SYLLABUS

COURSES OF STUDY

(Effective for the session 2017-2018)

M.Sc. in ZOOLOGY

Four-Semester Course

POST-GRADUATE DEPARTMENT OF ZOOLOGY
GOVERNMENT AUTONOMOUS COLLEGE, ROURKELA
PANPOSH, ROURKELA-757004

Members.

1. Sameer Samara Prusty ..
2. Kalakar Sahu
3. Hema Kumar nayak

chairman

FIRST SEMESTER

PAPER 101: MICROBIOLOGY

75 Marks (60 marks end semester and 15 marks mid semester examination)

UNIT –I

History and development of microbiology, General features of Bergy's manual for classification of microbes, Whittakar's five kingdom concept, Carl Woese's 3 domain classification, Isolation, culture and maintenance of microorganisms, Microbial growth, continuous culture (chemostat), Factors influencing growth of microbes, Role of microbes in agriculture and industry.

UNIT -II

General features of Archaea, Structure, Nutrition and Reproduction of Eubacteria, Genetic recombination in bacteria (Transformation, Conjugation and Transduction), General features and pathogenecity of mycoplasma, Rickttsia and Spirochaetes.

Cyanobacteria: Cell structure and reproduction. Heterocysts: Structure, development and function

UNIT-III

Virus: General characteristics and classification of viruses, nature , morphology and chemistry of virus, transmission of virus, virus-vector relationship, replication of Bacteriophage

Plant virus- TMV, structure, transmission, pathogenicity and replication
Animal viruses - HIV, structure, transmission, pathogenicity and replication
Treatment and prevention by anti-virals and vaccine
Viroids and Prions.

UNIT –IV

Microbial toxins: types, mode of actions and
pathogenicity. Bacterial toxins: Endo and exotoxins

Fungal toxins: toxins of Aspergillus, Penicillium, Fusarium and Alternaria

Algal toxins: cyanotoxins and dinotoxins

Chemotherapeutic agents: antibiotics and their mode of action; bacterial drugs (Penicillin, fluoroquinolones, tetracycline and aminoglycosides)

Kalakar Sahu

SEMESTER FIRST

PAPER 102: Genetics

75 Marks (60 marks end semester and 15 marks mid semester examination)

UNIT-I

Mendel's experiments and laws of inheritance, gene interaction with epistasis or modified mendelian dihybrid ratios: masking gene action, supplementary gene action, duplicate gene action, complementary gene action

Multiple allele in human (ABO blood group); eye colour in Drosophila, self incompatibility in plants:

Polygenic inheritance, pleiotrophy

Maternal effects and cytoplasmic inheritance, mitochondrial & chloroplast genome

UNIT-II

Sex chromosomes, Chromosomal sex determination: XX-XY, XX-XO and ZZ-ZW systems, Compound sex chromosome,

Meiotic behavior of chromosomes: Primary & Secondary non-disjunction, Genic balance theory of sex determination, Sex determination in humans and Drosophila with special reference to SRY and sex lethal genes.

Sex linkage: Sex linked genes in man, sex chromosome disorders in man, Sex influenced dominance by sex-linked gene expression.

Sex determination in plants with special reference to Melandrium

UNIT-III

Linkage groups: Complete and incomplete linkage

Crossing over: Relationship between genetic and cytological crossing over, Relationship between crossing over and chaisma formation, molecular mechanism of crossing over

Detection of linkage & Linkage maps: Test cross, test for linkage on the basis of F_2 generation, LOD score, gene mapping, three point test cross in Drosophila, construction of linkage maps, identification of particular linkage groups with specific chromosome, physical distance and map distance

Interference and coincidence

Mitotic Recombination, Recombination within gene

UNIT-IV

Structural and numerical alterations in chromosomes: Spontaneous and induced mutations, physical and chemical mutagens, chromosomal aberrations, meiotic behavior of deletion, duplication, inversion and translocation.

Euploids and aneuploids-classification, origin, induction, role of polyploidy in evolution and practical significance in crop improvement

Population genetics: Hardy-Weinberg's Law, genetics of quantitative traits in population

SEMESTER FIRST

PAPER 103: Biochemistry

75 Marks (60 marks end semester and 15 marks mid semester examination)

UNIT-I

Amino acids: Classification and properties, Acid–base properties, The Peptide bond, ionization behavior of peptides, biologically active peptides.

Levels of protein structure, Determination of primary structure of protein. Three dimensional structure of proteins (Secondary, tertiary and quaternary structures, structural patterns: motifs and domains), Protein denaturation and folding

Amino acid catabolism (transamination, oxidative deamination and urea cycle)
Protein degradation (proteosomal pathway) and Solid phase synthesis of peptides.

UNIT - II

Carbohydrates: Classification, configuration and conformation of monosaccharides, sugar derivatives, important disaccharides. Structural and storage polysaccharides, glucosaminoglycans, proteoglycans, glycoproteins and glycolipids

Carbohydrate metabolism: Glycolysis, TCA cycle, pentose-phosphate pathway. Gluconeogenesis, glycogen metabolism, regulation of carbohydrate metabolism, Oxidative phosphorylation, electron transport and ATP synthesis

UNIT –III

Enzymes: General properties, nomenclature and classification, extraction and assay Michaelis-Menten kinetics and its significance, Brigg's-Halden modification, determination of V_{max} and K_m

Mechanism of enzyme action: general acid-base catalysis, covalent catalysis, metal catalysis
Mechanism of action of RNAse, Lysozyme and Chymotrypsin

Enzyme inhibition: competitive, non-competitive inhibition, determination of K_i, allosteric regulation, covalent modification

UNIT – IV

Lipids: Classification, storage lipids, structural lipids (glycerophospholipid and sphingolipids), signaling lipids, cofactors, terpenes, and pigments.

Coenzymes and vitamins

Biosynthesis and oxidation of fatty acids, regulation of fatty acid metabolism

SEMESTER FIRST

Paper 104 : ANIMAL DIVERSITY (NON-CHORDATES &CHORDATES)

AND ANIMAL BEHAVIOUR

75 Marks (60 Marks end semester and 15 Marks mid-semester examination)

UNIT-I (Animal diversity-I: Non-chordates)

Nutrition in protozoa - Types and mode of feeding, Protozoan parasites in brief (*Trypanosoma, Plasmodium*), Canal system in Sponges, Coral reef formation and significance, Polymorphism in Coelenterates, Excretory structures and functions in Annelids, Helminth parasites (*Taenia, Ancylostoma*), Vision In insects

UNIT-II (Animal diversity-II: Non-chordates & Protochordates)

Torsion in Gastropoda, Nervous system in Cephalopods, Water vascular system in Echinoderms, Reproduction and development in Echinoderms with evolutionary significance, General characters & interrelationship of Proto-chordates and Siphon mechanism in Tunicates

UNIT-III (Animal diversity-III: Chordates)

General characters of Cyclostomes , Accessory respiratory organs in fishes , Origin of Amphibia, Adaptive radiation in reptiles, Classification of reptiles based on skull pattern, Flight adaptation in Birds General characters of Prototheria and Metatheria, Adaptive radiation in mammals

UNIT-IV (Animal behavior)

Classification & analysis of behavior patterns, Tools and Techniques in behavioural study, Neural & hormonal control of behavior , Communication in animals, Social organization of insects and mammals, Biological rhythms: Circadian , Parental care, Orientation & navigation: Migration of fish and bird

SEMESTER FIRST

Paper 105: PRACTICAL

100 marks (6 hours)

1. Study of museum specimens and micro-slides from phylum protozoa to mammalia

Protozoa	Euglena, Plasmodium, Paramoecium.
Porifera	Sycon, Hyalonema, Euspongia
Coelenterata	Physalia, Gorgonia, Pennatula, Aurelia, Fungia
Platyhelminthes	Dugesia, Fasciola, Ascaris, Taenia
Annelida	Hirudinea, Sabella, Aphrodite, Iereis, Heteronereis, Arenicola, Trochophore larva
Arthropoda	Lepas, Sacculina, Eupagurus, Larval forms in Arthropoda, Leaf insect and Stick insect
Mollusca	Chiton, Dentalium, Larval forms in Mollusca, Sepia, Nautilus, Loligo
Echinodermata	Larval forms , Antedon, Asterias, Echinus, Sea cucumber
Hemichordata	Balanoglossus
Cephalochordata	Amphioxus
Urochordata	Salpa, Doliolum, Ascidea
Cyclostomata	Petromyzon , Myxine
Pisces	Lung fish, Torpedo, Trygon, Exocoetus, Echines,Eel, Clarias, Hippocampus
Amphibia	Hyla, Alytes, Ichthyophis, Axolotl Larva, Salamander, Necturus
Reptilia	Chelone, Varanus, Draco, Russel viper, Naja naja, Gavialis
Aves	Psittacula, Dinopium, Type of Beaks, claws and feet
Mammalia	Echidna, Macropus, Pteropus, Rattus, Squirrel

2. Mounting of mouth parts of mosquito-identification of genera

3. Study of mitosis and meiosis

4. Preparation of karyotype and Pedigree analysis

5. Population genetics and Hardy-Weinberg Law (Blood group, Ear lobe and Tongue rolling experiment)

6. Estimation of protein by Biuret method.

7. Estimation of Carbohydrate by Anthrone method.

8. Estimation of lipid by Vanillin method.

9. Assay of Enzyme activity of alkaline phosphatase (Effect of temperature, Substrate, Concentration and time)

10. Determination of pKa value of Glycine

SECOND SEMESTER

Paper 201: PHYSIOLOGY & ENDOCRINOLOGY

75 Marks (60 Marks end semester and 15 Marks mid semester examination)

UNIT-I

Composition of blood, RBC anatomy, RBC Breakdown cycle, blood groups and mechanism of platelet plug formation and blood coagulation

The heart: cardiac cycle & its regulation, pulmonary ventilation, respiratory surface & gas exchange, regulation of respiration, transport of gases, acid base balance

Excretory system: Urine formation, glomerular filteration, tubular function, renal Mechanism of concentrating & diluting urine

UNIT-II

General organization of central nervous system, Type of neuronal cells, Structure and function of neuron and glia, Types of ion channels, Action potential, Electrical and Synaptic transmission, Neurotransmitters & Neuropeptides, Neuromuscular Junction, Blood brain barrier

Ultra structure of muscles, Regulatory, Structural and Contractile proteins, mechanism of contraction in Skeletal, Smooth and Cardiac muscle

UNIT-III

Chemical messengers, Hormones & their feedback systems, Mechanism of hormone action (fixed membrane- and mobile receptor mechanisms), hormonal signaling

Pineal, Thymus & gastrointestinal hormones, Anatomy, chemistry and biological action of adenohypophysial & neurohypophysial hormones, Thyroid gland: Anatomy, biosynthesis & function of thyroid hormones, Parathyroid gland: Anatomy & function of parathyroid hormone

UNIT-IV

Endocrine pancreas: Anatomy, Biosynthesis, chemistry & functions of pancreatic hormones, Adrenal gland: Anatomy, biosynthesis, functions of cortical & medullary Hormones, Gonads: Anatomy and biological actions of gonadal hormones.

Reference Books

1. Guyton's Physiology
2. Human physiology- Tortora
3. Endocrinology - Hadley
4. Endocrinology - Turner & Bagnora
5. Bentley, P. J. Comparative vertebrate endocrinology
6. Bern, H. A. Text book of comparative endocrinology
7. Colour Atlas of Physiology- Thieme
8. Harper's Illustrated Biochemistry(26th Edition)

SECOND SEMESTER

PAPER 202: Cell Biology

75 Marks (60 marks end semester and 15 marks mid semester examination)

UNIT –I

Cell Theory, Variability, Size, Shape, Complexity and functions. General organization of Prokaryotic and Eukaryotic cells

Plasma membrane: Composition and dynamics, membrane carbohydrates and their role in cell recognition.

Social context of cells: Cell junction, cell adhesion and extra-cellular matrix.
Cell motility: Cilia and flagella of prokaryotes and eukaryotes.
Cytoskeleton: Microtubules, intermediate filaments and microfilaments.
Cell Wall: Structure & functions, biogenesis, growth.
Cell inclusions: pigments molecules & nutritive materials

UNIT-II

Nucleus: Structure and function of nuclear envelope, nucleolus & Chromatin organization and its packaging role of nuclear matrix in chromosome organization and function, matrix binding proteins. Lampbrush chromosome, Polytene chromosome, telocentric chromosome, Inter-phase chromatin, Euchromatin and Heterochromatin, karyotype and its significance

Cell cycle: Molecular models and events. Regulators and checkpoints in cell cycle

Molecular mechanisms of cell division: Mitosis (Behavior of chromosomes, formation of mitotic spindle, Sister chromatid separation), Cytokinesis (Role of mitotic spindle in determining cytoplasmic cleavage site), Meiosis: Events & mechanism

UNIT – III

Plasmodesmata: Structure, role in movement of molecules & macromolecules, comparison with gap junctions.

Plant Vacuole: Tonoplast membrane, ATPases, transporters as storage organelle

Chloroplast: Structure, genome organization, gene expression, RNA editing, nucleo-chloroplastic interaction.

Mitochondria: Structure, genome organization, Biogenesis.

UNIT – IV

Transport across cell membrane: Major types of membrane transport, Active transport, Co-transport, Symport, Antiport, Ion channels, Osmosis.

Macromolecular trafficking into and out of nucleus

Protein sorting: Transport of proteins into mitochondria and lysosomes.

Vesicular traffic: Coated and un-coated vesicles, Transport of secretory materials, Endocytosis.

SECOND SEMESTER

PAPER 203: Molecular Biology

75 Marks (60 marks end semester and 15 marks mid semester examination)

UNIT –I

DNA replication: Replication in prokaryotes, replication fork, initiation, elongation, termination, Replication in eukaryotes, D-loop model of DNA replication, DNA replication in single stranded DNA, rolling circle replication,

DNA synthesis by reverse transcription

DNA Repair: mismatch repair, base excision, nucleotide excision, direct repair, SOS repair

UNIT –II

Prokaryotic transcription: Mechanism of transcription, Principle of gene regulation, The Operon concept, lac- & trp-operon. Processing of tRNA and rRNA

Eukaryotic transcription and regulation: RNA polymerases structure and assembly, Eukaryotic promoters and enhancers, General and specific transcription factors, transcriptional repressors, mechanism of transcription regulation, Transcriptional and post-transcriptional gene silencing.

Modifications in RNA: 5'-cap formation, transcription termination, 3'-end processing and polyadenylation, splicing, editing, synthesis and processing of non-coding RNAs.

UNIT –III

Prokaryotic and eukaryotic translation: The translation machinery, mechanism of initiation, elongation and termination

Co- and post-translational modifications of proteins

Cell Signaling: Signaling molecules and signal receptors, second messengers, G protein coupled receptors, activation of gene transcription by G protein coupled receptors.

UNIT –IV

Scope of Genetic engineering, Milestones in genetic engineering

Molecular tools: Enzymes (Nucleases, Restriction endonucleases, Phosphomonoesterase, Alkaline phosphatase, Polynucleotide kinase, DNA ligase, DNA polymerases, Reverse transcriptase, terminal deoxynucleotidyl transferase, Poly A polymerase). Hosts (E. coli, yeast, animal cells and Plant cells) and Vectors (Plasmids, Bacteriophages. Cosmids, Phagemids and artificial chromosomes)

SECOND SEMESTER

PAPER 204: Instrumentation & Analytical Techniques

75 Marks (60 marks end semester and 15 marks mid semester examination)

UNIT –I

Principle of operation and Instrumentation of Light, Fluorescence and Electron Microscopes Ultraviolet-visible absorption spectroscopy: Principle, Instrumentation and application, Fluorescence spectrophotometry: Principle, Instrumentation and application

Radioisotope techniques: Nature of radioactivity, isotopes in biochemistry, measurement of radioactivity (carbon dating, Geiger-Muller counting and liquid scintillation counting).

UNIT –II

Principles of electrochemical techniques: Electrochemical cells and reactions, potentiometry and voltametry, the pH electrode

Centrifugation techniques: Basic principles of sedimentation, Types of centrifuges, Types of rotors, Methods in preparatory ultracentrifugation (differential and density gradient centrifugation).
Chromatographic techniques: Principles of chromatography (Adsorption and Partition chromatography), Planar chromatography (Paper and Thin-layer chromatography), Column chromatography (Gas chromatography, Gel exclusion/permeation chromatography, Ion exchange chromatography, Affinity chromatography, HPLC).

UNIT III

Electrophoretic techniques: General principles, support media, electrophoresis of proteins (SDS-PAGE, native gels, gradient gels, isoelectric focusing gels and two dimensional gels), electrophoresis of nucleic acids (Agarose, pulse-field and sequencing gels).
Blotting techniques (Southern, northern and western blotting)

UNIT –IV

Statistical Methods: Sampling methods, sampling distribution, measures of central tendency and dispersion,

Probability distribution: normal, binominal and poisson distribution. Sample homogeneity and heterogeneity analysis by binomial and poisson distribution,

Parametric and nonparametric statistics: paired and unpaired t-test and χ^2 test, analysis of variance: one factor and two factor ANOVA, linear and non-linear regression and correlation

SECOND SEMESTER

PAPER 205: PRACTICAL

100 Marks (6 hours)

1. Estimation of DNA
2. Estimation of RNA
3. Separation of proteins, lipids & nucleic acids from tissues and their quantification
4. Isolation of genomic DNA from animal tissue/blood
5. Agarose gel electrophoresis of DNA
6. SDS PAGE (Demonstration)
7. Microscopy, Microtomy and Histological techniques.
8. Isolation of Mitochondria
9. WBC & RBC counting
10. Estimation of haemoglobin
11. Study of slides of endocrine glands
12. Chromatographic separation of biomolecules (Amino acids /sugars/lipid)

P.G. in Zoology
III Semester

301

PAPER 2.3.1: Ecology

750 Marks (6 hours) (60 marks end semester and 15 marks mid semester examination)

UNIT-I

Abiotic and biotic components;

Primary and secondary production, methods of measuring productivity, pattern of primary production and biomass in the major ecosystem of the world

Energy flow: sources and pattern; food chain and food web in terrestrial and aquatic ecosystems Biogeochemical cycles - Carbon, Nitrogen, Sulphur, Phosphorus.

UNIT-II

Community ecology: nature, structure and gradient analysis, structural analysis of plant and animal community

Niche and Random Niche model of species association

Species diversity in ecological gradient, Experimental and field test of diversity-stability Hypothesis, Ecotone and edge effect

Competition theory and coexistence

Succession - models of succession (monoclimax and polyclimax theories), Mechanism of succession in natural communities - facilitation, tolerance, and inhibition

Plant communities association

UNIT-III

Population ecology: Basic concept, population characters, biotic potential.

Kinetics of population growth, population growth curves, laws of population growth, regulation of population density, limiting factors of population growth, population fluctuation

r & k selection,

Population interactions: positive and negative interactions, interspecific relationship Population regulation: competitive exclusion, density dependent and independent regulation

UNIT-IV

Environmental pollution: Kinds and sources of pollutants, classification of pollutants,

Soil pollutants: sources, types, and effects; modification of plant productivity by soil pollution, effects on soil microflora.

Water & Air pollutants: fates and effects, role of plants for pollution control,
Global climate change, green house effect, ozone depletion- causes and effects.

ZO-2.3.2 IMMUNOLOGY AND CANCER BIOLOGY

50 Marks (3 hours) (40 marks end semester and 10 marks mid semester examination)

UNIT I

Phylogeny of Immune system, Innate and acquired Immunity, Haematopoiesis and differentiation, Cells of the Immune system- B lymphocytes, T-lymphocytes, Macrophages, Dendritic cells, Natural Killer cells, Eosinophils, Neutrophils and mast cells , Organization and Structure of Lymphoid Organs,MALT, CALT, NALT, BALT,Nature and Biology of antigens and super antigens, Structure and function of antibody molecule, Antigen – Antibody interaction (Antibody affinity, Radial and Double immunodiffusion, Radioimmunoassay, ELISA- Indirect, Direct, Sandwich, ELISPOT, Competitive, Western blotting)

UNIT-II

Major histocompatibility complex and MHC restriction, Antigen Processing and Presentation, Generation of humoral and cell mediated immune response, BCR and TCR, generation of diversity, Complement system(Classical, Alternate and lectin pathway), Cytokines- Types and their role in immune regulation

UNIT-III

Activation and regulation of B and T lymphocytes, Cell-mediated cytotoxicity and Antibody dependent cell mediated cytotoxicity, Hypersensitivity ,Autoimmunity
And Transplantation

UNIT-IV

Biology of cancer cell, Genetic basis of cancer-I: Proto-oncogenes, Viral and cellular oncogenes, Genetic basis of cancer-II: Tumor suppressor genes from humans: structure, function and mechanism of action of pRB and p53 tumor suppressor proteins, Role of carcinogens and DNA repair in cancer

1. Kuby's Immunology, 5th edition, By R. A. Goldsby et al.
2. Clinical Immunology By Brostoff, Seaddin, Male and Roitt
3. Fundamentals of immunology By William Paul.
4. Immunology by Janeway
5. Principles of Immunology by N.V. Shastri, Himalaya Publishing House
6. Cellular and Molecular Immunology- Abul Abbas and Andrew Lichtman
7. Immunology-Weir

ZO-2.3.3 DEVELOPMENTAL BIOLOGY AND ANIMAL BIOTECH OLOGY

50 Marks (3 hours) (40 marks end semester and 10 marks mid semester examination)

UNIT-1:

Principles of Developmental Biology : Potency, commitment, specification, induction, competence, Gametogenesis : Primordial germ cells, Spermatogenesis, Oogenesis, Fertilization: Ultrastructure of sperm and ovum, biochemical aspects of fertilization,Cell-cell interaction and cell signalling during morphogenesis in early embryo: gastrulation, neurulation and primordial organ rudiments, origin and fate of neural crest cells

UNIT-2:

Post-embryonic development: Growth, cell proliferation, growth hormone, Spatial and temporal gene expression during development, Apoptosis and its role in development

Ageing: Mitochondrial control of ageing, insulin pathway control of ageing and possible relation to oxygen radicals, "Ageless" animals and environmental control of ageing, senescence & cell death, Application of developmental biology in medicine and animal husbandry: In vitro fertilization and embryo transfer, embryo sexing

UNIT-3:

Embryonic stem cells, stem cell niche, their role in development, Genetic errors of human development: Nature of human syndromes- Pleiotropy, genetic heterogeneity, phenotypic variability, mechanism of dominance, Gene expression and human disease: Inborn errors of nuclear RNA processing, inborn errors of translation, Teratogenesis: Environmental assaults on human development, teratogenic agents like alcohol, retinoic acid etc

UNIT – IV

Equipments and materials for animal cell culture: Design and layout of culture room, Basic equipments used in cell culture, Sterilization and aseptic techniques, Culture media(Composition) : Natural media, Synthetic media, Nutritional compounds of media, Role of serum in cell culture, Primary culture and its maintenance: Various techniques of tissue disaggregation, Monolayer and suspension cultures, Growth curve, Culture of Cell lines, LSE culture, Scaling up of cultured cells: Anchorage dependent cell culture, Suspension culture and Cryopreservation

1. Developmental biology by Gilbert
2. Introduction to embryology by Balinsky
3. Fertilization FT Longo
4. Culture of animal cells by R.I. Freshney
5. Tissue Culture – Methods and Applications by Paul F. Kruse Jr. and M. K. Patterson Jr.
6. Cell Culture Lab Fax by Butler and Dawson.
7. Cell and Tissue culture: Laboratory procedures by Doyle and Griffiths
8. Basic Cell Culture by J.M. Davis

ZO-2.3.4 TAXO OMY, BIOSYSTEMATICS A D PALEOZOOLOGY

50 Marks (3 hours) (40 marks end semester and 10 marks mid semester examination)

UNIT-I

Definition and basic concepts of Biosystematics and Taxonomy, Historical resume of Systematics, Importance & Applications of biosystematics in biology, Different attributes of biosystematics, Dimensions of speciation and taxonomic characters, Species concept (species category-Polytypic species, Population systematics and other Infraspecific categories), Theories of biological classification and Hierarchy categories

UNIT-II

Procedure keys in taxonomy, Taxonomic procedures: Taxonomic collections, preservation, curetting, process of identification, International code of Zoological Nomenclature (ICZN): Its operative principles, interpretation and application of important rules, Zoological nomenclature, Formation of scientific names of various taxa,

Taxonomic publications: Strategy, Documentation, Kinds of Publication, Major features and Preparation of manuscript for publication

UNIT III

Evaluation of biodiversity indices: Shannon-Winner Index, Dominance Index, Similarity & Dissimilarity Index

Traditional taxonomy and newer trends in systematics

Chemo and serotaxonomy, Cytotaxonomy, Numerical taxonomy, Cladistics, Molecular systematic and DNA bar coding

UNIT-IV

Paleontology: Fossils and their significance; modes of fossilization , Study of morphology, range and broad classification of major invertebrate phyla viz. coelenterata, brachiopoda, mollusca, arthropoda (trilobite) and echinodermata (echinoidea), Introduction to micro fossils, Introduction to Paleobotany, Evolution and classification of vertebrates, Origin of Jaws (Class Placodermi: Armour-Plated Monsters, Class Chondrichthyes: The First Sharks, Class Acanthodii The Spiny Skins), Archaeopteryx, Flightless Birds: Division Palaeognathae, Ice Age Extinction of Large Mammals

PRACTICALS ZO-2.3.5

100 marks (6 hours) (80 marks end semester and 20 marks mid semester examination)

1. Antigen-Antibody interaction: Blood grouping
2. Preparation of Blood smear for Differential count and type of leucocytes
3. Study of Lymphoid organs
4. Study of life cycle of different anurans
5. Effect of thyroxin on amphibian development
6. Whole mount preparation of chick embryos
7. Study of Frog development through prepared slides
7. Sterilization & Preparation of media (liquid & solid)
8. Study of Fossils
9. Estimation of Dissolved oxygen content of water
10. Estimation of alkalinity of water samples.
11. Estimation of Total hardness.
12. Estimation of primary productivity
13. Determination of Chloride
14. Collection and preservation of water sample for qualitative and quantative analysis of Plankton.
15. Study of Diversity indices.

PRACTICALS ZO-2.3.5

100 marks (6 hours) (80 marks end semester and 20 marks mid semester examination)

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15. Study of Diversity indices.

P.G. Zoology
Semester-4

SPECIAL PAPER (6)

Paper 401 CHEMICAL FOU DATIONS, PROTEIN CHEMISTRY & ENZYME TECHNOLOGY

Theory - 60 MID Sem - 15

UNIT-I (Chemical foundations)

1. Chemical basis of life: Chemical composition and bonding, three dimensional structure (configuration and conformation, Isomerism and steriospecificity), Chemical Reactivity: Oxidation-reduction reactions, Nucleophilic substitution, Internal rearrangements, Group transfer reactions, Condensation.
2. Water: Structure of water, water as a solvent, ionization of water, Weak Interactions in aqueous solution (Dipole movement, van der Waal's, ionic and hydrophobic interactions, Hydrogen bonding). Weak acids and bases, pH and buffers, Blood buffering system.
3. Bioenergetics: Laws of Thermodynamics, entropy, enthalpy and free energy, standard free energy, chemical equilibrium. Phosphoryl group transfer and ATP.

UNIT – II (Protein chemistry)

1. Purifications & characterization of proteins: Objective and strategy, Choice of source, Methods of homogenization, Methods of separation: Basis of solubility (pH treatment; Salting in & salting out; Changing dielectric constant; Heat treatment), Basis of size and mass (Centrifugation; Dialysis; Ultrafiltration; Gel filtration), Basis of charge/polarity (Ion-exchange chromatography; iso-electric focusing; Electrophoresis; hydrophobic chromoatography), Basis of specific binding (Affinity binding; Affinity elution; Dye-ligand binding; Immunoadsorption, Covalent binding), Crystallization, Evaluation of purification, Recovery and fold of purification, Homogeneity of the purified protein (Native and denaturing electrophoresis; Isoelectrofocussing; Ultracentrifugation), Selection of purification methods.
2. Determination of Primary structure: Amino acid composition, N- & C- terminal determination, Amino acid sequence determination, assignment of disulfide bonds.
3. Forces and interactions involved in structural organization of fibrous and globular proteins, Prediction of higher order structure from the amino acid sequences, Structure-function relationship.
4. Protein denaturation, Molecular chaperones and protein folding

UNIT-III (Protein and Enzyme Engineering)

1. Site-directed Mutagenesis and protein engineering
2. Processing of recombinant proteins: Purification, refolding & characterization of recombinant proteins, Stabilization of proteins.
3. Abzymes or catalytic antibodies: Naturally occurring abzymes in normal and pathological states, there physiological role and mechanism of action, artificial abzymes and their application
4. Ribozymes: Discovery, Types, Structure, mechanism of action and applications of ribozyme technology, Basic idea about DNAzymes and aptazymes and their application potentials

UNIT – IV (Enzyme technology)

1. Problems with the use of enzymes in solution and objectives of immobilization, Methods of enzyme immobilization: Adsorption, entrapment, Direct covalent linking, crosslinking, Kinetics of immobilized enzymes, effect of solute partition & diffusion on the kinetics of immobilized enzymes, Measurement of enzyme activity, Regeneration of cofactors
2. Enzyme electro-catalysis (Biosensors): General approach to immobilization of enzymes into electrodes and their applications, Immobilized enzymes based bioreactors.
3. Industrial application of enzymes: Enzymes used in detergents, Application of enzymes in food processing; Medical applications of enzymes.

Reference Books

1. Nelson et al: Lehninger Principles of Biochemistry (3rd Ed.), MacMillan Worth, 2000
2. Berg et al.: Biochemistry (5th Ed.), Freeman, 2002
3. Mathews et al.: Biochemistry (3rd Ed.), Pearson, 2004
4. Zubay et al: Principles in Biochemistry (2nd Ed.), WCB, 1995
5. Rawn: Biochemistry, Neil Patterson, 1989
6. Molecular Clonning: A laboratory manual by J. Sambrook and E.F. Fritsch.
7. Molecular Biotechnology by S.B. Primrose
8. Molecular Biotechnology by Glick and Pasternack.
9. Enzymes in industry: Production and application by W.Gerhartz, VCH Publishers, New York
10. Principles of enzymology for technological applications, Butterworth Heinemann Ltd.
11. Enzyme technology by M.F. Chaplin and C. Bucke. Cambridge University Press.
12. Biochemical Engineering by Aiba, Humphery and Mills.

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Paper [redacted] REGULATION OF INTERMEDIARY METABOLISM

Theory - 60. Mid Sem - 15

UNIT I

1. Intermediary metabolism and metabolic pathways
2. Carbohydrates: Pathways, their integration and regulation
3. Lipids: Cholesterol: Biosynthesis and degradation, Lipid transport and storage, Biosynthesis of eicosanoids: Prostaglandins, leucotrienes and thromboxanes, Structure and function of eicosanoids

UNIT II

1. Sources of amino acids: Dietary proteins and intermediates of carbohydrate metabolism, Amino acids as sources for nitrogen. Molecules derived from amino acids: Porphyrin, bilirubin, creatine, glutathione, dopamine, noradrenaline, adrenaline, GABA, serotonin, histamine, melanin, thyroxine .
2. Synthesis and significance of polyamines.
3. Amino acid catabolism: Transamination, Deamination: Transdeamination and oxidative deamination, Toxicity of ammonia, Ammonia detoxification, Urea cycle (Reactions and their regulation)

UNIT III

1. Nucleotides
2. Biosynthesis and regulation of purine and pyrimidine nucleotides
3. Catabolism of purines and pyrimidines

UNIT IV

1. Biochemical basis of diseases/disorders
2. Disorders of enzyme deficiency: Alkaptonuria, Hartnup's desease , Phenylketonuria, Lesh-Nyhan syndrome
3. Disorders of protein deficiency/defects: Cystic fibrosis, Thalassemia, Diabetes and obesity
4. Storage and transport associated disorders: Glycogen storage disorders, Hypercholestrolemia and atherosclerosis, Tay-Sachs disease, Gout
5. Neurological disorders: Hutingston's disease
6. Biochemistry of aging

Paper [redacted] GENOMICS

UNIT-I Theory – 60 – midsem-15

Eukaryotic genome: Introduction to structural and functional genomics, Denaturation & renaturation kinetics of DNA, unique and repetitive DNA sequences, Chromatin organization: histones and non-histone chromosomal proteins, nucleosomes and higher order structures, telomere, chromatin modifications.

UNIT-II

Mapping of genome: Genetic and physical maps, physical mapping (restriction mapping, fluorescence in situ hybridization, sequence tagged site mapping), map based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, molecular markers in genome analysis (RFLP, RAPD, AFLP, SSLPs, STRs and SNPs)

UNIT-III

Genome sequencing: Construction of libraries (genomic and cDNA), strategies for sequencing genomes, packaging, transections and recovery of clones, application of sequence information for identification of defective genes. Expression cloning, Jumping or hopping libraries, Southwestern and Farwestern cloning.

[redacted]

DNA transfection: Physical methods (microinjection, electroporation, biolistics, somatic cell fusion, Gene transfer by pronuclear microinjection), Chemical method (liposomes), Virus mediated transfection.

UNIT-IV

Mapping and quantifying transcripts: Northern blot, S_1 mapping, RNase protection assay, Primer extension, Run-off Transcription and G-less cassette transcription, Nuclear Run-on transcription and Reporter gene assays.

DNA-protein interactions: EMSA, DNase foot printing, Methyl interference assay, CHIP

Protein-protein interaction: Yeast two hybrid system, Phage display.

Gene therapy

Knockout and transgenic technologies

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Paper [redacted] CELL SIGNALLING, APOPTOSIS AND CANCER Theory - 60, Mid - 15

UNIT I

1. Ions channels, Transporters and Receptors
2. Signal transduction: Concept of cell-signaling
3. Signaling through intracellular receptors: Lipophilic hormones
4. Signaling through cell surface receptors-I: G protein linked receptors; signaling via cAMP, PKA IP3, Ca^{++}/calmodulin, PKC, Ca-MK, ion channels (exemplified by vision).

UNIT II

Signaling through cell surface receptors-II: (Enzyme linked receptors)

1. Receptor tyrosine kinase (RTK), signaling of growth factors
2. Tyrosine kinase associated receptors, JAK-STAT signaling pathway
3. Receptor protein tyrosine phosphatase (PTP)
4. Receptor serine/threonine kinase
5. Receptor guanyl cyclase, cGMP, PKG
6. Histidine kinase associated receptors, bacterial chemotaxis

UNIT III

1. Receptor desensitization
2. Signaling by nitric oxide, carbon monoxide
3. Signaling network
4. [redacted] Tumorigenesis (Role of oncogenes & oncoproteins); [redacted], Hormonal disbalance and diseases

UNIT – IV

1. Necrosis, programmed & induced cell death and autophagy
2. Process of apoptosis: Initiation, Execution: cytochrome C, caspases, Phagocytosis
3. Regulation of apoptosis: Extracellular & Intracellular

[redacted]

Reference Books

1. Albert et al.: Molecular Biology of the Cell (4th Ed.), Garland Publishing Inc., 2002
2. Lodish et al.: Molecular Cell Biology (5th Ed.), Freeman and Company, 2004
3. Berg et al.: Biochemistry (5th Ed.), Freeman and Company, 2002
4. Murray et al.: Harper's Biochemistry (26th Ed.), Appleton & Lange, 2003.