

GOVERNMENT ARTS COLLEGE
(AUTONOMOUS)
KUMBAKONAM – 612 002



PG AND RESEARCH
DEPARTMENT OF ZOOLOGY

M.Sc., ZOOLOGY
SCHEME AND SYLLABI
(2020-2021 ONWARDS)

GOVERNMENT ARTS COLLEGE (AUTONOMOUS)-KUMBAKONAM- 612 002

SCHEME FOR M.Sc ZOOLOGY COURSE UNDER CBCS (2020 – 2021 ONWARDS)

Semester	Subject Code	Title of the Paper	Hrs	Credits	Marks
I	20P1Z1	CC 1 - Functional morphology of Invertebrates and Chordates	6	4	100
	20P1Z2	CC 2 - Cell and Molecular biology	6	4	100
	20P1Z3	CC 3 - Molecular and Human genetics	5	4	100
	20P1Z4EC1	EC 1 - Biotechnology and Bioinformatics	5	4	100
	20P1ZP1	CP 1 - Practical – I	4+4	4	100
			30	20	500
II	20P2Z5	CC 4 - Microbiology	6	5	100
	20P2Z6	CC 5 - Biochemistry	6	5	100
	20P2Z7	CC 6 - Biostatistics and Computer applications	5	5	100
	20P2Z8EC2	EC 2 - Entomology	5	5	100
	20P2ZP2	CP 2 - Practical - II	4+4	4	100
			30	24	500
III	20P3Z9	CC 7 - Developmental Biology & Immunology	6	5	100
	20P3Z10	CC 8 - Animal Physiology	6	5	100
	20P3Z11EC3	EC 3 - Conservation of Biodiversity and Wildlife	5	5	100
	20P3Z12EC4	EC 4 - Aquaculture and Vermiculture	5	5	100
	20P3ZP3	CP 3 - Practical –III	4+4	4	100
			30	24	500
IV	20P4Z13	CC 9 - Ecology and Evolution	5	5	100
	20P4ZP14	CC10-Biophysics and Bioinstrumentation	5	5	100
	20P4Z15EC5	EC 5 - Clinical Laboratory Techniques	5	4	100
	20P4ZP4	CP 4 - Practical –IV	4+4	4	100
	20P4ZPW	Project work	7	4	100
			30	22	500
		Total Credits	120	90	2000

	<u>Internal Marks</u>	<u>External Marks</u>
Theory	25	75
Practical	40	60
Project	20	80

Summary

Part	Course	No.	Credit	Marks
I	Core Courses	10	47	1000
II	Core Course (Practical)	4	16	400
III	Elective Course	5	23	500
IV	Project	1	4	100
	Total	20	90	2000

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
PG AND RESEARCH DEPARTMENT OF ZOOLOGY
CHOICE BASED CREDIT SYSTEM
PG COURSE PATTERN M.Sc., ZOOLOGY COURSE
FOR STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2020-2021 ONWARDS
PROGRAMME: M.Sc., ZOOLOGY

PO No.	PROGRAMME OUTCOME Upon completion of the M.Sc., Degree programme, the graduate will be able to
PO – 1	Apply the knowledge of Zoology, Life Sciences and allied subjects to understand the complex life processes and phenomena.
PO – 2	Identify, review research literature and analyse the complex situations of living forms.
PO – 3	Design processes/strategies to meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
PO – 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretations of data and synthesis of the information to provide valid conclusions.
PO - 5	Execute the project and based on the research hypothesis.

PSO No.	PROGRAMME SPECIFIC OUTCOME Upon completion of these course the students would be able to
PSO – 1	Explain how organisms function at the gene, genome, cell, tissue, organ and organ-system and develop theoretical and practical knowledge in handling the animals and using them as model organism.
PSO – 2	Describe the physiological adaptations, development, reproduction and behavior of different forms of life.
PSO – 3	Illustrate physiological adaptations. Development, reproduction and behavior of different forms of life.
PSO – 4	Subjects like Vermitechnology, Clinical Laboratory Technology, Apiculture and Aquaculture included in order to promote their skill and provide employable opportunities in the field of higher studies and research in Government and Private organizations.
PSO - 5	Develop proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization and relate concepts of comparative biology to explain evolution and success to live in varied environment.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – I

CC 1 - FUNCTIONAL MORPHOLOGY OF INVERTEBRATES AND CHORDATES

Subject Code: 20P1Z1	Credits: 4	External Marks: 75	Hours: 6
-----------------------------	-------------------	---------------------------	-----------------

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

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 anatomy of Invertebrates:** Skeletal structure in invertebrates. Neuro muscular system in invertebrates: Coelenterates, Annelids, Arthropods and Molluscs. **Circulation:** Circulation in Annelids, Arthropods and Molluscs. **Excretion:** Excretory organs in Annelids and Arthropods. **Reproduction:** Reproduction in Annelids and Molluscs.

Unit III: **Comparative anatomy of Vertebrates: Digestive System** - Alimentary canal and associated structures in Aves and Mammals. Respiration in vertebrates – Gill – cutaneous – buccal - pulmonary. **Circulatory System** - Types and evolution of heart and aortic arches.

Unit IV: **Comparative physiology: Excretory System** - Types and evolution of kidneys and ducts in vertebrates. **Nervous System** - Brain and spinal cord. Reproductive systems – Urinogenital organs in fishes, amphibians, reptiles and Aves.

Unit V: **Minor Phyla** – Organization and affinities of Chaetognatha, Ctenophora, Ectoprocta, Endoprocta, Brachiopoda, Phoronida and Rotifera.

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. SoundaraPandian. (2015). Invertebrate Zoology. Saras Publication, Nagarcoil.
4. Jordan, E. L. and P.S. Verma. 2005. Chordate Zoology, S. Chand & Company.
5. Saxena.R.K. and Saxena. S. 2015. Comparative anatomy of vertebrates. M.V. Learning, UK.
6. Wessells. N.K. 1974. Vertebrate structure and functions. W.H. Freeman and Company. San Fransisco.
7. Mani. M.S. and Hegde. V. 2004. Progress in Invertebrate Zoology. Orient Longman Pvt. Ltd, Hydrabad.
8. Sherman. I.W and Sherman. V.G. 2007. The invertebrates: Functions and Form, A laboratory Guide. Dorling Kindersley (India) Pvt. Ltd. South Asia.

Course No.	COURSE OUTCOME
CO1	Gave an idea of different organizational coelomate groups
CO2	Understood about the systems of higher groups of invertebrates
CO3	Obtained knowledge of the system and organization of vertebrate animals
CO4	Understood excretory and nervous system of vertebrate animals
CO5	Understood about the significance of minor phyla

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – I

CC 2 - CELL AND MOLECULAR BIOLOGY

Subject Code: 20P1Z2	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 – 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 composition – functions: cell respiration – respiratory chain complexes; oxidative phosphorylation - chemiosmotic hypothesis –Mitochondrial DNA & RNA; Structural organization and functions of Ribosomes – Biogenesis. Centrosome. Peroxisomes and Glyoxysomes.

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.

Course No.	COURSE OUTCOME
CO1	Acquired detailed knowledge about the basic properties of cells and fine structure and functions of cell organelles.
CO2	Explained the molecular events on Mitochondria structure and functions of cell organelles.
CO3	Understood that fundamental structure, properties and processes in which nucleus and chromosomes.
CO4	Described the cytoskeleton and signal pathways Hormones and their receptors.
CO5	Learned cellular communication and its regulation, cell adhesion molecules and cell cycle.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – I

CC 3 - MOLECULAR AND HUMAN GENETICS

Subject Code: 20P1Z3	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, Overlapping 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: **Genetic disorders-** 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.

Course No	COURSE OUTCOME
CO1	Imparted knowledge on genetic materials and its chemical nature
CO2	Understood the molecular mechanism of DNA replications and recombinations
CO3	Gained knowledge on the molecular structure of gene and its function
CO4	Learned about human genetic and counseling
CO5	Obtained knowledge on the genetic disorders

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – I

EC 1 - BIOTECHNOLOGY AND BIOINFORMATICS

Subject Code: 20P1Z4EC1	Credits: 4	External Marks: 75	Hours: 6
--------------------------------	-------------------	---------------------------	-----------------

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 culture, Enzyme biotechnology; Production of enzymes - Isolation & Purification of enzymes, immobilization of enzyme. 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 proteomedatabases, 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.

Course No	COURSE OUTCOME
CO1	The course is designed to give a perspective idea on the basics of biotechnology and genetic engineering
CO2	Familiarised with different approaches to generate transgenic animals, gene cloning and stem cell technology
CO3	Understood the fundamental concepts of gene therapy and bioremediation
CO4	Got an overview about types and biological database and tools
CO5	Ensured the knowledge on the basics of human genome and bioinformatic tools

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – I

CC1 –PRACTICAL I

Subject Code: 20P1ZP1	Credits: 4	External Marks: 60	Hours: 4+4
------------------------------	-------------------	---------------------------	-------------------

Dissection and Mounting

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

Invertebrata

Ceratium – polystomella – hyalonema – amphiblastula larva – bougainvillea – gorgonian – schistosoma – echinococcus granulosus – enterobius vermicularis – Wuchereria bancrofti – serpula – bonellia (female) – squilla – scolopendra – loligo – osphradium of pilaglobosa – ophiethrix – 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 – sphenodon punctatum – 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 – tRNA Polytene chromosome – Lampbrush chromosome.

Genetics

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

Biotechnology

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

Bioinformatics

EMBL and DDBJ, GEN bank, Primary domain data base – TrEMBL – Swiss Prot – Phylogenetics.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – II

CC 4 – MICROBIOLOGY

Subject Code: 20P2Z5	Credits: 5	External Marks: 75	Hours: 6
-----------------------------	-------------------	---------------------------	-----------------

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

Unit I: **Introduction to Microbes:** Scope of Microbiology, outline classification of Bergy's - Three domain system of classification. Morphology and fine structure of bacteria, cyanobacteria, fungi, virus, viroids, prions and T4 Phage; Reproduction of 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 anaerobes; Isolation and maintenance of pure culture methods; Cultural characteristics. Smearing and Gram's Staining. Biochemical methods. 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. **Aero Microbiology:** Indoor Aeromicrobiology – Aeroallergens and Aeroallergy; Phylloplane microflora 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 - Diphtheria, Gonorrhoea & Typhoid; Viral diseases - AIDS, Chicken pox, SARS, COVID 19 & Rabies; Fungal diseases – Mycoses and Mycotoxicosis and Bioterrorism – types and agents. **Pharmaceutical Microbiology:** Production of Vitamins – Vitamin B12 (Cyanocobalamin) 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 Dagainwala, 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.

CO NO.	Course outcomes
CO-1	Got knowledge and basic informations on microbes
CO-2	Obtained different methods of Microbiology
CO-3	Learned the soil, water and aerobic microbiology
CO-4	Acquired knowledge about industrial and food microbiology
CO-5	Gained knowledge on medical micro biology with various diseases and agents

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – II

CC 5 – BIOCHEMISTRY

Subject Code: 20P2Z6	Credits: 5	External Marks: 75	Hours: 5
-----------------------------	-------------------	---------------------------	-----------------

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, Monooxygenase). 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, Pasteur 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.

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.

Course No.	COURSE OUTCOME
CO1	Acquired detailed knowledge about the structure and function of biomolecules, Mechanisms of enzyme action.
CO2	Understanding the various chemical constituents of living organisms.
CO3	To understanding that energy flow occurs in cells through the breakdown of carbohydrates metabolism.
CO4	Know the significance of protein and amino acid metabolism and its human health.
CO5	Understand that lipid and nucleotide metabolism and its significance in human health.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – II

CC 6 – BIOSTATISTICS AND COMPUTER APPLICATIONS

Subject Code: 20P2Z7	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 collection and secondary data collection. 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: **Introduction to Computer** - Introduction, Advantages of using computer, Generation of computers, Computer codes - BCD code, ASCII code, Functional units of a computer; Types of computers: Desktop, Laptop, palmtop, PDA etc. Definition: Hardware, Software and Firmware, ROM, RAM, CD-ROM, DVD, Pendrive, Hard disc, LCD projector.

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.

Course No.	Course outcome
CO1	Understood different methods of representation of various graphical and diagrammatic data
CO2	measured the basic statistical tools for data analysis
CO3	Tested various hypothesis of statistical data representation
CO4	Understood the uses and importance of computer on biological field
CO5	Awared various computer softwares to analyse biological data.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.

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

M.Sc., ZOOLOGY

(Effective for those admitted from 2020-2021 onwards)

SEMESTER – II

EC 2 – ENTOMOLOGY

Subject Code: 20P2Z8EC2	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 and Anatomy:** Principles of insect taxonomy- Classification of insects up to order. Morphology and anatomy of insects-segmentation and divisions of the body. Head-Mouth parts and its types. Thorax-legs-Modifications of the basic leg structure. Exoskeleton-integument-Basic structure of cuticle-wings and flight. Insect collection, preservation and culture techniques.

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

Unit III: **Agricultural Entomology:** Biology, Life cycle and culture of major pest crops – paddy (*Scirpophaga incertulas* & *Orseolia oryzae*), sugarcane (*Chilo fuscicollis*, *Pyrilla perpusilla* & *Tryporyza novella*), cotton (*Aphis gossypii* & *Earia sinulana*) and coconut (*Opisina arenosella* & *Oryctes rhinoceros*); insect pests of stored products. **Medical Entomology:** Biology, mechanism of transmission and their control of Anopheles, Culex, Aedes 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 – weed killers.

Unit V: **Insect control** – Prophylactic measures – cultural, mechanical, physical methods – Biological control: Parasites, Predators and Microbial agents. Chemical methods: Bio Pesticides, classification – mode of action – toxicity– insecticide resistance – environmental safety. Non-conventional methods: Use of insect growth regulators (IGR), repellents, anti-feed ants, 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.
6. Mary Louise Flint and Robert Van den Bosch.1983.Introduction to Integrated Pest Management. Plenum Press, New York.
7. Chapman.R.F.1998.The insects .structure and function .4th edition, Cambridge University Press, UK.

Course No	COURSE OUTCOME
CO1	Acquired basic knowledge on insect classification and anatomy
CO2	Understood the mechanism of insect physiology of various systems
CO3	Gained knowledge on agricultural and medical entomology
CO4	Enhanced various beneficial insects and their commercial uses
CO5	Learned about various insect pest management methods

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – II

CC 2 – PRACTICAL II

Subject Code: 20P2ZP2	Credits: 4	External Marks: 60	Hours: 4+4
------------------------------	-------------------	---------------------------	-------------------

MICROBIOLOGY

1. Isolation of pure culture of microorganism
2. Sampling of microorganism from soil
3. Gram's staining for differentiation of bacteria
4. Hanging drop mount method
5. Measurement of microorganisms by micrometry method
6. Presumptive coliform test (MPN)

Spotters

Basic instrument of microbiology laboratory
Bunsen burner
Millipore filter
Autoclave
Laminar air flow
Quebec colony counter

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

Spotters

Keyboard
Mouse
Monitor
Digital video disc
Hard disc
Pendrive

BIOSTATISTICS

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

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – III

CC 7 – DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

Subject Code: 20P3Z9	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 germ lines – germ cell lineage – migration of germ cells – spermatogenesis – spermiogenesis – oogenesis – Egg maturation – Hormonal regulation of vitellogenesis. Genetic control of vitellogenesis. Types of eggs. Egg envelopes. **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–Holoblastic and meroblastic cleavages. 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. Immunological techniques – VDRL test- Immunodiffusion –Immuno electrophoresis - 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. Sinauer associates., INC Publishers.
6. Balinsky, B.H. 1975. In introduction to embryology. 5th edition CBS College publishers.

Course No	COURSE OUTCOME
CO1	Gave knowledge about gametogenesis and fertilization events
CO2	Gave knowledge about embryos development of cleavage and gastrulation.
CO3	Knew about the differentiation and organogenesis and terratogenesis
CO4	Learned about immune systems and their functions
CO5	Gained knowledge about immune disorders and immunological techniques and prevention methods

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – III

CC 8 – ANIMAL PHYSIOLOGY

Subject Code: 20P3Z10	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 deficiency;
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, Tactile 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.I. 1962 Comparative physiology, W.B. Saunders company (II).
2. David Randall 1978 Animal physiology W.H. Freeman and company.
3. Giese A.C. 1968 Cell physiology W.B. Saunders company (III)
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; Forgotten languages publishing house.
7. W.W Tuttle, Byron A. Schottliuss 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.
9. James A. Wilson 1979 Principle of Animal physiology Macmillan publishing co. (II).

CO NO.	COURSE OUTCOMES
CO-1	Gained fundamental knowledge of nutrition, respiration and muscular contraction
CO-2	Enabled the mechanism of circulation and excretion
CO-3	Gained the knowledge of mechanism of osmoregulation and neuro transmitters
CO-4	Understood the types of receptors and biological clock
CO-5	Gained knowledge of endocrine systems and their functions.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – III

EC 3 – CONSERVATION OF BIODIVERSITY AND WILDLIFE

Subject Code: 20P3Z11EC3	Credits: 5	External Marks: 75	Hours: 5
---------------------------------	-------------------	---------------------------	-----------------

Objectives: *To enable the students to know the need of conservation of biodiversity, wildlife and their importance.*

Unit I: **Biodiversity:** Definition - Types - Genetic, Species and Ecosystem diversity. Values of biodiversity. Biogeographical 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 and tissue culture, Zoo, Zoological Park, Arboretum.

Unit II: **Conservation of Natural Resources:** Resources types - Food, water, energy and minerals. Human impact on Terrestrial and Aquatic resources –Distribution and 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. Exclusive Economic Zone; 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 Meera Asthana. (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.
6. Maiti.P.K and Maiti.P. 2011. Biodiversity – perception, peril and preservation. PHI, Learning Pvt. Ltd., New Delhi.

CO NO.	COURSE OUTCOME
CO-1	Understood the significance of conservation of biodiversity values
CO-2	Impart knowledge of different types of habitats for conservation of nature.
CO-3	Knew the different organizations involving conservation of biodiversity and Wildlife
CO-4	Interpreted various threats for depletion of wildlife and their conservation
CO-5	Made solutions for various types of conflicts between animals and human

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – III

EC 4 – AQUACULTURE AND VERMICULTURE

Subject Code: 20P3Z12EC4	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, Brackish water aquaculture, Mariculture and Metahaline culture. **Culture practices adopted in India:** Monoculture, Monosex culture, Polyculture and Integrated fish farming. Craft and Gears.

Unit II: **Freshwater aquaculture:** Biology of freshwater cultivable fin fishes and shell fishes. **Fin fishes** - Indian major carps, Murrels, Tilapia. **Shell fishes** -Giant freshwater prawn: *Macrobrachium rosenbergii*. 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 (Gill rot and Saprolegniasis), viral (Epizootic Ulcerative Syndrome (EUS and Erythrocytic Necrosis) and Parasitic diseases of fishes - Diagnosis and their control measures.

Unit III: **Marine Aquaculture:** Biology of brackish water and marine cultivable finfish and shellfishes- **Fin fishes:** Sea bass (*Lates calcarifer*), **Shell fishes:** Pearl oyster *Pinctada fucata*. Associated flora and fauna in mariculture -Nutritional requirements of fish - Types of feeds- Natural and supplementary feed. Preparation and storage of feed. Mass culture of live feed artemia. Role of organizations in aquaculture - CMFRI, CIFA, CIBA, CIFT, FSI, CFTRI and MPEDA.

Unit IV: **Vermiculture:** Biology of earthworm *Lampito maruitti*, *Eudrillus euginea*, *Perionyx excavatus*, *Eisenia fetida*. 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.Virabhadrrao, 1994. Marine fisheries of India. TATA McGraw hill publication, Chopasani Road, Jodhpur.

4. Samuel Paul 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.

Corse No.	COURSE OUTCOME
CO1	Gave an idea on the basic principles of aquaculture practices
CO2	Understood culture of fin fishes and shell fishes and their diseases
CO3	Understood about the marine organisms for aquaculture and the organizations involved in Mariculture
CO4	Knew the different species of earth worms and methods of vermiculture
CO5	Acquired the by products through vermitechnology and its applications

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – III

CC 3– PRACTICAL III

Subject Code: 20P3ZP3	Credits: 4	External Marks: 60	Hours: 4+4
------------------------------	-------------------	---------------------------	-------------------

DEVELOPMENTAL BIOLOGY:

- | | |
|---|--|
| 1. Hen's egg. | 5. Chick embryo - 48hours |
| 2. Primitive streak | 6. Chick embryo – 72 hours |
| 3. Temporary mounting of chick blastoderm of different stages | 7. Chick embryo – 96 hours |
| 4. Chick embryo - 24 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. Sphygmomanometer.

CONSERVATION OF BIODIVERSITY AND WILDLIFE

1. Marking major National Parks and Tiger Reserves of India
2. Marking major Wildlife Sanctuaries of Tamil Nadu
3. Marking Biodiversity Hotspots of India
4. Calculating capture and recapture method of estimating animals using beans seeds.
5. Spotters: Compass, Binocular, GPS, Camera Trap, Tranquilizer Gun

AQUACULTURE

1. Morphometric Characters of Tilapia.
2. Meristic characters of Tilapia
3. Gastrosomatic Index
4. Gonadosomatic Index
5. Analysis of gut content of fish

Spotters

Catla catla

Labeo rohita

Cat fish (clarius).

Mullet (mugil).

Tilapia.

Macrobrachium rosenbergii.

Penaeus monodon.

Lobster.

Scylla serrata.

Gears (nets).

Crafts (boats).

VERMICULTURE**Spotters**

Cocoon

Windrow method of
vermicomposting

Vermicast

Lambito marutii,

Eudrillus euginea,

Perionyx excavatus,

Eisenia fetida

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – IV

CC 9 – ECOLOGY AND EVOLUTION

Subject Code: 20P4Z13	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 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: **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. 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, 7th Revised edition. Saras Publication.

7. Sanjib Chattopandhyay, 2002. Life – Evolution, Adaptation and Ethology, Books & Allied (P) Ltd.
8. Yadav, P. R. 2003. Fossils. Discovery Publishers.
9. Arora, M. P. (1992). An Introduction to palaeontology. Himalaya Publishers.
10. Raup, D.M and S.M. Stanley. (1999). Principles of Paleontology. CBS Publishers & distributors, New Delhi.

CO NO.	COURSE OUTCOME
CO-1	Dealt limiting factors, population and community ecology
CO-2	Learned various ecosystems with the knowledge of biogeochemical cycles
CO-3	Obtained knowledge about environmental pollution and remote sensing
CO-4	Gained informations on evolution and origin of earth, life and evolutionary time scale
CO-5	Gave an idea of evolutionary significance of fossils

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – IV

CC 10 – BIOPHYSICS AND BIOINSTRUMENTATION

Subject Code: 20P4Z14	Credits: 5	External Marks: 75	Hours: 5
------------------------------	-------------------	---------------------------	-----------------

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 Properties of biopolymers – Conformations and dynamics – Brownian motion. 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 and applications of Nanotechnology.

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 centrifuges and applications.

Unit V: **Chromatography:** Paper, Thin Layer, Ion Exchange, Column, Gas and liquid chromatographies– Principles and their applications: Electrophoresis – PAGE, GEL, MALDI – TOF (Protein sequence). Immuno electrophoresis - Principles and their applications; Spectrophotometry - 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. Saunders Golden Sunburst Series. Philadelphia.
8. VasanthaPattabhi and N.Gautham , 2001 'Biophysics', Narosa Publishing Company, New Delhi.

Course No.	COURSE OUTCOME
CO-1	Understood the chemical bonds and principles of thermodynamics
CO-2	Studied the principles of kinetics of molecules
CO-3	Got an idea on tools and techniques on radiation biology
CO-4	Understood the principle and applications of biophysical instruments
CO-5	Learned about the principles and application of chromatography techniques.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – IV

EC 5 – CLINICAL LABORATORY TECHNIQUES

Subject Code: 20P4Z15EC5	Credits: 4	External Marks: 75	Hours: 5
---------------------------------	-------------------	---------------------------	-----------------

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

Unit I: **Introduction:** 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. Haemoglobin Estimation (Hb): Acid Haematin method. Bleeding Time(BT) and Clotting time(CT).

Unit III: **Serology:** VDRL TEST – Kahn test and Flocculation test. Blood Urea Nitrogen (BUN) estimation: Hensch 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 Faecal Analysis :**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 – Fausts Zinc Sulphate 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 – Strip test. Diagnostic equipments: ECG, EEG, X ray, Scanning and laser equipments.

References:

1. Clinical lab techniques – K.M. Samuel, M.K.G. Iyyarstans, 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. M.D, 2009. Concise book of medical laboratory technology –First edition, JAYPEE publishers.

Course NO.	COURSE OUTCOME
CO-1	Understood the basic principles of clinical laboratory
CO-2	Gained knowledge on blood collection and estimation of blood components
CO-3	Understood the serological techniques
CO-4	Studied the urine and faecal specimens analysis
CO-5	Enhanced the knowledge on gastric juice analysis and pregnancy tests

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – IV

CC 4– PRACTICAL IV

Subject Code: 20P4ZP4	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. Identification of freshwater & marine plankton sample
8. Quantitative estimation of plankton sample

Spotters

Water Sampler, Secchi disc, Plankton net, sedgewick rafter

EVOLUTION:

Spotters

Homologous organs.

Analogous organs.

Vestigial organs.

Stick insect.

Leaf insect.

Peripatus.

Chameleon.

Limulus.

Nautilus.

BIOPHYSICS

1. Separation of biomolecules using Paper chromatography
2. Separation of biomolecules using Thin layer chromatography
3. Separation of biomolecules using electrophoresis (PAGE)

Spotters

Centrifuge

Ultra centrifuge

Rotary microtome

pH meter

Spectrophotometer

HEMATOLOGY

1. Methods of sterilization.
2. Estimation of Haemoglobin.
3. Erythrocytes sedimentation Rate [ESR].
4. Haematocrit Value [packed cell volume-PCV].
5. Bleeding Time by Duke's Methods.
6. 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

Spotters

Electro cardio Gram (ECG).

Ryle's Tube.

Catheter.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Re-accredited with 'A' Grade by NAAC & Affiliated to Bharathidasan University
M.Sc., ZOOLOGY
(Effective for those admitted from 2020-2021 onwards)

SEMESTER – IV

PROJECT WORK

Subject Code: 20P4ZPW	Credits: 4	External Marks: 80	Hours: 7
------------------------------	-------------------	---------------------------	-----------------

MAPPING WITH PROGRAMME OUTCOMES

		Programme outcomes					
		PO1	PO2	PO3	PO4	PO5	PO6
Course outcomes	CO1	✓	✓	✓	✓	✓	✓
	CO2	✓	✓	✓	✓	✓	✓
	CO3	✓	✓	✓	✓	✓	✓
	CO4	✓	✓	✓	✓	✓	✓
	CO5	✓	✓	✓	✓	✓	✓

Note: The question paper setter is kindly informed to strictly follow the following questions paper pattern

	Unit I	Unit II	Unit III	Unit IV	Unit V
Section A (Q. Nos.)	1 (A&B)	2 (A&B)	3 (A&B)	4 (A&B)	5 (A&B)
Section B (Q. Nos.)	6 (A&B)	7 (A&B)	8 (A&B)	9 (A&B)	10 (A&B)