GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

KUMBAKONAM 612 002

Re - accredited With 'A' Grade by NAAC & Affiliated to Bharathidasan University

DEPARTMENT OF ZOOLOGY

(Effective for those admitted from 2017-2018 onwards)

SYLLABI

M.Sc., ZOOLOGY

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.

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M.Sc., ZOOLOGY

(Effective for those admitted from 2017-2018 onwards)

SEMESTER – I

CC 1 - FUNCTIONAL MORPHOLOGY AND PALAEONTOLOGY

Subject Code: 17P1Z1	Credits: 4	External Marks: 75	Hours: 6

Objectives: *To give a thorough understanding in the morphology of invertebrate and vertebrate animals and to acquire an in-depth knowledge on the palaentology.*

Unit I: Organization: Symmetry and its significances – Asymmetry, radial, biradial and bilateral symmetry. Coelom and its significances: Acoelomate, pseudocoelomate and coelomate groups. Metamerism, types and its significance.

Unit II: Comparative study of Invertebrates and Chordates: Circulation: Circulation in Annelids, Arthropods and Molluscs. Excretion*:* Excretory organs in Annelids and Arthropods. Nervous System: Coelenterates, Annelids, Arthropods and Molluscs. Reproduction:Reproduction in Annelids and Molluscs.

Unit III: **Vertebrates**: Digestive System - Alimentary canal and associated structures in Aves and Mammals. Respiratory System – Gill respiration in cyclostomes, Air bladder respiration in fishes, Pulmonary respiration in aves. Circulatory System - Types and evolution of heart and aortic arches.

Unit IV: Excretory System - Types and evolution of kidneys and ducts. Nervous System - Brain and spinal cord. Reproductive systems – Urinogenital organs in fishes, amphibians, reptiles and Aves. Neotenous chordates: Types, factors and significances. Minor Phyla – Organization and affinities of Chaetognatha, Ctenophora, Ectoprocta, Endoprocta and Rotifera.

Unit V: **Palaeontology** : Geological Time Scale, Fossils and Fossilization, Dating of fossils. Invertebrate fossils - Evolutionary trends and phylogenetic importance of Trilobites, Ammonoids, Belemnoids, Nautiloids and Echinoderm fossils. Living fossils. Vertebrate Fossils - Evolutionary significance of Ostracoderms, Placoderms, Crossopterygians, Labyrinthodonts and Archaeopteryx. Mesozoic reptiles.

References:

1. Barnes, R.D. (1982), Invertebrate Zoology, IV Ed., Holt Saunders International Edition.
2. Jordan, E. L. and P.S. Verma. 2009. Invertebrate Zoology, S. Chand & Company.
3. Arumugam. N., N.C. Nair., S. Leelavathy and N. SoundaraPandiyan. (2015). Invertebrate Zoology. Saras Publication, Nagarcoil.
4. Jordan, E. L. and P.S. Verma. 2005. Chordate Zoology, S. Chand & Company.
5. Yadav, P. R. 2003. Fossils. Discovery Publishers.
6. Arora, M. P. (1992). An Introduction to palaeontology. Himalaya Publishers.
7. Raup. D.M and S.M. Stanley. (1999). Principles of Paleontology. CBS Publishers & distributors, New Delhi.

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SEMESTER – I

CC 2 - CELL AND MOLECULAR BIOLOGY

Subject Code: 17P1Z2	Credits: 4	External Marks: 75	Hours: 6

Objectives: *To enlighten our students about the cellular organelles and its functions. The knowledge in Cell communications and signaling pathways.*

Unit I: Structure and functions of Plasma membrane – ultra structure - membrane models – junctionalcomplex ; Functions - passive transport - active transport – ion pumps, translocation across the membrane, carrier and fixed pore mechanism, transport of macromolecule. Structural organization and functions of Golgi bodies, Lysosome, Endoplasmic reticulum and Microsomes.

Unit II: Structure and functions of Mitochondria – ultra structure – structural variations–Chemical compisition – functions: cell respiration – respiratory chain complexes; oxidative phosphorylation - chemiosmotic hypothesis – Mitochondrial DNA & RNA; Structural organization and functions of Ribosomes – Biogenesis. Centrosome. Peroxisomes andGlyoxysomes.

Unit III: Ultra structure and functions of Nucleus – Nuclear envelope – Nucleolus – Nucleoplasm, Structural organization and functions of Chromosomes– Folded fibre model of Dupraw; Nucleosome; L, m chromosome, S & E chromosome – mega chromosome; Heterochromatin – Euchromatin – Giant chromosomes : Polytene and Lamp brush chromosome.

Unit IV: Cytoskeleton – Microtubules, Cell signaling pathways : Hormones and their receptors, cell surface receptor, Signaling through G-protein coupled receptor, second messengers – cyclic AMP, Ras triggered MAP kinase pathway; regulation of signaling pathways.

Unit V: Cellular communication: Regulation of hematopoiesis, general principles of cell communications, cell adhesion and roles of different adhesion molecules; cell cycle –Phases and regulation. Cancer – carcinogenic agents – oncogenes – metastasis - interaction of cancer cells with normal cells – apoptosis - therapeutic interventions of uncontrolled cell growth and Ageing.

References:

1. Ajay Paul, 2011. Text Book of Cell and Molecular Biology, Books and allied (P) Ltd. Kolkata.
2. Powar, C.B. 2006, Cell Biology, Himalaya Publishing House, Bombay.
3. David Freifelder 2007. Molecular Biology, II Edn., Narosa Publishing House, New Delhi.
4. Emmaanuel.C, Ignachimuthu.S.J and Vincent. S. 1969. Applied Genetics. Recent Trends and Techniques. MJP Publishers, Chennai.
5. De Robertis, E.D.P., and De Robertis, Jr. E.M.F. 2001. Cell and Molecular Biology. Williams & Wilkins, USA.
6. Prakash, S. Lohar, 2009. Cell and Molecular Biology, MJP Publishers, Chennai.
7. Verma. P.S. and V.K. Agarwal. 2009. Molecular Biology. S. Chand and Co., New Delhi.

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SEMESTER – I

CC 3 - MOLECULAR AND HUMAN GENETICS

Subject Code: 17P1Z3	Credits: 4	External Marks: 75	Hours: 5

Objectives: *To inculcate knowledge on molecular level organization of cell and its mode of inheritance.*

Unit I: **Introduction :** DNA as a genetic material, Transformation and Transduction experiments; RNA as a Genetic material, chemical structure of DNA, Alternative forms of DNA [A-DNA, B-DNA & Z-DNA], circular super helical DNA, Types of RNA molecules, micro RNA.

Unit II: **DNA - replication, recombination, damage and repair**: Semi conservative model; Enzymes involved replication. Molecular mechanism of recombination - Homologous recombination - Breakage and reunion - heteroduplex - Holiday model - Site specific recombination.DNA Damage and repair: Biochemical basis of Mutation; Transposable elements in prokaryotes and retroposons, DNA repair - Types and its mechanisms.

Unit III: **Structure and Functions of Gene** – Concept of gene, Split genes, Overlaping genes, Transcription, Post transcriptional modifications, Inhibitors of transcription; Translation - post translational modification of proteins. Regulation of gene expression - Lactose and Tryptophan operon.

Unit IV: **Human Genetics** - Normal human chromosome complement - chromosome karyotype - idiogram; banding techniques of chromosomes. Structural and numerical alteration of chromosomes: Autosome and Sex chromosomal abnormalities; Non - disjunction types. Pedigree analysis; Genetic counselling and prenatal screening - Amniocentesis.

Unit V: **Geneticdisorders**- Genetics of haemoglobin - Thalassemia - Sickle cell anaemia - Phenylketonuria - Alkaptonuria - Albinism – Tyrosinosis; Williams syndrome, Cystic fibrosis. Inbreeding in consanguineous marriage and outbreeding - Concealed genes - Detrimental genes.

References:

1. David Freifelder 2007. Molecular Biology, II Edn., Narosa Publishing House, New Delhi.
2. Emmaanuel.C, Ignachimuthu.S.J and Vincent. S. 1969. Applied Genetics. Recent Trends and Techniques. MJP Publishers, Chennai.
3. Prakash, S. Lohar, 2009. Cell and Molecular Biology, MJP Publishers, Chennai.
4. Verma. P.S. and V.K. Agarwal. 2009. Molecular Biology. S. Chand and Co., New Delhi.

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SEMESTER – I

CC 4 - BIOTECHNOLOGY AND BIOINFORMATICS

Subject Code: 17P1Z4	Credits: 4	External Marks: 75	Hours: 5

Objectives: *To update the bio technical methods and its application in industries, medical and agricultural fields.*

Unit I: **Introduction to biotechnology** – scope, commercial potential; Molecular tools in Genetic engineering: Enzymes & vectors - plasmids, Cosmids, Phasmid, phages, BAC, YAC, YEC. Gene expression of cloned genes; DNA amplification – PCR; Methods of DNA sequencing (Sanger's method), DNA finger printing – methodology and application; Bio bar coding.

Unit II: **Animal Biotechnology :** Cell culture, fundamental facilities, Culture Media-types and its preparation; Characterization of cultured cells; primary culture and cell lines; cell transformation and cell cloning; Transgenic animal – Fish, Sheep and Mice.

Industrial biotechnology : Hybridoma technology - production of monoclonal antibodies : Stem cell technology – embryonic stem cell culture and adult ulture, Enzyme biotechnology; Isolation & Purification of enzymes, immobilization of enzyme. Nano – biotechnology – Drug delivery system and Drug delivery technology

Unit III: **Medical Biotechnology:** Pharmaceutical products of DNA Technology - Gene Therapy- Production of antibiotics, vaccines, steroid hormones; Microbial production: Sweetners – Thaumatin, Monellin.

Environmental Biotechnology: Biological monitoring of hazardous waste – superbug – construction & culture; biomining – bioleaching - Heaps or Dumps methods; bio remediation and phytoremediation. Biosensors.

Unit IV: **Bioinformatics :** Introduction to Bioinformatics; Information networks, Databases – Nucleic acid databases, Genome databases, protein sequence databases, Databases of structures, Specialized databases, Expression and proteome databases, Databases of Metabolic pathways, Bibliographic databases. Gateways to archives – ENTREZ, Sequence Retrieval System (SRS), Protein Information Resource (PIR), ExPASy, Ensembl.

Unit V: **Bioinformatics tools** : BLAST, FASTA; Genomics and proteomics, Human Genome Project, DNA Sequence Analysis, Pair wise alignment techniques, multiple sequence alignment, Phylogeny, Protein Structure and drug designing.

References:

1. Desmond,S. T. Nicholl, 2010, An introduction to Genetic engineering, Cambridge university press, New Delhi.
2. Satyanarayana, U., 2009. Biotechnology. Books and Allied(P) Ltd.
3. Kumaresan, 2009, Biotechnology, Saras Publications
4. Gupta, P.K., 2005. Elements of Biotechnology. Rastogi publication.
5. Dubey, R.C., 2007. A text book of bio-technology. S.Chand& Company
6. Gautham N., 2006. Bioinformatics, Narosa publishing house.
7. Bryan Bergeron, M.D. Bioinformatics computing 2003, Prentice – Hall of India.

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SEMESTER – I

CC 1 – PRACTICAL I

Subject Code: 17P1ZP1	Credits: 4	External Marks: 60	Hours: 4+4

Dissection and Mounting

Vaginulus reproductive system – Ariophanta reproductive system – Shark Arterial system – Spirostreptusgnathochilarium – penial setae of earthworm – scoliodon dorsal vein of brain.

Invertebrata

Ceratium – polystomella – hyalonema – amphiblastula larva – bougainvilla – gorgonian – schistosoma – echinococcusgranulosus – enterobiusvermicularis – Wuchereriabancrofti – serpula – bonellia (female) – squilla – scolopendra – loligo – osphradium of pilaglobosa – ophiothrix – sea urchin.

Minor Phyla

Sagitta – Pleurobrachia – Bugula – Pedicellina – Branchionus

Prochordata

T.S of proboscis of Balanoglossus – Tornaria larva – T.S of Amphioxus Through posterior pharynx – oral hood of Amphioxus – Salpa – Sexual phase – Ammocete larva – Doliolum sexual form.

Chordata

Trygon – Exocoetus – Ichthyophis – Ambystoma – chrysemys – sphenodonpunctatum – bubo – dinopium – echidna – Manis.

Palaeontology

Ammonoid – Belemnoid – Nautiloid – Trilobites – Limulus – Peripatus

Cell Biology

Preparation of Human buccal smear and identification of bar bodies – squash preparation of onion root tips – camera lucida – ocular and stage micrometer – DNA double helical structure - tRNAPolytene chromosome – Lampbrush chromosome.

Genetics

Normal human karyotype (Male & Female) – Banding techniques – Down's, Pataus's, Edward's, Turner's, Klinefelter's, William's syndroms - Pedigree analysis of Haemophilia and colour blindness.

Biotechnology

Isolation of DNA from Plant tissue – Immobilization of Enzyme – shuttle vectors – electrophoresis – southern blotting – Northern blotting – Polymerase chain reaction – Gene cloning.

Bioinformatics

EMBL and DDBJ, GEN bank, Primary domein data base – TREMBL – Swiss Prot – Phylogenetics.

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SEMESTER – II

CC 5 – MICROBIOLOGY

Subject Code: 17P2Z5	Credits: 5	External Marks: 75	Hours: 6

Objectives: *To enrich knowledge on invisible microorganisms, culture techniques and applications.*

Unit I: **Introduction toMicrobes**: Scope of microbiology, Three domain system of classification. Morphology and fine structure of bacteria, cyanobacteria, fungi, virus, viroids, prions and T4 Phage; Reproductionof bacteria, fungi and virus – lytic and lysogenic cycles.

Unit II: **Methods in microbiology**: Cultural media: characteristics, types and preparation; Microbial cultures: Physical conditions for growth – chemical methods – biological methods; Methods of culturing aerobic bacteria and anerobes; Isolation and maintenance of pure culture methods; Cultural characteristics. Smearing and Gram's Staining. Microbial Growth: continuous culture, batch culture, synchronous culture.

Unit III: **Soil microbiology**:Microbes in the production of Nitrogen, Symbiotic nitrogen fixation; Mechanism of nitrogen fixation. Production of Biogas; **Water microbiology**: Microbiological analysis of water purity-MPN Technique; Purification of drinking water and Sewage (waste) water treatment. **Aeromicrobiology:** Indoor Aeromicrobiology – Aeroallergens and Aeroallergy; Phylloplanemicroflora and its characteristics.

Unit IV: **Industrial microbiology**: Fermentor – Design, types and function – fermentation; Production of Alcohol, Vinegar, Citric acid. **Food microbiology**: Microbial contamination of food- contamination of Meat, mechanism of Myoglobin changes and growth factors – contamination of fish, spoilage of food – food poisoning - food preservative methods.

Unit V: **Medical microbiology**: Clinical types and therapy of bacterial diseases - Diptheria, Gonorrhoea& Typhoid; Viral diseases - AIDS, Chicken pox & Rabies; Fungal diseases – Mycoses and Mycotoxicosis and Bioterrorism. **Pharmaceutical microbiology:** Production of Vitamins – Vitamin B12 (Cyanocobalamine) and Vitamin B2 (Riboflavin).

References:

1. S.Rajan, 2007. Medical Microbiology. MJP Publishers Chennai.
2. Mashrafuddin Ahmed and S.V. Basumatary, 2006. Applied Microbiology. MJP Publishers Chennai
3. Powar, C.B. and Daginwala, 2005. General Microbiology. Himalaya publishing house.
4. Prescott & Donald, 2003, Microbiology 5th Edition. McGraw Hill publishing House.
5. Dubey, R.C., and Maheswari,K., 2000. A Text Book of Microbiology, S.Chand& Company, New Delhi.
6. Roger Y. Stainer, John L. Ingraham, Mark L.Wheelis, Page R.Painter., 1987. General microbiology, Macmillan education Ltd (V).
7. L.E. Casida JR., 1984. Industrial Microbiology. Wiley International Ltd.

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SEMESTER – II

CC 6 – BIOCHEMISTRY

Subject Code: 17P2Z6	Credits: 5	External Marks: 75	Hours: 6

Objectives: *To impart knowledge on the fundamentals of chemical components present in a living cell.*

Unit I: **Biomolecules:** Structure, Classification, Properties and biological significance of macromolecules: Carbohydrates, Proteins, Lipids, Nucleic Acids and vitamins. **Enzymes**-Nomenclature and Classification.Enzyme kinetics. Mechanism of Enzyme action and Enzyme inhibition.Enzymes in clinical diagnosis.

Unit II: **Bioenergetics:** Endergonic- Exergonic process. High energy phosphates. Biological Oxidation: Redox potential. Enzymes involved in Oxidation & Reduction (Cytochrome Oxidase, Peroxidase, Catalase, Monoxygenase). Superoxide free radicals. Respiratory Chain & Oxidative Phosphorylation: Chemo-osmotic Theory -Respiratory chain inhibition.

Unit III: **Carbohydrate Metabolism:** Glycogenesis, Glycogenolysis, Glycolysis, Gluconeogenesis. Glycolytic pathway. Blood glucose regulation. HMP Shunt pathway, TCA cycle and Inhibitors of TCA Cycle -regulation of Carbohydrate metabolism-Anaplerosis, Pasture effect, Crabtree effect, Cori cycle.

Unit IV: **Protein Metabolism :** Transamination of Amino Acids- Deamination of Amino Acids-Ammonia formation,- transport and Detoxification-Ornithine Cycle and biosynthesis of Urea. Catabolism of methionine and phenylalanine. Hyperammonemia, Parkinson's Disease and Cystinuria**.**

Unit V: **Lipid Metabolism:** Biosynthesis of fatty acids and cholesterol. Beta Oxidation of Fatty Acids: Oxidation of Saturated and Unsaturated Fatty acids. Formation and oxidation of Ketone bodies.**Nucleotide Metabolism**- Purine and Pyrimidine Metabolism. Clinical Disorders of purine and pyrimidine metabolism.

References:

1. Lehninger AL, DL .Nelson, and Cox MM.2005, 4th Edition. Principles of Biochemistry. CBS Publishers and distributors.
2. Tom Brody, 2006. Nutritional Bio-Chemistry. Academic Press.
3. Jain. J.L., 2007. Fundamentals of Biochemistry. S. Chand & company Ltd.(IV)
4. KeshavTrehan 1987. Biochemistry. Wiley Eastern Ltd.
5. RanganathaRao. K. 1986. Text book of Biochemistry. Prentice Hall of India PVT Ltd. (III)
6. Philip.W. Kuchel, 2003. Schaum'sout lines Bio-Chemistry, 2nd edition. TATA Mc Grew Hill.
7. Robert. K. Murray, Daryl K. Granner. 1993. Harper's illustrated Biochemistry, 23rd edition, McGraw Hill publishers.

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SEMESTER – II

EC 1 – BIOSTATISTICS AND COMPUTER APPLICATIONS

Subject Code: 17P2Z7EC	Credits: 5	External Marks: 75	Hours: 5

Objectives: *To make knowledge on basic statistics on biological data and use of computers in Biological fields.*

Unit I: **Data collection and Tabulation:** Primary data in the field and secondary data through questionnaire survey and literatures. Processing data: classification and tabulation. Organising of data: individual, discrete and continuous series. Diagrammatic representation of data: line diagram, bar diagram and pie diagram. Graphic representation of data: histogram, frequency polygon, frequency curve and ogive.

Unit II: **Measures of central tendencies and Deviations:** Mean, Median, Mode. Measures of dispersion: range, standard deviation ,variance, standard error, Skewness and kurtosis. Correlation: Types and methods of correlation, correlation coefficient. Regression analysis: Regression lines and equations.

Unit III: **Testing of Hypothesis:** Null and alternative hypothesis – chi square test , student 't' test, F test (ANOVA) with experimental samples (one way & two way). Probability; Basic Principles - apriori and aposteriori probabilities - addition and multiplication rules of probability - conditional probability.

Unit IV: **Computer applications in biology** - Introduction, Advantages of using computer, Generation of computers, Computer codes - BCD code, ASCII code, Functional units of a computer; Types of computers: PCs, desktop, Laptop, palmtop, PDA etc. Definition: Hardware, Software and Firmware, ROM, RAM, CD-ROM, DVD.

Unit V: **Software programs and Tools:** MS Word processor, MS Excel for Charts, MS PowerPoint and Multimedia. Viruses and Worms, Software packages in Biostatistics: Applications of MINITAB and SPSS. Communication networking and Computer networking.

References:

1. Khan &Khanum. 1994 Fundamentals of Biostatistics. Ukaaz publications.
2. Gurumani,N, 2005. An introduction of Biostatistics. MJP Publishers
3. Palanichamy and Manoharan, 1990. Statistical methods for biologists. Palani paramount publications.
4. Veer BalaRastogi 2009. Fundamentals of biostatistics. ANE Books Pvt Ltd.
5. R.Dheenadayalan, 1987. Computer Science, Vol I, II, Tata McGraw Hill.
6. Sathish Jain,1990. Introduction to computer science& basic programming. BPB Publications.
7. K.S.Negi, 2008. Bio-statistics. A.I.T.B.S. Publishers. Delhi.

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SEMESTER – II

EC 2 – ENTOMOLOGY

Subject Code: 17P2Z8EC	Credits: 5	External Marks: 75	Hours: 5

Objectives: *To enrich the knowledge about different kinds of insects prevalent in an ecosystem and their life cycle*

Unit I: **Insect Taxonomy:** Basics of insect classification – Classification of insectsuptofiveorders (Lepidoptera, Isoptera, Hymenoptera, Diptera and Coleoptera) – Key characteristics with common South Indian insects; **Morphology of an insect:** body segmentation. Mouth parts and its types.

Unit II: **Insect Physiology:** Respiration – aerial respiration – aquatic respiration; Circulatory system – structure of heart, haemolymph and its composition. Excretory system: Malpighian tubules and their functions – structure and function of compound eye. Reproductive system: male and female – Endocrine control of moulting and metamorphosis.

Unit III: **Agricultural Entomology:** Biology, Life cycle andcultureofmajor pest crops – paddy (Scirpophagaincertulas&Orseoliaoryzae), sugarcane (Chiloinfuscatellus, Pyrillaperpusilla&Tryporyza novella), cotton (Aphis gossypii&Eariasinsulana) and coconut (Opisinaarenosella&Orycetes rhinoceros); Pests of stored products. Medical Entomology: Biology, mechanism of transmission and their control of Ades mosquito, house flies, sandflies and Rat fleas.

Unit IV: **Economic Entomology** – Biology of Honey bee, silk moth and Lac insect – Culture methods for honey bee and silk worm – Appliances used and problems related to these cultures. Beneficial insects – Pollinators, predators, parasitoids – scavengers – weeds killers.

Unit V: Principles of Insect control – Prophylactic measures – cultural, mechanical, physical methods – Biological control: Parasites, Predators and Microbial agents. Chemical methods: Pesticides, classification – mode of action – toxicity – insecticide resistance – environmental safety. Non-conventional methods: Use of insect growth regulators (IGR), repellents, anti-feedants, pheromones, chemosterilants and irradiation. Integrated Pest Management (IPM) – definition, integration of methods – potential components – need for IPM and uses.

References:

1. M.S. Nalinasundari and R. Santhi. 2008. Entomology, MJP Publishers, Chennai.
2. Ambrose, Dunston P. 2004. The Insects; Structure, function and Biodiversity. Kalyani publishers, Ludhiana, New Delhi, Chennai.
3. Nayar, K.K., Ananthakrishnan, T.N. and David, B.V. 1986. General and applied entomology, Tata McGraw Hill Publications, New Delhi.
4. Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot. Chennai – 15.
5. Snodgrass, R.E. 1985. Principles of Insect Morphology, McGraw Hill and Co., New York.

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SEMESTER – II

CC 2 – PRACTICAL II

Subject Code: 17P2ZP2	Credits: 4	External Marks: 60	Hours: 4+4

MICROBIOLOGY

1. Basic instrument of microbiology laboratory
2. Bunsen burner
3. Millipore filter
4. Autoclave
5. Laminar air flow
6. Quebec colony counter
7. Isolation of pure culture of microorganism
8. Sampling of microorganism from soil
9. Gram's staining for differentiation of bacteria
10. Hanging drop mount method
11. Measurement of microorganisms by micrometry method
12. Presumptive coliform test (MPN)

BIOCHEMISTRY

1. Estimation of carbohydrates by Anthrone method
2. Estimation of protein by Lowry's method
3. Estimation of Nitrogen by Nessler's method

ENTOMOLOGY

1. Mouth parts of honeybee
2. Mouth parts of housefly
3. Mouth parts of butterfly
4. Mouth parts of anopheles
5. Mouth parts of cockroach
6. Honeybee stages of life cycle
7. Silkworm stages of life cycle
8. Pest of Rhinoceros beetle
9. Pest of Rice Morphology
10. Pest of sugarcane morphology
11. Pest of cotton morphology

COMPUTER APPLICATION

1. Keyboard
2. Mouse
3. Monitor
4. Digital video disc
5. Hard disc
6. Pendrive

BIOSTATISTICS

1. Standard deviation and standard error
2. Chi square test
3. Correlation analysis
4. Regression analysis

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SEMESTER – III

CC 7 – DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

Subject Code: 17P3Z9	Credits: 5	External Marks: 75	Hours: 6

Objectives: *To impart knowledge on the basis of development of organisms and the immune system.*

Unit I: **Gametogenesis:** Origin of germlines – germ cell lineage – migration of germ cells – spermatogenesis – spemiogenesis – oogenesis – Egg maturation – Hormonal regulation of vitellogenesis. Genetic control of vitellogenesis. Types of eggs. Egg envelops.**Fertilization**: Sperm aggregation – activation – chemotaxis – sperm maturation and capacitation – Acrosome reaction – sperm entry into egg – prevention of polyspermy – cortical reaction – post fertilization metabolic activation.parthenogenesis.

Unit II: **Cleavage:** Mechanism of cleavage – patterns – radial and spiral cleavages– Holoblasticandmesoblasticcleavages.Blastulation – Determinate and regulatory embryos.Cell lineages. **Gastrulation**: Molecular mechanisms determining germ layers. Morphogenetic movements – epiboly, invagination, involution – ingression. Gastrulation in Chick; Exogastrulation. Fate maps. Embryonic Induction: Embryonic induction and neurulation – neural tube formation.

Unit III: **Differentiation:** Mechanism of gene action during cell differentiation –levels of differentiation – factors influencing cellular differentiation - developmental gradients – Axis specification – anterior, posterior polarity – dorso, ventral polarity – genetic control of body segmentation – gap genes – Homeotic genes – Hox genes. **Organogenesis**: Brain development in chick.**Terratogenesis -** terratogenic agents and disformities during development.

Unit IV: **Immune system:** Innate and Acquired immunity - Interferons-,Cells of the immune system. Lymphoid organs – primary and secondary lymphoid organs. Cell mediated and humoral immunity: B-and T Cell system-Interleukins; Antigens, Haptens, Epitopes and paratopes; perporin. Structure, function and classes of immunoglobulins; Antigen-antibody reactions, Primary and secondary immune responses.

Unit V: **Complement system:** Classical and Alternative pathways -complement fixation; MHC molecules-antigen processing and presentation-Hypersensitivity and allergic reactions. Auto immune system. Vaccines-Immunization – Active and passive immunization. Immunodeficiency diseases— Transmission of HIV - Symptoms – Diagnosis, treatment for AIDS. Immunological techniques – VDRL test- Immunodiffusion – Immunoelectrophoresis -Widal test – Coomb's test– Immunofluorescence – ELISA – HLA typing –RIA.

References:

1. Berril N .J and G. Karp. Developmental Biology. McGraw Hill, New York. 7.
2. Subramanian, T. 2008, Molecular developmental Biology, Narosa Publishing House, Kolkata
3. Ivan Roitt,1994. Essential immunology. 8th edition Black well science Ltd.
4. Rao. C.V. .2011. Immunology. 2nd edition Narosa publishing house Ltd. New Delhi.
5. Gilbert S.F., 2003. Developmental biology.7th edition. Sinauerassociates., INC Publishers.
6. Balinsky, B.H. 1975. In introduction to embryology. 5th edition CBS College publishers.

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SEMESTER – III

CC 8 – ANIMAL PHYSIOLOGY

Subject Code: 17P3Z10	Credits: 5	External Marks: 75	Hours: 6

Objectives: *To understand the basic structure and working mechanisms of organ and its functions.*

Unit I: **Nutrition** - Nutritional types and its Significances. Vitamins and their role; **Respiration** - Lung air volumes, Respiratory pigments and their functions, Exchange of gases - Transport of gases in blood - regulatory mechanism. Haemoglobin - Structure and Chemistry - Respiratory quotient. **Effectors**: Chemistry of muscular contraction.

Unit II: **Circulation** – Types of Circulation, Heart, heartbeat, cardiac rhythm, Cardiac output and Regulation, blood pressure, ECG. **Excretion -** Relation to different habitats - Detoxification pathways of ammonia, uric acid and urea formation. Micturition. Vertebrate Nephron –Mechanism of urine formation and acid base balance, JGA application.

Unit III: **Homeostatic mechanism** – Osmo and Ionic regulation in fishes, Temperature and pH regulations in animals. Acclimatization to high altitudes, Floating adaptation, Buoyancy. **Nervous System**: Axonal and neuronal Transmission, Neurotransmitters. Autonomic nervous system- sympathetic and parasympathetic.

Unit IV: **Receptors** – Chemoreceptor – Gustatory and olfactory receptor. Photoreceptor - vertebrate eye, visual cycle, image formation and adaptations of eye. Mechanoreceptor – Phonoreceptor - vertebrate ear, physiology of hearing, Tango and Rheoreceptor. Bioluminescence - Chemistry and Control. Chromatophore - mechanism of colour change and regulation, chronobiology – Biological rhythm and Biological clock.

Unit V: **Endocrine glands in mammals**–Hormone secretion and functions of Hypothalamus, Hypophysis, Pineal Thyroid, Parathyroid, Pancreas, adrenal, Testis and Ovary. Reproductive physiology - Hormonal control of Male and Female reproductive cycle - Molecular mechanism of hormone action – cAMP& Steroid pathway.

References:

1. Prosser C.l.1962 Comparative physiology, W.B.Sunderscompany(II).
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4. Robert M.Berne, Matthew N.Levy 1990. Principles of physiology wolfe publishing Ltd.
5. Knut Schmidt and Nielsen. 2002. Animal physiology; Adaptations and environment Cambridge University.
6. K.M Bykow 1960 textbook of physiology; Forgiven languages publishing house.
7. W.W Tuttle,Byron A. Schottlius 1960 textbook of physiology C.V.Mosby Company.
8. P.C Hurkat, P.N.Mathur, 1976 textbook of Animal physiology S.Chand and Co(Pvt) Ltd.
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SEMESTER – III

EC 3 – CONSERVATION OF BIODIVERSITY AND WILDLIFE

Subject Code: 17P3Z11EC	Credits: 5	External Marks: 75	Hours: 5

Objectives: *To enable the students on the need of conservation of biodiversity, wildlife and its importance.*

Unit I: **Biodiversity:** Definition - Types - Genetic, Species and Ecosystem diversity. Values of biodiversity. Biogeographically classification of India. Biodiversity measurements, mega diversity centers. Loss of biodiversity. Hotspots, Biosphere Reserves, Threats, Endangered and Endemic species. Conservation strategies: *In-situ* - National Parks, Wildlife Sanctuaries, Community Reserve and conservation Reserves. *Ex-situ* – Cryopreservation, gene banks, sperm banks, DNA banks, tissue culture.

Unit II: **Conservation of Natural Resources:** Resources types - Food, water, energy and minerals. Human impact on Terrestrial and Aquatic resources – Distributionand conservation of Forest, Grasslands and semi-arid habitats of India. Wetland Habitats of India: Definition and types of wetlands, important wetlands of India and their conservation issues.

Unit III: **Organizations:** Organization at State level- State Biodiversity Board, National level –NBA, ZSI, BSI, FRI, FSI. International level - CITES, IUCN, CBD and WWF. NGOs - BNHS, Zoo outreach organization, WCT and WPSI. International agreements for conserving marine life. Convention on wetlands of International Importance (Ramsar convention).National Forest Policy –1988, Biodiversity Act - 2002.

Unit IV: **Wildlife in India**: Protected Area concept: National parks, Wildlife Sanctuaries, Biosphere Reserves – Core, buffer and tourism zones. Wildlife wealth of India and threatened wildlife. Reasons for wildlife depletion in India. Wildlife conservation approaches and limitations - Wildlife Habitat - Characteristic, Fauna and Adaptation with special reference to Tropical forest.

Unit V: **Management of Wildlife:** Wildlife Trade and legislation - Assessment, documentation, Prevention of trade. Wildlife laws and ethics. Human - wildlife conflict management –Human death, cattle lifting, crop damage – Mitigation measures and corridor. Techniques of tranquilization and translocation of problematic animals. Important projects for the conservation of wildlife – Project Tiger and Project Elephant. Wild Life (Protection) Act, 1972. Use of GIS and Remote sensing in Wildlife field.

References:

1. Asthana. D.K. and MeeraAsthana. (2010). A text book of Environmental Studies. S. Chand and Company LTD, New Delhi.
2. Saharia, V.B. 1982 Wildlife in India, Nataraj Publishers, Dehra Dun
3. Seshadri, B.1986 India's Wildlife Reserves , Sterling Publishers Pvt. Ltd., New Delhi
4. Giles, R.H. Jr.(Ed) 1984. Wildlife Management Techniques 3rd edition. The wildlife Society, Washington. D.C. Nataraj Publishers, Dehradun. India.
5. Robinson, Wl. and Eric, G. Bolen, 1984. Wildlife Ecology and Management Mac Millan Publishing Co, New York. Pp 478.

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SEMESTER – III

EC 4 – AQUACULTURE AND VERMICULTURE

Subject Code: 17P3Z12EC	Credits: 5	External Marks: 75	Hours: 5

Objectives: *To make expertise in the rearing of fishes and earthworms.*

Unit I: **General Consideration in Aquaculture :**Present status and scope of Aquaculture – Economic values of Aquaculture. Desirable qualities in the Selection of species for culture- **Types of culture systems**: Extensive, Semi-intensive, Intensive.**Types of aquaculture**: Freshwater aquaculture, Brackishwater aquaculture, Mariculture and Metahalineculture.**Culture practices adopted in India**: Monoculture, Monosexculture, Polycultureand Integrated fish farming. Craft and Gears- Sea ranching.

Unit II: **Freshwater aquaculture :**Biology of freshwater cultivable fin fishes and shell fishes. **Fin fishes** - Indian major carps, Murrels, Cat fish, Tilapia. **Shellfishes** -Giant freshwater prawn :*Macrobrachiumrosenbergii*- Freshwater edible mussel *Lamellidensmarginalis*. Construction of freshwater fish ponds; Management of fish farming; Induced breeding of carps- Hypophysation techniques- Predatory and Weed control. **Diseases**–Protozoan (White spot disease and Costiasis), bacterial (Erythroderma and Enteritis), fungal (Gile rot and Saprolegriasis), viral (EpizosticVelcerative Syndrome (EVS and Erythrocytic Necrosis) and Parasitic diseases of fishes - Diagnosis and their control measures.

Unit III: **Marine aquaculture :**Biology of brackishwater and marine cultivable finfish and shellfishes- **Finfishes** : Mullet Mugilcephalus, **Shellfishes**: Pearl oyster Pinctadafucata. Management of water quality and feeding-Associated flora and fauna -Nutritional requirements of fish - Types of feeds- Natural and supplementary feed. Preparation and storage of feed. Mass culture of live feed artemia. Role of CMFRI,CIFA,CIBA, CIFT, FSI , CFTRI and MPEDA.

Unit IV: **Vermiculture:** Biology of earthwormLampitomaruitti, Eudrilluseuginea, Perionyxexcavatus, Eiseniafetida. Culture methods- Breeding techniques - Indoor and outdoor culture methods. Application and Advantages of vermiculture. Need for earthworm culture- Considerations of vermibed – maintenance of vermibed. Quality control- Marketing Techniques- Predator and Pathogens of worms.

Unit V: **Vermitechnology:** Waste management through vermiculture practice – Solid waste management by using earthworm – (organic, inorganic, municipal waste, selected Bio medical Waste)- Vermicomposting : - Methods of vermicomposting – Factors affecting vermicomposting – Application of vermicompost.Vermiwash –Physico-chemical properties and its application.

References:

1. Beavan, R., 1982. Hand book of freshwater fishes of India. Narendra publishing house.
2. Bhawalkar, U.S. and V.U. Bhawalkar, 1992. VermiBiotechnology. Bhawalker Earthworm research Institute, Pune, India.
3. Bal, D.V. and K.Virabhadrarao, 1994. Marine fisheries of India. TATA McGraw hill publication, Chopasani Road, Jodhpur.
4. Samualpaul raj, 1996. Aquaculture for 2000 AD. Palani Paramount publication.
5. Tripathi, G., 2003. Vermisource Technology, Discovery publishing house.
6. Mary Violet Christy, A., 2008. Vermitechnology. MJP Publishers.
7. Arumugam. V., 2008. Aquaculture .Saras publications. P. 480.

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SEMESTER – III

CC 3 – PRACTICAL III

Subject Code: 17P3ZP3	Credits: 4	External Marks: 60	Hours: 4+4

DEVELOPMENTAL BIOLOGY:

1. Hen's egg.
2. Primitive streak
3. Temporary mounting of chick blastoderm of different stages
4. Chick embryo - 24 hours
5. Chick embryo - 48hours
6. Chick embryo – 72 hours
7. Chick embryo – 96 hours
8. T.S of ovary of a mammal
9. Observation of chick embryo by vital staining

IMMUNOLOGY:

1. ABO Blood grouping.
2. Determination of Rh Factor.
3. Smear Preparation of Human Blood to Identify Leucocytes.
4. Rocket Immuno Electrophoresis.

ANIMAL PHYSIOLOGY:

1. Test of Human Saliva
2. Oxygen Consumption and body size of fish.
3. Effect of Thyroxin respiratory Metabolism fish.
4. Kymograph.
5. Sphymomanometer.

AQUA CULTURE:

1. Morphometric Characters of Tilapia.
2. Mersitic characters of Tilapia
3. Gastrosomatic Index
4. Gonadosomatic Index
5. Catlacatla
6. Labeorohita
7. Cat fish (clarius).
8. Mullet (mugil).
9. Tilapia.
10. Macrobracriumrosenbergii.
11. Penaeusmonodon.
12. Penaeusindicus.
13. Lobster.
14. Scyilaserrata.
15. Gears (nets).
16. Crafts (boats).

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SEMESTER – IV

CC 9 – ECOLOGY, EVOLUTION AND ETHOLOGY

Subject Code: 17P4Z13	Credits: 5	External Marks: 75	Hours: 5

Objectives: *To develop the knowledge about the parameters associated with the environment and understanding the significance of the evolution and behaviour of organisms.*

Unit I: **Limiting factors** - Light, Temperature, Soil, Law of minimum, Law of tolerance. **Population ecology**- Density, Natality, Mortality, Growth curves, Equilibrium fluctuation, Biotic potential, Regulation. **Community ecology** - Structure, Stratification, Ecotone and Edge effect, Ecological niche, Ecological succession.

Unit II: **Ecosystem** - Structure, dynamics, energy flow, Primary production and decomposition. Structure and function of some Indian ecosystems-terrestrial (forest, grassland) and aquatic (freshwater, estuarine, marine), **Biogeochemical cycles**-gaseous (Carbon, Nitrogen, Oxygen), Sedimentary (Sulphur, Phosphorus).

Unit III: **Environmental pollution**-Air, Water, Land, Noise, Thermal, Radioactive - Conservation of Natural Resources. Environmental Impact Assessment (EIA). **Remote Sensing**-Aerial Photography, Satellite images, Thermal, Infra Red, Radar Images. Geographical Information System (GIS) and its application; Space Ecology.

Unit IV: **Evolution :** Origin of life on earth, Abiotic synthesis of organic monomers and polymers, concept of Oparin and Haldane; Evolution of prokaryotes and eukaryotes; Evolutionary time scale – Eras, Periods and Epoch, Variations and its concept; Hardy Weinberg Law-Genetic drift, Speciation- Evolution of man-Fossil records of man, Cultural evolution of man, Future evolution of man.

Unit V: **Ethology :** Historical background of animal behavior; types and patterns of behavior; stereo typed behavior-spatial orientation – reflexes – instinct – motivation; acquired behavior; conflict behavior; learning and memory; imprinting; foraging behavior; territorial behavior and reproductive behavior.

References:

1. Verma, P.S. and V.K. Agarwal, 1983. Environmental Biology (Principles of Ecology), S. Chand & Co., New Delhi.
2. Eugene Odum, P., 1971. Fundamentals of Ecology. Third Edition. Nataraj Publishers, Dehradun.
3. Clarke, G.L., (1954). Elements of Ecology. John Wiley & Sons. Inc Toppan Company Ltd.
4. Ananad, P.H. and Rajesh Kumar, V. (2003). Principles of Remote Sensing and GIS Sri Venkateswara Publishers, Kumbakonam.
5. Edwin Colbert, (1969). Palaeontology and Evolution of vertebrates. Second Edition Wiley and Sons Ltd.
6. Arumugam, N. 2009. Organic evolution, 7thRevised edition. Saras Publication.
7. SanjibChattopandhyay, 2002. Life – Evolution, Adaptation and Ethology, Books & Allied (P) Ltd.

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SEMESTER – IV

CC 10 – BIOPHYSICS AND BIOINSTRUMENTATION

Subject Code: 17P4Z14	Credits: 5	External Marks: 75	Hours: 4

Objectives: *To Provide information regarding with basic physical principles involved in bioinstrumentation.*

Unit I: **Introduction to Biophysics:** Stability of biological molecules – Covalent bond, Hydrogen bond and Ionic bond; Absorption spectra of Photo pigments – Biopolymers - Model of polymer chain – Conformations and dynamics – Brownian motion – Properties of biopolymers. Principles of thermodynamics.

Unit II: **Principles and Kinetics of Molecules:** Simple diffusion - Fick's law of diffusion, Facilitated diffusion; Osmosis and Mercury Osmometer, Filtration & Dialysis and kinds, Surface tension- Kinetic theory, capillary rise and drop weight method; Adsorption, Hydrotropy, Viscosity and Gibb's Donnan equilibrium.

Unit III: **Radiation biology:** Radioactivity –Natural and artificial – half life. detection and measurement – dosimetry, geiger - muller counter, scintillation counter, autoradiography, Radio Immuno Assay (RIA) – Principles and application. **Nanotechnology:** Introduction of Nanobiology - Nano sensors and Nano medicines.

Unit IV: **Instrumentation:** Principles and application of Electron microscope – TEM & SEM - Microtomy – types of microtomes - fixation, sectioning, staining and mounting; Principles and application of pH meter; Centrifugation – Types of centrifuge and applications.

Unit V: **Chromatography:** Paper, Thin Layer, Ion Exchange, Column, Gas and liquid chromotographies– Principles and their applications: Electrophoresis – Paper, gel, MALDI – TOF (Protein sequence). Immune electrophoresis - Principles and their applications; Spectrophotomerty - spectrophotometer-principle and applications – Atomic absorption spectroscopy – Nuclear Magnetic Resonance (NMR).

References:

1. Palanichamy, C and Shanmugavelu, M., 2002, Principles of Biophysics, Palani Paramount Publications, Palani.
2. Subramanian, M.A., 2005. BioPhysics: Principles and Techniques, MJP publications, Chennai.
3. Arora, M.P. 2004. Biophysics. Himalaya Publishing House, Mumbai.
4. Arumugam, N and Kumaresan. V. 2013. Biophysics and Bioinstrumentation. Saras Publication.
5. Danial, M., 1992. Basic biophysics for Biologists, Wiley International, New Delhi.
6. Pranabkumar and Banerjee. 2008. Introduction to Biophysics. S. chand and Co., New Delhi.
7. Skoog, A., Douglas, J and Leary, J.J. 1992. Principles of Instrumental analysis. Sauders Golden Sunberst Series. Philadelphia.
8. VasanthaPattabhi and N.Gautham , 2001 'Biophysics', Narosa Publishing Company, New Delhi.

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SEMESTER – IV

EC 5 – CLINICAL LABORATORY TECHNIQUES

Subject Code: 17P4Z15EC	Credits: 4	External Marks: 75	Hours: 5

Objectives: *To provide the clinical knowledge about the serological and urological analysis.*

Unit I: Scope for the study of clinical laboratory techniques. Sterilization procedure: physical & chemical methods, dry method - heat treatment, wet heat method (autoclaving). Safety regulation in clinical lab. First aid for superficial wounds, burns and electrical shocks. Disposal of hospital wastes and infected materials, disinfections of laboratory glassware and equipments.

Unit II: **Haematology :**Collection of blood - capillary blood collection and venous blood collection. Anti-coagulants and serum preparation – Double oxalate mixture, EDTA, heparin and sodium citrate . Determination of packed cell volume (PCV). Erythrocyte Sedimentation Rate (ESR): Westergren's and wintrobe's method. Haemologlobin Estimation (Hb): Acid Haematin method. Bleeding Time(BT) and Clotting time(CT).

Unit III: **Serology and Blood Bank :**VDRL TEST – Kahn test and Flocculation test. Blood Urea Nitrogen (BUN) estimation: Hench and Aldrich's method. Serum cholesterol estimation – Anderson and Key's method. Blood sugar estimation – Glucose Tolerance Test (GTT) (Folin–Wu method). Testing the Blood donor, Compatibility test – Coomb's test only.

Unit IV: **Urine and FaecalAnalysis :**Collection of Urine: Colour, specific gravity, pH, Albumin and sugar (Qualitative and Quantitative), Blood, Bile salt and Bile Pigment (Bilirubin and Urobilinogen). Microscopical examination for pus cells and casts. Collection of Faeces. Identification of intestinal parasite–direct smear examination – FaustsZincSulphate method and Anal Swab method. Physical and Microscopical Examination: Diagnosis of chronic diseases: Mycobacterium leprae. Microscopic Examination of pathological sputum.

Unit V: **Gastric Juice Analysis :**GJ- aspiration by Ryles tube, fractional test meal – Free acid and total acid(FA&TA). CSF Examination: Composition, physical examination, chemical examination, total count, differential count and Pandy's test. Semen analysis: Total count, abnormality, movement, pH, viscosity (Brief points only). Pregnancy test – Male frog test and gravindex test. Diagnostic equipments and apparatuses: ECG, EEG, X ray, Scanning and laser equipments.

References:

1. Clinical lab techniques – K.M. Samual, M.K.G. Iyyarstsans, 4th edition,1984.
2. Clinical Pathology and Bacteriology, Dr.K.n. Sachdev, Jaypee Brothers, Medical publishers, 1988.
3. Medical Laboratory Techniques- Vol-I, II & III – Kania Mukherjee, Tata Mcgraw hill publishing company, 4th edition.
4. RamnikSood,M.D., 2006. Medical Laboratory Technology – 5th Jaypee brothers Medical publishers.
5. RamnikSood., 2009. Concise book of medical laboratory technology –First edition, JAYPEE publishers.

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SEMESTER – IV

CC 4 – PRACTICAL IV

Subject Code: 17P4ZP4	Credits: 4	External Marks: 60	Hours: 4+4

ECOLOGY:

1. Estimation of dissolved oxygen in water samples.
2. Estimation of free oxygen
3. Estimation of calcium polluted water samples
4. Estimation of salinity
5. Estimation of phosphates in polluted water samples
6. Estimation of Alkalinity
7. Water Sampler
8. Ekman grab
9. Secchi disc
10. SteroDissection Microscope.
11. Inverted microscope.

EVOLUTION:

1. Homologous organs.
2. Analogous organs.
3. Vestigial organs.
4. Stick insect.
5. Leaf insect.
6. Peripatus.
7. Chaemeleon.
8. Limulus.
9. Nautilus.

BIOPHYSICS

1. Paper chromatography
2. Thin layer chromatography
3. Page electrophoresis
4. Centrifuge
5. Ultra centrifuge
6. Rotary microtome
7. Preparation of permanent slides
8. pH meter
9. Spectrophotometer

HEMATOLOGY

1. Basics of Weights and Measurements.
2. Methods of sterilization.
3. Haemoglobin Estimation.
4. Erythrocyte sedimentation Rate [ESR].
5. Haematocrit Value [packed cell volume-PCV].
6. Bleeding Time by Duke's Methods.
7. Coagulation [Clotting Time] by Capillary Tube methods.

SEROLOGY

1. Estimation of Serum Cholesterol by Zak Method.
2. Estimation of Serum Urea by Dactyl Monoxime Method.

URINE ANALYSIS

1. Estimation of Urine Albumin.
2. Estimation of Urine Bile Salt.
3. Estimation of Urine Sugar.
4. Specific Gravity of Urine.
5. Microscopic Examination of Urine For Blood Cells, Casts, Bacteria, Yeast cells, Parasites, Squamous cells.

GASTRIC JUICE ANALYSIS

1. Electro cardio Gram (ECG).
2. Electro Encephalo Gram (EEG).
3. Ryle's Tube.
4. Catheter.