 The pre-processing and processing plant, cold storage - general conditions relating to premises building, equipment, general conditions of hygienic of plant and workers, conditions of storage of frozen products
13.2 Requirements for registration with MPEDA, approval of processing plant by FIA allotment code

14. Quality control (7 hrs)
14.1 Fundamental aspects of quality
14.2 Major quality problems in sea foods
14.3 Quality of water and ice - chlorination and use of UV rays
14.4 Microbiology
14.5 Microbial hazards of sea foods - *E. coli, Salmonella, V. cholerae, Staphylococcus*
14.6 Inspection systems
14.7 Brief introduction to the quality control concepts of HACCP, ISO and IQM (total quality management)

15. Packing and export of seafood (4 hrs)
15.1 Methods of packing of various sea food products for export
15.2 Identification marks
15.3 In house stuffing and transport in refrigerated containers

16. Fishery education, research, development and export promotion agencies (3 hrs)
16.1 Objectives and activities of the following institutions (very brief) – CIFT, CMFRI, CIFNET, CIFE,NIO, FSI, CIBA, EIA, MPEDA
16.2 Objectives of fishery extension
16.3 Qualities for fishery extension workers
16.4 Organizations of extension programs

SECTION B: FISHERY MANAGEMENT & INTERNATIONAL MARKETING (6 hrs)

1. Fishery management (2 hrs)
1.1.Marketing of fish in India
1.2.Fisherman and fisherman co-operatives

2. International marketing (4 hrs)
2.1 Scope and importance
2.2 Major sea food products and markets of India
2.3 Documents required for export - letter of credit, invoice, bill of landing etc
2.4 Buyers and buyer‟s
agents Trade promotion

Role of trade promotion offices and
embassies Seafood trade fairs
Trade promotion visits
Value added products and its marketing

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