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BE BOUNDLESS

BENGALURU CITY UNIVERSITY

SYLLABUS FOR M.Sc Animal Science (I to III Semester)

**CHOICE BASED CREDIT SYSTEM
(SEMESTER SCHEME)**

2020-2021



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HCT 101: SYSTEMATICS AND BIODIVERSITY
(4 Credits, 4 hr/week, 52hr)

Unit I

Fundamental of Systematics: Biological classification, hierarchy of categories and higher taxa. Taxonomical characters – Procedures and keys. Species concepts: varieties, subspecies, sibling species and race. International code of Zoological Nomenclature (ICZN).

Kingdoms of Life: General outline of kingdoms including Monera and Protista; broad outline diversity of animal kingdom.

Methodologies in Systematics: Morphology based taxonomy, numerical taxonomy, cytotoxicology and chemotaxonomy, DNA fingerprinting and markers for detection/evaluation of polymorphism. **09 hr**

Unit II

Systematics of Lower Invertebrates: Classification, general characters of Phylum Protozoa, Porifera, Coelenterate, Platyhelminthes and Aschelminthes.

Systematics of Minor phyla: General characteristics and classification. Structural affinities and life history of Minor Phyla. **13 hr**

Unit III

Systematics of Higher Invertebrates: General characteristics, classification of Phylum Annelida, Arthropoda, Mollusca and Echinodermata.

Systematics of protochordate and Chordate: General characters and outline of classification of Protochordate and Chordate (up to orders). Origin of chordates in the light of recent theories. Systematic position and Phylogenetic interrelationship between Protochordates and Chordates. Migration in fishes and birds. Parental care in fishes and amphibians. Adaptive radiations in birds, reptiles and mammals. **13 hr**

Unit IV

Biodiversity in Biosphere -Basic principles: Biodiversity, Introduced Biodiversity and Native Biodiversity. Components of Biodiversity, Classification of Habitats: Biomes, Species Diversity: α , β and γ diversity. Endemic species and patterns of distribution with special reference to India. Western Ghats and Silent valley as “biodiversity hot spots”. Characterization, generation and maintenance, scope and constraints of biodiversity; genetic diversity, species diversity, eco-system diversity. **08 hr**

Unit V

Biodiversity and conservation: Biosphere reserves, resources and management. Global diversity hotspots, effect of manmade alterations of environment on biospheres. Biodiversity Indices, threat to biodiversity. Modern tools and techniques to assess biodiversity, strategies of conservation. Global programmes and concept of endangered species.

Conservation-approach: Landscape approach to biodiversity conservation, Corridor approach, individual species approach, habitat conservation approach. National biodiversity strategy and action plan. **09 hr**

Bibliography

1. Biodiversity Conservation and Phylogenetic Systematics. Pelleus R and Gandcolas P (2011) Springer.NY.
2. Biodiversity: Perception, Peril and Preservation. PrabodhMaiti and PaulainMaiti (2011). PHI Learning. New Delhi
3. Principles of Animal Taxonomy. Simpson G G (2011). Oxford & IBH Pub.Company.
4. Plant Systematics. Balfour A (2016). SyrawoodPub.House. London
5. Text book of Biosystematics. Pullaiah T (2013). Regency Publishers. USA.
6. Biology of Biodiversity. Kato M (2007). Springer, NY.
7. Description of Taxonomy. Watson M.F., Lyal C.H.C. and Pendry C A. (2015). Cambridge University Press.
8. Biodiversity Taxonomy and Ecology. Sing G.K.M (2008). Alp books
9. Biology. Raven P., Johnson G, Mason K, Losos J and Singer S (2005). McGraw Hill.

HCT 102: ECOLOGY, ENVIRONMENTAL BIOLOGY AND EVOLUTION
(4 Credits, 4 hr/week, 52hr)

Unit I

Concept of Ecology and Ecosystem: Evolutionary ecology, environmental concepts-laws and limiting factors, ecological models. Nature of ecosystem, production, food webs, energy flow through ecosystem, bio-geochemical cycle, resilience of ecosystem, ecosystem management.

Limiting Factors: Concept of limiting factors-Liebig's law of the minimum, Shelford's law of tolerance. Population and community ecology. Natality, mortality, growth rate as factors determining the population density-population interactions. Types of community-structure-community succession and homeostasis.

Habitat Ecology: Fresh water, marine, estuarine habitats, terrestrial habitats. Eco-tourism. **12 hr**

Unit II

Resource Ecology and Management: Concept-classification; non-renewable and renewable resources, conventional and non-conventional source and energy. Conservation of natural resources, use of alternate energy sources.

Environmental Pollution: Air, water, soil and land pollution. Impact of pollutants on general fauna, flora and ecosystem. Factors influencing environmental concentration of toxicants and toxicity. Environmental monitoring of pollutants. Major conventions and agreements for environmental protection. Rehabilitation of lakes. **12 hr**

Unit III

Climate change: Environmental stresses and their management, global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition, coping with climatic variations. El-Nino effect.

Bioremediation: Major classes of contaminants. Uptake, biotransformation, detoxification, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Impact of chemicals on biodiversity of microbes, animals and plants. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals. **10 hr**

Unit IV

Evolutionary concepts: Evolution of Eukaryotes from Prokaryotes. Lamarckism, Darwinism-merits and demerits. Modern synthetic theory, theory of population genetics leading to Neo-Darwinism. Evolution of *Homo Sapiens*. **08 hr**

Unit V

Evidences and Elemental forces of evolution: Paleobiological- concepts of stratigraphy and geological time scale; fossil study. Anatomical- vestigial organs; homologous and analogous organs (concept of parallelism and convergence in evolution). Taxonomic – Transitional forms/evolutionary intermediates; living fossils. Phylogenetic- A) Fossil based. B) Molecular

based-protein model (Cyt-C); C) Gene model (ne). Mutation, Selection (types of selection, selection coefficient, selection in natural population). Random genetic drift, Migration. **10 hr**

Bibliography

1. Fundamentals of Ecology. Eugene P. Odum(1972). W.B. Saunders company, London
2. Environmental Biology, Michael Reiss and Jenny Chapman (2000) Cambridge Press ,UK
3. Principals of Ecotoxicology. Butler, O.C. (1978). John Wiley & Sons, USA.
4. Environment and Ecology. Majid Husain (2015) Access Publishing.UK
5. Environmental Science. Cunningham and Saigo (1999). McGraw Hill, 5thEdition. London
6. A primer of Conservational Biology. Primark (2001) Sinauer, 2nd Ed.
7. Process of Organic evolution. Stebbins, G.L. (1989). Prentice Hall of India, New Delhi
8. Evolutionary Biology. Douglas, J. Futuyma. (1997). Sinauer Associates.
9. Evolution: Making Sense of Life. Zimmer C and Elmen D J. (2013). Roberts & Co. NY

HCT 103: BIOCHEMISTRY AND BIOPHYSICS

(4 Credits, 4 hr/week, 52hr)

Unit I

Molecules and their characteristic features: Review of basic concepts of solution chemistry – acid, base, ionic strength, principles of thermodynamics: chemical potential, free energy, entropy, enthalpy, heat capacity; dimensions of atoms, bonds: covalent and non-covalent bonds and molecules. Dihedral angles, steric conflict, classes of organic compounds and functional groups. **07 hr**

Unit II

Carbohydrates and Lipids: Sugars and polysaccharides: chemistry, classification and function; glycoproteins: structure and function. Fatty acids- Saturated, unsaturated and eicosanoids; phosphor and spingolipids- structure, classification, lipoprotein, liposomes and prostaglandins. **Nucleic acids:** Nucleotides, single and double- stranded DNA structures, types of DNA, RNA world. **10 hr**

Unit III

Amino acids, peptides and polypeptides: Chemical reactions and physical properties, Three dimensional structures of proteins, the Ramachandran plot, α -helix, β - sheet. Structure of collagen, conformational map, tertiary structure, quaternary structure. **Enzymology:** Classification, specific activity, coenzymes. Kinetics of enzyme reactions, regulation of enzymatic activity. Isoenzymes: structure and function. **10 hr**

Unit IV

Light and Biomolecules: Properties of light and laser light, Polarisation of light, linear and circular dichroism (CD), CD spectra of protein and nucleic acids.

Spectrometry and X-ray diffraction: Principles of spectroscopy, ionization, protein mass determination, MALDI-MS, ESI-MS. Methods of glowing crystals, theory of x-ray diffraction, Bragg's law, x-ray scattering in reciprocal space, low-angle x-ray scattering, fibre diffraction of helices. **13 hr**

Unit V

Fluorescence and Infrared spectroscopy (IR): Phenomenon of fluorescence, fluorescence decay, fluorescence anisotropy, fluorophores, linear polarization of fluorescence, Fluorescence microscopy and Fluorescence resonance energy transfer (FRET) and its biological applications.

Electron Spin Resonance (ESR) and Nuclear Magnetic Resonance (NMR) spectroscopy: Magnetic phenomena, spin labels, Theory of nuclear resonance, chemical shift and shielding, spin-spin interaction, coupling constant and coupling behaviour, two-dimensional NMR in protein structural studies. NMR in bio-medical research. **12 hr**

Bibliography

1. Basic concepts of Biochemistry. Gilbert H.F. (2002). McGraw Hill Professional. New York.
2. Biochemistry. Down M.B. (1999). LipincottWillam& Wilkins. London
3. Biochemistry. Cambell M and Farrell D (2005). Thomas Books/Cole.
4. Biochemistry .Stryer L. (1999). Freeman and Company, New York.
5. Biochemistry with clinical correlations. Devlin , T.M. (2006). Wiley-Liss Inc. NY.
6. Biochemistry. Mathew, Van Holde and Ahem (2001). 3rd Ed. Pub Pearson education
7. Biochemistry & Molecular Biology of plants. American Society of Plant Physiologists.
8. (Buchanan, B.B., W.Gruissem& Jones R.L. (2015),2nd edition) Rock Ville, USA, Maryland.
9. Principles of Biochemistry. Cox, M., Michael.,Nelson,L.D. (2008 5th edition.W.H.
10. Freeman and company, Newyork.
11. Biochemistry. Voet , D and Voet, J.G. (2011), 4th edition J.Wiley and sons

HCT 104: CELL - MOLECULAR BIOLOGY AND GENETICS

(4 Credits, 4 hr/week, 52hr)

Unit I

Molecular organization of cell: Cell membrane structure; lipid bilayers- fluid mosaic model; Membrane proteins of small molecular transport and membrane potentials; Structure and biogenesis of endoplasmic reticulum, Golgi, mitochondria and nucleus; Vesicular transport-from ER through Golgi, trans Golgi network to lysosomes; Endo-exocytosis.

Cytoskeleton, cell interaction and communication: Structure of cytoskeletal filaments and their regulation; Molecular motor proteins; Cell junctions, cell-cell adhesion and extracellular matrix; Cell communication- principles, signaling through G-protein coupled receptors, enzyme-linked receptors. **13 hr**

Unit II

Cell cycle, cell division and cancer: Components of cell cycle control system; Intracellular events to control cell-cycle; Extracellular control of cell growth and division; Molecular mechanism of cell division (Mitosis and cytokinesis).

Cancer- Types of cancer; Cancer genes- oncogenes, proto-oncogenes and tumor suppressor genes; Molecular basis of cancer-cell behaviour and Cancer therapy: Early detection and prevention, Molecular diagnosis; treatment; Cancer cell lines.; Apoptosis – Definition; Signaling in apoptosis and Regulated proteolysis. **13 hr**

Unit III

Concept of gene and **Mendelism and deviation:** - Fine structure and function of gene, Split gene, Jumping gene, Overlapping gene and multiple genes; Mendelian laws, allelic variations, Incomplete dominance, multiple allele, gene action, gene interaction, penetrance, expressivity, epistasis, pleiotropy, Chromosomal theories of inheritance. Meiotic non disjunction, Sex linked inheritance.

Mutations and mutagenesis: Types of Mutations- Spontaneous mutation, induced mutation, conditional mutation, lethal mutations; Gene mutation - base substitution mutation, Missense, Nonsense and Silent mutations; Mutagenesis - Chemical, Physical and Biological mutagenesis, Detection of mutations. Molecular basis of mutation and its applications. **13 hr**

Unit IV

Eukaryotic chromosome and Sex Determination: Ultrastructure of eukaryotic chromosomes; Types of chromosomal banding; Evolution of Sex chromosomes; Chromosomal and molecular basis of sex determination in *C.elegans*, *Drosophila* and Human. Dosage compensation- Genic balance, Gene dose. **08 hr**

Unit V

Population Genetics: Genotype and allelic frequency, Hardy-Weinberg equilibrium, Non-random mating; Consequences of homozygosity; Factors affecting gene frequencies, Inbreeding; Heterosis; Mutation-effect on allele frequencies; migration and Genetic drift. **05 hr**

Bibliography

1. Cell Biology. Karp, G. (2016). McGraw Hill book Co. NY, 16th Edition.
2. The Cell: Molecular approach. Cooper, G.M. (2009). ASM Press, USA.
3. Molecular Biology of the Cell. Alberts M, Johnson A, Raff M, Bray D and Lewis J (2008) 6th edition. Garland Sciences, NY
4. Molecular Biology. Lodish, Berk, Zipursky, Matsudaira, Baltimore and Darnell (2006). Freeman Press, London.
5. Cell Biology. Pollard P and Earnshaw W.C. (2002). Saunders.
6. Genes. Benjamin Lewin. (1995). Oxford University Press.
7. Principles of Genetics. Snustad D.P. & Simmons M.J. (2015) John Wiley.
8. An Introduction to Genetic Analysis. Griffith A J P, Miller J H, Suzuki D T, Lewontin R C, Gelbert W M (2002). Freeman and Company.
9. Essential Genetics: A Genomic Perspective. Hartl D L. and Jones E W. (2002). Jones & Bartlet.
10. Lewin's Genes XI. Krebs, J. E., Goldstein E.S., Kilpatrick S.T. (2014). Jones & Bartlet
11. Modern Genetic analysis: Integrating Genes and Genomes. Griffiths A J G, Gilbert W M and Miller J H and Lewontin R C. (2003). W.H. Freeman Co. NY.

SCT 105: BIOSTATISTICS AND BIOINFORMATICS
(2 Credits, 3hr/week, 39hr)

Unit I

Statistics in biology: Importance of statistics in biology, samples and populations, variables in biology, accuracy and precision, collection and condensation of data, types of biological data and graphical representation of the data (histogram/ogive curve/frequency curve).

Descriptive Statistics: Measures of central tendency; mean, mode and median, standard deviation, Concept of variation, measure of variation such as variance, coefficient of variation. **07 hr**

Unit II

Introduction to probability distribution: Elements of probability, relative frequency approach, Binomial and Poisson distribution. Normal distribution: frequency distribution of continuous variables, properties of normal distribution, application of normal distribution, applying a normal distribution to observed data.

Regression and correlation analysis, curve fitting: Simple linear regression equation and testing significance of regression, data transformation in regression, hypothesis about correlation coefficient, multiple regression equation, polynomial regression and curve fitting. **08 hr**

Unit III

Hypothesis testing: Tests of simple hypothesis using normal and t-distribution. Types of errors. Test of significance: parametric and non-parametric tests, T-tests, Chi-square test for goodness of fit. F-test of comparing variance, one-way ANOVA. Mann-Whitney test, Kruskal-Wallis test. **05 hr**

Unit IV

Introduction to Bioinformatics: Branches of Bioinformatics, applications of Bioinformatics, Biological databases: Classification, Biological data retrieval systems.

Sequence comparison and Database Search: Global alignment, Pair wise alignment, local alignment, multiple sequence alignment, scoring a multiple alignment, multiple sequence alignment methods. Progressive alignment, iterative methods, pattern searching in DNA and protein sequences, PAM matrices, BLAST, FAST and FASTA. Identification of peptide finger print by nano LC-MS/MS database searching by using MASCOT and OMSSA. Introduction to microarray technology. **11 hr**

Unit V

Molecular phylogenetics: Application of phylogenetic trees, basic terminology-taxa, taxonomy, root, leaf, node, branch, clad, dendrogram, rooted tree, unrooted tree and scaled tree.

Molecular Clocks: Basic steps of phylogenetic tree construction, Data based methods-UPGMA, NJ algorithm, Character based methods-Maximum parsimony method, maximum likelihood method, validating phylogenetic methods-bootstrapping and jack-knifing, study of Phylip, NJ plot, Clustal X softwares. **08 hr**

Bibliography

1. Statistics for Biologists. Cambell R.C. (1967). Cambridge University Press, UK.
2. Biological data analysis, a practical approach. Fry, J.C. (1993). IRL Press, UK.
3. Statistitcal Methods. Snedecor, P.S. (2000). Affiliated East-West press, New Delhi.
4. Biostatistics: A Foundation for Analysis in Health Science. Wayne W Daniel and Cross Chad L. (2013). 10th edition. Wiley. ISBN-13:978-118302798
5. Applied Calculus. Hughus-Hallet. (2005). Wiley Publishers
6. Bioinformatics and Functional Genomics. Pevsner J (2003). John Wiley & Sons.Inc
7. Molecular Modelling Principles and Applications. Andrew R (2001). 2nd Edition. Prentice Hall.
8. ICRF Handbook of genomic analysis. Spurr B D, Young S P, Bryant S P. (2009). Blackwell Science Publishers.
9. A Practical approach to Microarray Data Analysis. Daniel P, Berrar.Dubitzky W and Granzow M. (2003). Kluwer Academic Publishers.
10. Protein structure, stability and folding. Murphy K. P (ed.) (2001). Humana Press.
11. Bioinformatics, Principles and Applications. Ghosh Z and Mallick B (2008). Oxford University Press<New Delhi.
12. Introduction to Bioinformatics. Attwood, T. (2006). Pearson Education, Singapore.

HCP 101: SYSTEMATICS AND BIODIVERSITY
(2 Credits, 4 hr/week, 52hr)

1. Construction of dichotomous key
2. Construction of Cladogram
3. Identification and classification of wild animals (at least 20 species of invertebrates and 20 species of vertebrates from different groups) found in any localities
4. Identification (photographs) – Critically endangered, endangered and vulnerable and animals of India.
5. Biodiversity indices -Problem solving: Shannon -Wiener diversity index, Simpson index, Sorenson index, Evenness index, and Marglef species richness index.
6. Field activities: field visits- zoos, sanctuaries, national parks, forests.
7. Identifying the larval forms of different insect species in their host plants in the campus.
8. Study of museum specimens and slides of chordates with emphasis on evolutionary and adaptive significance

HCP 102: ECOLOGY, ENVIRONMENTAL BIOLOGY AND EVOLUTION
(2 Credits, 4 hr/week, 52hr)

1. Estimation of chloride, sulphate in water samples.
2. Estimation of the B.O.D. (Demonstration) and C.O.D. in water sample
3. Thermal lag studies in terrestrial habitat.
4. Population ecology- Population growth in *Paramecium/Drosophila* larva.
5. Estimation of soil biomass and soil organisms. (Wet and dry methods)
6. Identification and observation of - a) Hospital waste (Solid waste) b) Pollution indicator species
7. Evidence for Evolution: Types of fossils, Connecting links/transitional forms, Living fossils, Vestigial, Analogous and Homologous organs.
8. Adaptive strategies: Coloration, Mimicry, co-adaptation and co-evolution, aquatic, terrestrial, arboreal adaptations. Comparative study of Ape and Human skull

HCP 103: BIOCHEMISTRY AND BIOPHYSICS
(2 Credits, 4 hr/week, 52hr)

1. pH : Structure and operation of pH meter; Preparation of phosphate and citrate buffers
2. Colorimetric/Spectrophotometric estimation of biomolecules:
 - a) Total free amino acids (ninhydrin reagent method)
 - b) Total Protein (Lowry et al 1951 method)
 - c) Total soluble carbohydrate (Anthrone reagent method)
 - d) Total cholesterol (Zlatkis et al method)
3. Effect of Temperature, pH and substrate concentration on salivary amylase activity.
4. Estimation of inorganic phosphate (Fiske-Subburao method)
5. Absorption spectra of amino acids, protein and nucleic acids by Spectrophotometer
6. Verification of Beer-Lambert Law
7. Fluorescent Microscopy; Staining with fluorescent dyes & image processing

HCP 104: CELL- MOLECULAR BIOLOGY AND GENETICS
(2 Credits, 4 hr/week, 52hr)

1. Vital staining of mitochondria
 2. Study of meiotic stages and chromosome anomalies in grass hopper testis
 3. Preparation of *Drosophila* Karyotype (at least two species)
 4. Study of Polytene chromosomes of *Drosophila melanogaster*
 5. Counting of cells using haemocytometer
 6. Preparation of semi-permanent slides
 7. Genetic problems
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HCT 201: COMPARATIVE ANATOMY

(4 credits, 4 hr /week, 52 hr)

Unit I

Locomotion and feeding habits of animals: Locomotion and adaptive mechanism in invertebrates- flagellar, ciliary movements in protozoa. Hydrostatic movements in Coelenterate, Annelid and Echinodermata. Feeding habits: nutrition and feeding mechanism in invertebrates, nutrition in protozoa, types and mode of feeding, feeding diversity in insects, filter feeding in lower metazoans, crustaceans, molluscs and echinoderms- functional mechanism. **08hr**

Unit II

Organ system of invertebrates: Origin and organization of coelom: acoelomates-pseudocoelomates and eucoelomates. Digestive systems, overview of circulatory system, respiratory systems, excretory systems, nervous and sensory system and reproductive organs of animals. **10hr**

Unit III

Organ system of vertebrates: Study from fishes to mammals. Respiratory organs: structure and function. Excretory systems: urinary system-structure and function of mammalian kidney. General plan of circulation in various groups and evolution of heart. Nervous system: peripheral and central nervous system- comparative account of sensory organs. **12hr**

Unit IV

Integument and skeletal system: General features of integument (dermis and epidermis) from pisces to mammals. Integumental derivate (nails, claws, hoofs, hairs, horns, scales, feathers). Skeletal system: the skull- overview of skull morphology, skull function and design types. Evolutionary significance of axial, appendicular joints and placenta. **10hr**

Unit V

Reproduction and development: overview of reproduction and development from invertebrate phyla to mammals. Reproduction, development and phylogenetic significance of the larval forms of arthropods and echinoderms. Comparison of male and female reproductive systems from fishes to mammals. **12hr**

Bibliography

1. Invertebrates (2nd edition) Brusca R C, Moore W and Shuster S M 2016, Oxford Press London.
2. Invertebrate structure and function. Barrinton E J W . 1967, Houghton Mifflin U.K.
3. Invertebrates Zoology. Holyak A.R 2013, ELBS, U.K.
4. Invertebrate Tree of life . Gilbert G, Edgecomb G D. 2020. Princeton Univ. Press, USA.
5. Invertebrate Zoology (3rd edition) Meglitsch P A, Schran F R 1994, Oxford Univ. Press. U.K.

6. Life of Invertebrates. Prasad S N 1989, Vikas Pub. House Pvt. Ltd. New Delhi.
7. Atlas of Invertebrate Anatomy. Anderson D T 1997, UNSW Press, Australia.
8. Principles of systematic Zoology. Mayer E and Aschlock P D, 1991, McGraw Hill India.
9. Chordate Zoology. Jordan E L and Verma P S 2012. S.Chand & Comp. Ltd. New Delhi
10. Comparative Anatomy of Vertebrates. Kent G C & Carr R K 2000, McGraw Hill India
11. Life of Vertebrates. Young J Z 1968. Oxyford Press, U.K.
12. Comparative anatomy of vertebrates. Saxena R K & Saxena A, 2008, Anshan Pub. India.

HCT 202: ANIMAL PHYSIOLOGY

(4 credits, 4 hr/week, 52hr)

Unit I

Osmoregulation: An overview of osmoregulation, osmolarity and toxicity, cell volume and ionic regulation, osmoregulation in invertebrates and vertebrates, hormonal control of osmoregulation, osmo-regulatory genes. Role of renal and extra renal tissues in osmoregulation.

Thermoregulation: Poikilotherms, homeotherms, heterotherms and their mechanism of survival. Central control of homeothermy, lethal limits, rate functions. Cold death, cold resistance, heat death; Torpor, hibernation and aestivation. **10hr**

Unit II

Digestion: Types of nutrition in lower and higher invertebrates. Nutrients-digestive enzymes-digestion, absorption in vertebrates. Cellulose digestion-ruminant and non-ruminant digestion, intestinal motility, role of digestive fibre and nutritional disorders, neural and hormonal control of digestion.

Excretion: Basic process in urine formation, nitrogenous wastes, acid-base regulation in vertebrate kidney, renal function in animals -mammalian kidney, renal portal system, hormonal regulation-ADH and aldosterone, Detoxification of nitrogen products and purine cycle. **10hr**

Unit III

Blood vascular system: open and closed systems, vascular pumps, buffering mechanism by body fluids, blood and its composition, blood groups and blood coagulation, hemopoiesis, blood volume, blood pressure-neural and chemical control.

Heart: Structure of mammalian heart, electrical activity of the heart, cardiac pump, regulation of heart beat and principles of hemodynamics, the arterial system, microcirculation and lymphatics. Control of cardiac output. **10hr**

Unit IV

Respiration: Gas exchange and mechanism of respiration in invertebrates and vertebrates, respiratory pigments, transport of O₂ and CO₂- Bohr's and Haldane's effects, oxygen toxicity and control of respiration.

Muscle physiology: Molecular structure and function of skeletal muscle, cross-bridge cycle and regulation of contraction, sarcoplasmic reticulum and role of calcium in contraction, energetic of contraction, fatigue, smooth muscle contractile apparatus, cross-bridge regulation in smooth muscles, anatomy and regulation of cardiac muscle contraction, atrial and atrioventricular conduction. **10hr**

Unit V

Nerve physiology: Types of neurons and glial cells, basis and significance of membrane potentials, equilibrium potentials and their changes during stimulation, action potential generation and its propagation, Na⁺, K⁺ currents in action potential, types of synapses, synaptic transmission-electrical and chemical, neurotransmitters and synaptic inhibition, neurohormones and their function.

Sensory physiology: mechanism involved in perception of mechano, chemo and photoreception, visual pigments, lateral and compound vertebrate eye. **12hr**

Bibliography

1. Introduction to Comparative Physiology. Wilson A 1979. Macmillan Publishing Co.Inc. NY
2. Comparative Animal Physiology (2nd ed). Prosser C L. 1965. Saunders Company, London
3. General and comparative physiology. Hoar R S 1983. Prentice-Hall, USA
4. Text book of Medical Physiology (12th ed) Gayton A & Hall J E 2004. WB Saunders. U K
5. Principles of Physiology. Levy M N, Berne R M, Koepper B M and Stenton B A 2006, Elsevier Mosby, USA.
6. Human Physiology (2nded). Houssay B A 1970. McGraw Hill Book Company, U S A
7. Animal Physiology: Mechanism and adaptation. Lckert R and Randall D 1983.W H Freeman &Co
8. Animal Physiology: Adaptation and Environment (5th ed) 1997. Nelson K N. McGraw Hill USA
9. Animal Physiology. Verma P S, Tyagi B S and Agrawal U V 2005. S Chand & Co.Ltd. New Delhi
10. Essentials of Animal Physiology. Rastogi S T 2000. Wiley Eastern Ltd. Madras.

HCT 203: PARASITOLOGY

(4 credits, 4 hr/week, 52hr)

Unit I

Basic concept and overview of parasitology, inter relationship between host and parasites, responses of host to parasitic infection, mode of transmission of parasites, host specificity and parasitic adaptations, ecology and evolution of parasites. 8hr

Unit II

Physiology and cell biology of parasites, molecular mechanism of susceptibility and resistance, immunity and immune responses. Diagnosis and control of parasites. 8hr

Unit III

General characters of parasitic protozoans, morphology, life cycle, epidemiology and management of *Entamoeba histolytica*, *Giardia*, *Trichomonas naeglaria*. Haemoflagellates: *Trypanosoma*, *Leishmania*. Apicomplexa: *Plasmodium*, differential diagnosis. 12hr

Unit IV

General characters, classification, epidemiology and management of helminthes, identification characters, life cycle, pathogenecity and control of *Chlonorchis sinensis* (Chinese liver fluke), *Taeniasolium* (tape worm), *Ascaris lumbricoides* (round worm), *Ancylostoma duodenale* (hook worm), *Wuchereria bancrofti* (filarial worm). 12hr

Unit V

Vectors- types of vectors; arthropod vector of medical and veterinary importance- sand flies, mosquito species, house fly, rat flea, cockroach, bed bug and their control. Life history and importance of acarine ticks: *Argas*, *Rhipicephalus* and *haemaphysalis* mites: sarcoptes, psoroptes. Kyasanur Forest disease (KFD)-epidemiology and management. 12hr

Bibliography

1. Introduction to Animal Parasitology (2nded.) Smith D G 1997. John Willey Sons, NY
2. Parasitology Sood R 1995. C.B.S. Publishers, New Delhi
3. Foundations of Parasitology (2nded). Roberts L S and Janovy J (Jr) 2000. McGraw Hill Publ.
4. Parasitism. Bush A O, Fernandez J C and Seed J R 2000. Cambridge Univ. Press
5. Introduction to Parasitology. Matthews B E 1999, Cambridge Univ. Press U K.
6. Hand book of Medical Parasitology. Zaman V and Keong L H 1989. K.C. Ang publishing pvt. Ltd.
7. Ecology of Animal Parasitology. Kennedy C R 1975. Blackwell Scientific Publ.
8. A to B of Parasitology (4nded). Kekar L and Kelkar R S 1997, Bombay popular prakshan
9. Helminths, Arthropods and Protozoa of domesticated animals. Soulsby E J L 1979. ELBS Publ. UK.
10. Physiology and Biochemistry of Cestodes. Smyth J D and MEmanus D P 1990. Cambridge Univ. press

HCT 204: ECONOMIC ZOOLOGY

(4 credits, 4hr /week, 52hr)

Unit I

Apiculture- Honey bee species, bee flora and nectar composition. Pollen calendar and management of bee flora. Division of labour, comb building, communication, queen rearing, seasonal management and bee keeping. Medicinal value of honey and apitherapy. Pests and diseases of honey bees and their management.

Sericulture-Rearing and production of mulberry silk and non-mulberry silk (eri, tasar, muga) in India. Races and voltinism of mulberry silkworms and sericulture by-products. Global silk production, Indian silk industry. Pests and diseases of silkworms and their management.

Vermiculture: vermiculture process and components, vermicomposting. **12hr**

Unit II

Fisheries: marine and inland. Induced breeding, bundh breeding, fish seed trade, fish culture and composite fish culture. Hybridization, post-harvesting technology, freezing, canning and fish form management. Fish and shell fish diseases and their control. Prawn oyster culture and pearl formation. Composition, colour, size and quality of pearl. Fish industry in India and fishery economics. **10hr**

Unit III

Poultry: breeds, principles and techniques of breeding. Management of growers and overcrowding. Management of layers and broilers, broiler industry. Prevention of poultry diseases and vaccines. Poultry products- nutritional value of egg and meat. Meat products and by-products of poultry.

Dairy breeds and management: cattle breeds-milk breeds, draught breeds, exotic and cross breeds. Buffalo breeds. Techniques in cattle breeding and artificial insemination. Dairy products: physico-chemical properties of cow and buffalo milk. Processing, preservation and marketing of dairy milk and meat. **12hr**

Unit IV

Pests and their management : Insect pests and vectors- major pests of crops (rice, coconut, sugar cane and mango)- biology, damage and management. Pests of stored products-rice weevil, rice moth, pulse beetle- biology, damage and management. House hold pests-cockroach, house fly –vector status and control. Insect vectors of human diseases (malaria, dengue, chikungunya, encephalitis). Rodent pests and their management. Integrated pest management. **10 hr**

Unit V

Pet Animals: Maintenance of pet animals (ornamental fish, reptiles, birds, cats and dogs), breeds and breeding of cats and dogs. Pests, diseases of pet animals and their management. **08hr**

Bibliography

1. General and applied entomology (2nd edition). David B V and Ananthakrishnan T N 2004. Tata McGraw Hill Pub. Co .Ltd.
2. Handbook of Practical Sericulture. Ullal S R and Narasimhan M N 1987. CSB Pub. Bangalore
3. An introduction to Sericulture (2nd edition). Ganga G and Chetty S J 1997. Oxford and IBH Publ. co Ltd. New Delhi
4. Economics of Sericulture and silk industry in India. Ramana D V 1987, Deep and Deep Pub.
5. Principles of Sericulture. Aruga H 1990. Oxford and IBH Pub. New Delhi.
6. FAO manual of Sericulture. Anonymous 1972. Vol. I-IV. CSB Pub. Bangalore
7. Text book on beekeeping. Rahman A 2003. Kalyan Pub. Lucknow.
8. Fundamentals of Beekeeping, Sathe T V 2001. Daya Pub. House. New Delhi
9. The practical beekeeper (4th edition) Bush M 2011. X Star Pub. Company .U K
10. The beekeeper's handbook. Sammataro D 20017. Cornal Univ.Press. USA
11. Fish biology and Fisheries. Khanna S S and Singh N R 2014. Narendra Pub. House. India
12. A Text book of Fish, fisheries and Technology (2nd Ed). Biswas KP 1996. Narendra Pub.House
13. Aquaculture. Lucas J S, Southgate PC & Tucker CS 2015. Willey, U K
14. Aquaculture : an introductory text. Stickney R R 2017. CABI U K.
15. Text book of poultry science. Sreenivasaiah P V 2015. Write & Print Publications. New Delhi
16. Poultry Diseases. Vegad J L 2016. CBS Pub. Distributors.India
17. Dairy Science and technology Handbook. Hai Y H 2001. Wiley, U K
18. Principles of Dairy chemistry. Jenness R and Patton S 2017. Meditech.

SCT 205: ANIMAL BEHAVIOUR

(2 Credits 3hrs/week, 39hr)

Unit I

Development of behaviour: History of behavioural studies, development of behaviour, development of bird song, causes of behavioural changes during development, Analysis of behaviour-ethogram.

Innate behaviour-orientation, kineses, taxes, motivation, tropism, reflex and nest building. **06hr**

Unit II

Learning and memory: Learning: sensitization and habituation, associative learning, imprinting, latent and insight learning, reasoning, instrumental conditioning, trial-and-error, discrimination, neural mechanism of learning. Memory- nature, types, anatomy of memory, memory storage. **07hr**

Unit III

Evolution- and Genetics of behaviour: Genes and behavioural evolution, evolutionary stable strategies, cultural transmission of behaviour, Hamilton's rule, kin selection and inclusive fitness, altruism, cost and benefits of social life, sex and sexual selection, phylogeny of behaviour, genetic control of behaviour (single and multiple gene effect). **10hr**

Unit IV

Animal communication: Types of communication- auditory, visual, vocalization, tactile, chemical signaling, pheromones, vibration, echolocation in bats, bee dance, and infrasound communications (elephant and whales). Signals- cost and benefit of signaling, and adaptive value of communication signals. **08hr**

Unit V

Social behaviour: Types of social groups, advantages of grouping, social organization- insects (honey bees, ants, termites) and primates. Feeding and mating strategies in animals, cooperation and conflict in birds-mammals, evolution of eusocial behaviour. **08hr**

Bibliography

1. Alcock J 2003 Animal behaviour (SinauerAsso. Inc. Pub.: Sunderland Massachusetts)
2. Alcock J 2013 Animal Behavior: An Evolutionary Approach, 10th edition (Sinauer Associates, Inc.)
3. Bolhuis J J and L Giraldeau (eds) 2005 The behaviour of animals (Blackwell Pub.)
4. Breed and Moore 2011 Animal Behavior, 1st Edition (Academic Press)
5. Gadakar R 1997 Survival strategies (Universities Press)
6. Goodenough J, McGuire B and Jakob E 2009 Perspectives on Animal Behavior (John Wiley and Sons)
7. Hnidae R A 1966 Animal behaviour (2nd Ed.) (McGraw Hill Book, London)

8. Kappeler P (Ed) 2010 Animal Behaviour: Evolution and Mechanisms (Springer)
9. Korb J and Heizze J C (eds) 2008 Ecology of social behaviour (Springer)
10. Krebs J R and N B Davies 1984 Behavioural ecology – An evolutionary approach. 3rdeds (Blackwell Scientific Publications)
11. Mandal F B 2010 Textbook of Animal Behaviour (PHI Learning Pvt. Ltd.: New Delhi)
12. Manning A and Dawkins M S 1997 An Introduction to Animal behaviour (4theds)
13. Mathur R 2008 Animal behaviour (Rastogi Pub.: India)
14. Nelson R J 2005 An introduction to behavioural endocrinology (Sinauer Asso. Inc. Pub.)
15. Sherman P W and Alcock J 1997 Exploring animal behaviour (Sinauer Asso. Inc. Pub.: Sunderland, Massachusetts)
16. Slater P J B 1999 Essentials of Animal Behaviour (Cambridge Uni. Press)
17. Thorpe W H 1963 Learning and instinct in animals (Methuen and Co. Ltd.: London)

HCP 201: COMPARATIVE ANATOMY
(2 Credits, 4 hr/week, 52hr)

1. Computer based study of artery, vein, lung, kidney, oesophagus, stomach, intestine, liver, testis and ovary of frog/fish/reptiles/mammals.
2. Mounting of Gills (tilapia fish), Tracheal gills (mosquito larvae)
3. Specimens of filter feeding species-Metazoa, Curstacea, Mollusca and Echinodermata
4. Mounting of *Naupilus*, *Zoea* and *Mysis* larvae.
5. Types of feathers, beaks and feet of birds
6. Dissection: Reproductive system of male and female cockroach and silk worm
7. Dissection: Nervous system of silkworm larva and adult cockroach
8. Demonstration of skeletal muscle fibre types.
9. Skull of reptiles, birds and mammals.

HCP202: Animal Physiology
(2 Credits, 4 hr/week, 52hr)

1. Determination of excretory products in aminotelic, ureotelic and uricotelic animals.
2. Activity of salivary amylase
3. Estimation of Hb, ESR and blood clotting time
4. Determination of cell fragility
5. Effect of Thyroxin on the respiratory metabolism of fish.
6. Estimation of Acetylcholine esterase activity.
7. Determination of ascorbic acid in blood and urine.

HCP 203: PARASITOLOGY
(2 Credits, 4 hr/week, 52hr)

Identification and economic importance of parasites and vectors:

1. Slides/museum specimens of selected parasites of representative groups of protozoans and helminths (*Plasmodium*, *Trypanosoma*, *Leishmania*, Roundworm (male & female), Hookworm, Filarial worm.
2. Vectors: *Anopheles*, *Culex* and *Aedes* species (Adults, eggs, larvae and pupae), house fly, cockroach, bed bug.
3. Ticks and mites: *Argas*, *Sarcoptes*, *Psoroptes*, *Hemaphysalis spinigera*

HCP 204: ECONOMIC ZOOLOGY
(2 Credits, 4 hr/week, 52hr)

Identification and economic importance:

1. Honeybee species, bee products (bee wax, pollen), pests of honey bees- wax moths, Varroa mites.
2. Mulberry and Non-mulberry silkworms and their cocoons (adults, larvae, bivoltine, multivoltine, defective and double cocoons, muga, tasar and eri cocoons). Pests of silkworm- uzi fly.
3. Earthworm species (indigenous and exotic) and cocoons
4. Comparative account of any five of fresh water and seawater fishes.
5. Identification of larval and adult forms of prawns.
6. Poultry and Dairy –breeds.
7. Pests crops: **Rice:** *Nilaparvata lugens* (Brown planthopper); **sugarcane:** *Chilo* spp. (Shoot & stem borers); **coconut:** *Oryctes rhinoceros* (Rhinoceros beetle), *Rhynchophorus ferrugineus* (Red palm weevil); **mango:** *Sternonchetus mangiferae* (Mango Seed Weevil); **cotton:** *Helicoverpa armigera* (American Bollworm), *Spodoptera litura* (Tobacco caterpillar).
8. Stored products: *Sitophilus oryzae* (Rice weevil), *Callosobruchus maculatus*, *C. chinensis* (Pulse beetles), *Corcyra cephalonica* (Rice moth).

THE NEW YORK STATE BAR ASSOCIATION

THE JUDICIAL BRANCH

Identification and description of the various branches of the judicial system and their functions.

1. Identification and description of the various branches of the judicial system and their functions.

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HCT 301: DEVELOPMENTAL BIOLOGY

(4 Credits 4hr/week, 52hr)

Unit I

Basic concepts of developmental biology: Cell division, cell differentiation, signalling in control of development, patterning, evolution of developmental patterns. Early embryonic development, Cleavage—types and mechanism. Gastrulation-movements involved. Cell specification in amphibians and chick. Neural tube formation and cell migrations. **12hr**

Unit II

Axis specification in *Drosophila*: Role of maternal genes, patterning of early embryo by zygotic genes- gap genes, pair- rule genes, segment polarity genes, homeotic selector genes- bithorax and antennapedia complex. *Drosophila* as a model organism. **10hr**

Unit III

General concepts of organogenesis: Development and patterning of vertebrate limb, homeobox genes in patterning, signalling in patterning of the limb; Insect imaginal discs—organizing centre in patterning of the leg and wing, the homeotic selector genes for segmental identity; insect compound eye. Vertebrate model organism- *Xenopus laevis* and chicken. Invertebrate model system- *Caenorhabditis elegans*. **14hr**

Unit IV

Postembryonic development and Regeneration: Growth, cell proliferation, growth hormones; aging- genes involved in alteration in timing of senescence. Regeneration—Epimorphic regeneration of reptile (salamander) limb; morpholaxis regeneration in hydra; embryonic stem cells and their applications. **08hr**

Unit V

Programmed cell death, aging and senescence: Apoptosis, autophagy and necrosis. Theories of aging and senescence. Environmental regulation of animal development: types of polyphenism, environmental sex determination. Environmental disruptions of normal development (teratogenesis), teratogenic agents: alcohol, retinoic acid, environmental esters. **08hr**

Bibliography

1. Gilbert, S F 2006. Developmental Biology, 8th edition. Sunderland, MA: Sinauer Associates,
2. Slack, JMW 2002. Essentials of Developmental Biology. 3rd edition. Willey-Blackwell
3. Wolpert L, Tickle, C and Alfonso Martinez Arias, A M 2018. Principles of Development. 6th edition. Oxford University Press.
4. Waddington C H 1966. Principles of Development and Differentiation. Elsevier.
5. Balinsky B L 2012. An Introduction to embryology. 5th edition. Cengage Learning.
6. Barresi, M J F and Gilbert, S F 2020. Developmental Biology. Oxford University Press. N.Y.

7. Yadav M 2008. Molecular Developmental Biology. Discovery Publishing house. New Delhi.
8. Hodge R 2009. Developmental biology. From cell to organism. ELBS
9. Muller W A 1997. Developmental biology. Springer.

HCT 302: COMPARATIVE ENDOCRINE PHYSIOLOGY

(4 Credits 4hr/week, 52hr)

Unit I

Concept of Endocrinology: Introduction to the endocrine system, Classes of hormones, synthesis release and transport of amino acid derivatives, peptides and steroid hormones, membrane bound and intra cellular receptors. Action of amino acid derivatives, peptide and steroid hormones. **08hr**

Unit II

Invertebrate Endocrine system and their mechanisms: Neurosecretory system in annelids, molluscs, hormonal functions in coelenterates, helminths, neurohemal organ and its function. Arthropods: Types of hormones and their release sites, Vertebrate-type hormones in Crustaceans: X-organ, Y- and associated neurohemal organs. Endocrine control of moulting, diapause, growth and metamorphosis, osmoregulation, myotropic and metabolic factors, colour changes and reproduction. Hormone mimics and their applied value. **12hr**

Unit III

Endocrine system in vertebrates: Pituitary gland, physiological actions of pituitary hormones-Adenohypophysial hormones: Somatotropin and prolactin, Glycoprotein hormones (FSH, LH, and TSH). Neurohypophysial hormones: Oxytocin and vasopressin, Urotensin. Adrenal gland, physiological role of adrenal hormone, catecholamine storage and release mechanism, adrenocortical and adrenomedullary interaction. Thyroid hormone action in poikilotherms and homeotherms; comparative account of parathyroid gland and synthesis of parathyroid hormone. **12hr**

Unit IV

Hormones in GI system: Hormonal control of feeding behaviour and gastrointestinal (GI) tract functioning including acid release, gall bladder contraction and relaxation, water balance, pancreatic enzyme secretion, and GI tract motility. Pancreatic hormones and glucose homeostasis. Pathophysiology-pituitary dwarfism, gigantism and acromegaly. **10hr**

Unit V

Clinical and applied endocrinology: Obesity- role of hormones and its metabolic complications – The role of adipokines, insulin resistance and dyslipidemia. Hormones in IVF, pregnancy testing, and amniocentesis. Clinical disorders of male and female gonads. Hormones and human health- production of hormones as pharmaceuticals. Genetic analysis of hormonal disorders. Pheromones in applied endocrinology. Induced breeding in fish. **10hr**

Bibliography

1. Norris D O 2013. Vertebrate endocrinology. 6th edition. Academic Press
2. Squires E J 2004. Applied animal endocrinology. CABI Pub.
3. Kleine B and Rossmannith W G 2008. Hormones and the endocrines system. Springer
4. Bently P J 1996. Comparative vertebrate endocrinology. Cambridge Press

5. DeGroot, L J and Jameson J L 2006. Endocrinology 5th edition. Willey
6. Highnam K C 1977. The comparative endocrinology of invertebrates. Elsevier.
7. Chapman R F. 2002. The insect structure and function. ELBS pub.
8. Hadley M E 2000. Endocrinology. Pearson education Inc.
9. Bolander F F 2006. Molecular endocrinology. Academic Press
10. Williams R H 1998. Textbook of endocrinology. W B Saunders.

HCT 303: IMMUNOLOGY

(4 Credits 4hr/week, 52hr)

Unit I

Scope of Immunology. Innate Immunity: lines of defence, inflammatory response, Mechanism of innate immune recognition. **Acquired immunity:** naturally and artificially acquired active/passive immunity, **Cells of immune system:** Lymphoid lineage -Myeloid lineage–**Organs of immune system:**Primary and Secondary lymphoid organs. **08hr**

Unit II

Antibodies (immunoglobulins): Immunoglobulin structure and function-Immunoglobulin classes. **Major histocompatibility complex (MHC):** Structure and types. **Types of antigen–antibody interactions and hypersensitivity.** **Complement system:** Classical complement pathway, **Alternative complement pathway.** **08hr**

Unit III

Lymphocytes: B-cell maturation, activation and differentiation: bone marrow microenvironment, Ig –gene rearrangements and formation of pre B-cell receptors, B cell activation and proliferation. **T–cell maturation activation and differentiation:** discrete stages in early T cell development, **Thymic selection of T cell repertoire,** T cell activation, co stimulation in T cell response. **Antigen processing and presentation:** Cytosolic pathway of antigen presentation.**Endocytic pathway of exogenous antigen presentation.****Regulation of immune effectors response, Immunological memory.** **12hr**

Unit IV

Immune response to infectious diseases and Vaccines: Immune response against viral, bacterial, protozoan and helminth parasite infections. **Autoimmune diseases.** **Immune deficiency diseases.** **Bird flu (H5N1), Swine flu (H1N1), SARS-Cov, COVID-19 infections.** **Vaccines:** Vaccines from whole organisms, **Polysaccharide vaccines,** **Outer membrane protein vaccines,** **Toxoid vaccines,** **Vaccines from recombinant vectors,** **DNA as vaccines,** **Vaccines from synthetic peptides.** **14hr**

Unit V

Transplantation immunology: Classification of grafts, graft rejection, graft versus host reaction. **Tissue and organ transplantation,** **Immunosuppressive therapy during transplantation,** **Immunological tolerance –Mechanism of tolerance.** **Immunology of tumours:** **Tumour antigens,** **Immune response to tumour antigens,** **Immunological surveillance,** **Immune therapy of cancer.** **10hr**

Bibliography

1. William E. Paul. 2008. Fundamentals of Immunology. Lippincott Williams & Wilkins Publishing.
2. Kindt T.J., Goldsby R A, Osborne B A 2008. Kuby Immunology .W.H.Freeman and Company, N.Y.

3. Klans.D.Elbert 2000. Immunology. Wiley –Liss Pub. Co. U.S.A.
 4. I.M.Roitt, 2003 Essential Immunology E.L.B.S.
 5. Donald M.Weir and John Shewart 1999. Immunology.Churchill Livingston 9th Edn.
 6. GerogePinchuk 2004. Schum's (SIM) Outlines Immunology .Tata McGraw –Hill.
 7. Talwar .G.P. 2002. A hand book practical immunology - Third edition,Backwell scientific
 8. Janeway C A, Travers,P Jr., Walport M and Shlomchik M J. 2001. Immuno Biology- The immune system in health and disease, Garland Science Publishing.
 9. Brostoff J, Roth D, Roitt M and Delves P 2001. Essentials of Immunology. Mosby & Elsevier Pub.
 10. William E. Paul 2008. Fundamentals of Immunology. Lippincott Williams & Wilkins
 11. Abdul Abbas, Andrew Lichtman, Shiv Pillai. 2017. Cellular and Molecular Immunology. Elsevier Pub.
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HCP 301: DEVELOPMENTAL BIOLOGY

(2 Credits, 4hr/week, 52hr)

1. Vital staining of chick blastoderm
2. Histology of testis showing spermatogenesis
3. Histology of ovary showing oogenesis
4. Regeneration in frog tadpole tail.
5. Study of insect metamorphosis - Developmental Biology & Endocrinology
6. Identification of different developmental stages of frog – Egg, blastula, gastrula, neurula, tadpole external gill and internal gill (slides)
7. Preparation of temporary/permanent whole mounts of chick embryo of the following stages to study the extent of development of the circulatory and nervous system in detail in 20, 24, 33, 48 & 72 hours of incubation.
8. Preparation of stained temporary/permanent mounts of larvae.
9. Effect of juvenile hormone (JH) on larval stage

HCP 302: COMPARATIVE ENDOCRINE PHYSIOLOGY

(2 Credits, 4hr/week, 52hr)

1. In situ demonstration of endocrine glands of rat.
2. Histology slides of Endocrine glands - Pituitary, Thyroid, Parathyroid, Thymus, Adrenal, Pancreas, Ovary, Testis, and Uterus.
3. Effect of Eye Stalk ablation on Blood Glucose levels in Crabs.
4. Identification of Gonadotrophin in Human urine samples.
5. Effect of thyroxin and thiourea (antithyroid agent) on oxygen consumption in fish.
6. Effect of insulin and adrenalin on blood glucose levels in Rat.
7. Induction of ovulation in fish by injecting pituitary homogenate
8. Blood glucose – Oral Glucose Tolerance Test

HCP 303: IMMUNOLOGY

(2 Credits, 4hr/week, 52hr)

1. Agglutination test
2. Precipitation
3. Neutralization and complement fixation
4. Separation of lymphocytes
5. Collection of macrophages and their characterization
6. Identification of histological slides of lymphoid tissue - Spleen, thymus, lymphnode and bone marrow
7. Immunological diagnosis of pregnancy.
8. Agar gel diffusion.
9. Demonstration of Immunoelectrophoresis
10. Demonstration of Mast cells.

HCP 304: TOOLS AND TECHNIQUES

(2 Credits, 4hr/week, 52hr)

1. Identification and working principle of different analytical instruments: pH meter, Colorimeter, Spectrophotometer and Particles size analyser
 2. Study of optical instruments: High resolution, Phase contrast and Fluorescent microscopes, Cell imaging, TEM and SEM (demonstration)
 3. Centrifugation: High speed, Density gradient centrifugation
 4. Chromatography: Paper chromatography and thin layer chromatography
 5. Electrophoresis: SDS PAGE, Agarose gel, Immunoblotting
 6. Demonstration of perfusion technique
 7. Microtome: Paraffin Block preparation and sectioning. Ultra-microtome (demonstration)
 8. Media preparation and culture technique: Microbial and Cell lines
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Bengaluru City University
M.Sc. Animal Science (CBCS Syllabus)

Course content, Credits, Scheme of Examination and Model question paper

Details of Course content

I Semester

Paper Code	Title of the Paper	Total Hr	Hr/Week	Marks			Credits
				IA	Exam	Total	
HCT 101	Systematics and Biodiversity	52	4	30	70	100	4
HCT 102	Ecology, Environmental biology and Evolution	52	4	30	70	100	4
HCT 103	Biochemistry and Biophysics	52	4	30	70	100	4
HCT 104	Cell Molecular biology and Genetics	52	4	30	70	100	4
SCT 105	Biostatistics and Bioinformatics	39	3	30	70	100	2
HCP 101	Systematics and Biodiversity	52	4	15	35	50	2
HCP 102	Ecology, Environmental biology and Evolution	52	4	15	35	50	2
HCP 103	Biochemistry and Biophysics	52	4	15	35	50	2
HCP 104	Cell Molecular Biology and Genetics	52	4	15	35	50	2
	Total	455	35	210	490	700	26

II Semester

Paper Code	Title of the Paper	Total Hr	Hr/Week	Marks			Credits
				IA	Exam	Total	
HCT 201	Comparative Anatomy	52	4	30	70	100	4
HCT 202	Animal Physiology	52	4	30	70	100	4
HCT 203	Parasitology	52	4	30	70	100	4
HCT 204	Economic Zoology	52	4	30	70	100	4
SCT 205	Animal Behaviour	39	3	30	70	100	2
HCP 201	Comparative Anatomy	52	4	15	35	50	2
HCP 202	Animal Physiology	52	4	15	35	50	2
HCP 203	Parasitology	52	4	15	35	50	2
HCP 204	Economic Zoology	52	4	15	35	50	2
	Total	455	35	210	490	700	26

III Semester

Paper Code	Title of the Paper	Total Hr	Hr/Week	Marks			Credits
				IA	Exam	Total	
HCT 301	Developmental Biology	52	4	30	70	100	4
HCT 302	Comparative Endocrine Physiology	52	4	30	70	100	4
HCT 303	Immunology	52	4	30	70	100	4
HCP 301	Developmental Biology	52	4	15	35	50	2
HCP 302	Comparative Endocrine Physiology	52	4	15	35	50	2
HCP 303	Immunology	52	4	15	35	50	2
HCP 304	Tools and Techniques	52	4	15	35	50	2
OE	---	52	4	30	70	100	4
	Total	416	32	180	420	600	24

Details of Credits

I Semester

Subjects	Paper	Instruction Hr/week	Duration of Exam (hr)	Marks			Credits
				IA	Exam	Total	
Hard Core	4T	4x4	4x3	4x30	4x70	4x100	4x4=16
	4P	4x4	4x4	4x15	4x35	4x50	4x2=08
Soft Core	1T	1x3	1x3	1x30	1x70	1x100	1x2=02
						Total	26

II Semester

Subjects	Paper	Instruction Hr/week	Duration of Exam (hr)	Marks			Credits
				IA	Exam	Total	
Hard Core	4T	4x4	4x3	4x30	4x70	4x100	4x4=16
	4P	4x4	4x4	4x15	4x35	4x50	4x2=08
Soft Core	1T	1x3	1x3	1x30	1x70	1x100	1x2=02
						Total	26

III Semester

Subjects	Paper	Instruction Hr/week	Duration of Exam (hr)	Marks			Credits
				IA	Exam	Total	
Hard Core	3T	3x4	3x3	3x30	3x70	3x100	3x4=12
	4P	4x4	4x4	4x15	4x35	4x50	4x2=08
Open Elective	1T	1x4	1x3	1x30	1x70	1x100	1x4=04
						Total	24

Scheme of Examination: I-III Semester (M. Sc. Animal Science)

THEORY

Duration of the Examination: **3 Hours, Marks 70**

Part A: Comprises **5 compulsory questions**. Each question carries **Two marks**
(Questions should be from all units). **05x2=10 marks**

Part B: Comprises **5 questions with internal choice within a unit**. Each question carries
Six marks (Questions should be from all units). **05x 6=30 marks**

Part C: Comprises **5 questions**, of which **Three questions** should be answered. Each
question carries **Ten marks** (Questions should be from all units) **03x10=30 marks**

PRACTICAL

Duration of the Examination: **4 Hours, Marks 35**

HCP 101-104: Each Practical Paper Examination: **30 marks + Viva voce 05 marks= 35**

HCP 201-204: Each Practical Paper Examination: **30 marks + Viva voce 05 marks= 35**

HCP 301-304: Each Practical Paper Examination: **30 marks + Viva voce 05 marks= 35**

Internal Assessment:

Theory papers: 30 marks for each Theory paper (Seminar/Assignment 10 marks, Two
class tests: 10+10= 20 marks)

Practical papers: 15 marks for each Practical paper (Test-10 marks + 05 marks record)

Model question paper

**I –III Semester M.Sc. Examination, January/February 2021
(CBCS)**

**ANIMAL SCIENCE
HCT 101-105, 201-205, 301-303**

Time: 3 Hours

Max. Marks: 70

PART- A

Write short notes on the following: **(5x2=10)**

1. Unit 1
2. Unit 2
3. Unit 3
4. Unit 4
5. Unit 5

PART- B

Write critical notes on the following: **(5x6=30)**

6. Unit 1 OR Unit 1
7. Unit 2 OR Unit 2
8. Unit 3 OR Unit 3
9. Unit 4 OR Unit 4
10. Unit 5 OR Unit 5

PART-C

. Write in detail on **any three** of the following: **(3x10=30)**

11. Unit 1
12. Unit 2
13. Unit 3
14. Unit 4
15. Unit 5
