Tribhuvan University
Institute of Science and Technology
M Sc Zoology
Semester System
Micro-syllabus 2071

General Objectives

- To make the M. Sc. Programme in Zoology more practical and relevant to the professional needs as required by the country.
- To provide the students with advanced knowledge in the area of specialization and upgrading the quality so that M.Sc. students in Zoology could compete academically with other universities of the international level.

Semester I

Course Title: Taxonomy & Lower Non-Chordates
Course No: Zoo 501
Nature of the course: Theory

Credits: 3
Lecture hrs: 45
Full marks: 75
Pass marks: 37.5

Objectives

- To help knowing the basic concept of biosystematics and procedures in taxonomy.
- To know about some of the important and common protozoans and helminthes of parasitic nature causing diseases in Nepal.
- To make able to discuss some of the important phenomena in Lower-chordates.

Teaching materials required to fulfill the objectives are boards, charts, flex prints, overhead projector (OHP), power-point projector and other basic teaching materials prepared by teachers and as provided by the campuses.

Unit	**Sub-unit**	**Description of content of the sub-unit (depth)**	**Lec.hrs**	**Text/Ref. for the topics** (for detail see the list of text & references)
Taxonomy (12 hrs)	**History and importance**	Brief history of taxonomy, concept of Linnean hierarchy, phyletic lineage, newer trends in taxonomy, importance of taxonomy.	1	Mayr & Ashlock; ICZN; Winston; Simpson.

	Species concepts, species taxon	Species concepts: Biological species concept (detail), other species concepts (basic idea): Phenetic, phylogenetic, recognition, ecological, cladistic, competition and evolutionary species concepts. The species taxon.	1.5	Mayr & Ashlock; ICZN; Winston; Simpson.
	Cladistics, Overview of character based methods	Concept of cladistics (phylogenetic systematics). Meaning of different terms: apomorphies, synapomorphies, monophyletic, paraphyletic and polyphyletic grouping & cladograms. General concept of character based methods for phylogeny construction.	1	Mayr & Ashlock; Winston; Simpson.
	Infraspecific categories and terms	Variety, subspecies, cline & race.	1	Mayr & Ashlock
	Origin of new species	Overview of origin of new species, modes of speciation.	1	Mayr & Ashlock; Lull
	Taxonomic characters: Kind and weighting of characters	Taxonomic characters- Kinds of characters: Morphological, physiological, molecular, ecological, behavioral & geographic characters. Weighting of characters: Correlated characters, a priori & a posteriori weighting, characters with high weight & characters with low weight.	2	Mayr & Ashlock; ICZN; Winston; Simpson.
	Taxonomic keys and types	Identification keys: Introduction, dichotomous & polytomous keys, single-access, free-access & multi entry keys. Variants of single access keys: linked style, nested style & graphical style. Muliti-access keys: tabular keys, multiple access or polyclave or synoptic key, interactive (computer-aided) keys.	1	Mayr & Ashlock; ICZN; Winston; Simpson.
	Systematic collection, curation, identification and taxonomic publication	Concept of systematic collection, scientific curation, identification, authors, descriptions, identifying specimens (using a key & matching), type specimens, taxonomic publications (checklists, revisions, monographs, faunas and floras, field guides, descriptions of new taxa).	1.5	Mayr & Ashlock; ICZN; Winston; Simpson.

	International Codes of Zoological Nomenclature (ICZN)	Important aspects of International Code of Zoological Nomenclature (ICZN or ICZN Code),. Principles: Principles of binominal nomenclature, priority, typification, the first reviser, homonymy and co-ordination..	2	Mayr & Ashlock; ICZN; Winston; Simpson.
Protozology (11 hrs)	**Classification**	Brief history, general characters and classification up to important families with examples..	2	Hyman;
	General Characters of Radiolaria and Suctoria	Structures and characteristic features of Radiolaria and Suctoria.	1	Hyman; Parker and Haswell.
	Skeleton	Body covering and skeletons.	1	Kotpal
	Osmoregulation	Mechanism of contractile vacuole and pellicular movement.	1	Jordon &Verma; Kotpal.
	Reproduction	Asexual and sexual modes of reproduction.	2	Kotpal
	Parasitism	General concept, kinds of parasites and their adjustment.	1	Cameron; Dogiel; Parker & Haswell.
	Life-cycle, pathogenicity, prevention and control of – *Trypanosoma cruzi*, *Entamoeba coli*, *Isospora belli* and *Cyclospora cayetanensis*.	Introduction, morphology, mode of transmission, life-cycle, pathology, clinical symptoms and preventive measures of *Trypanosoma cruzi*, *Entamoeba coli*, *Isospora belli* and *Cyclospora cayetanensis*.	3	Arora & Arora; Chandler.
Porifera (3 hrs)	**Classification**	Introduction, definition and characters of Porifera. Classification up to important families with examples.	1.5	Hyman; Kotpal; Parker and Haswell; Sedgwick.
	Origin	History, fossils records, evolutionary pattern and origin.	0.5	Hyman; Kotpal; Parker and Haswell; Sedgwick.
	Affinities	Metazoan affinities (Resemblance and difference), Protozoan affinities (Resemblance and difference), Unique features of Porifera.	1	Hyman; Kotpal; Sedgwick.
Cnidology (6 hrs)	**Classification**	Introduction, definition and characters of Coelenterata. Classification up to important family with examples	2	Hyman; Kotpal.
	Nematocysts	Introduction, position, structure, kind of nematocysts,	1	Hyman;

		mechanism of discharge.		Parker and Haswell.
	Mesenteries in Anthozoa	Introduction, structure of mesentery (attachment, mesenterial filament, acontia, stomata, gonads).	1	Hyman,; Kotpal.
	Corals: Growth, theories of formation and importance	Introduction, types of coral, coral reefs (definition, distribution, types), theories of coral reef formation (Darwin Dana theory of subsidence, Supper Murray solution theory, Submerged Bank theory, Daly Glacial control theory), Economic importance of coral reefs.	2	Hyman, Kotpal, Jordan & Verma
Helmintholog y (13 hrs)	**Classification**	Introduction definition and characters of Helminthology. Classification upto important families with examples.	1	Jordan & Verma
	Host and parasite relationships	Effects of parasites on hosts: Consumption of non-nutritional materials, Competition for nutrients, Change in the growth patterns, Tissue damage, Effects of secretions and excretions, Mechanical interference and Castration and sex reversal of the host. Effects of hosts on parasites: Effect of diet, Crowding effect, Temperature, Sex, Age, Host's immunity, Host's specificity.	2	Jordan & Verma
	Larval forms	Turbellaria: Muller's larva & gotte's Larva. Trematoda: Miracidium, sporocyst, redia, cercaria, metacercaria. Cestodes: Cysticercus, coenurus, hydatid cyst, strobiolocercus, cysticercoid, procercoid, plerocercoid.	2	Hyman; Jordan & Verma.
	Classification	Introduction, definition and characters of Nemathelminthes. Classification up to important families with examples.	1	Chatterji.
	Structure, life-cycle, pathogenecity, prevention and control of – *Paragonimus westermani, Schistosoma* spp., *Echinococcus granulosus,*	Introduction, geo – distribution, habitat, morphology, life cycle, pathogenicity, mode of infection, clinical features and symptoms, diagnosis, treatments and preventions of *Paragonimus westermani*, *Schistosoma* spp., *Echinococcus granulosus*, *Hymenolepis nana*, *Trichinella spiralis*, *Ascaridia galli* and *Enterobius vermicularis*.	6	Chatterji; Arora & Arora; Chandler.

	***Hymenolepis nana, Trichinella spiralis, Ascaridia galli* and *Enterobius vermicularis*.**			
	Common plant parasitic nematodes of citrus and potato with reference to Nepal	Introduction, Pathogenicity of major nematode pest of citrus (*Tylenchus semienetrans, Pratylenchus coffeae, Hoplolaimus indicus, Meloidogyne* spp Introduction, Pathogenicity of major nematode pest of potato(*Globodera rostochiensi, Meloidogyne* spp, *Ditylenchus dipasaci).*	2	Chitwood

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Course Title: Higher Non-Chordates and Lower Chordates **Credits: 3**
Course No: Zoo 502 **Lecture hrs: 45**
Nature of the course: Theory **Full marks: 75**
Pass marks: 37.5

Objectives

- To identify the taxonomic status of the higher non-chordates and discuss the evolutionary model of the group.
- To describe the general biology of a few selected non-chordates useful to mankind.
- To make able to discuss some of the important phenomena in higher non-chordates.

Unit	Sub-unit	Description of content of the sub-unit (depth)	Lec. hrs	Text/Ref. for the topics
Annelida (7 hrs)	**Classification**	General introduction, general characters and classification upto important families with examples.	1.0	Kotpal; Parker and Haswell; Sedgwick.
	Structure and affinities of Archiannelida	Structure of Archiannelida, Affinities of Archiannelida with Polychaeta, Oligochaeta, Hirudinaria and its special features.	1.0	Kotpal; Parker and Haswell; Sedgwick; Prasad.
	Adaptive radiation in Polychaeta	Adaptive radiation in Polychaeta in two aspects – habitat and nutrition (feeding). **Habitat :** Crawling polychaetes (surface dwellers), pelagic polychaetes (planktonic), burrowing polychaetes, gallery dwellers, sedentary burrowers, tubicolous polychates . **Nutrition:** Carnivorous (raptorial feeders), herbivorous, scavengers and browsers, sand and mud feeders, direct deposit feeders, indirect deposit feeder, filter or suspension feeders, transitional filter feeders, true filter feeders.	2.5	Kotpal; Prasad.
	Earthworms in soil and nutrient dynamics	Earthworms in soil and nutrient dynamics: Earthworm technology, Use of surface or epigeic worms, Use of Burrowing worms, Principles of composting.	1.0	Abbasi; Arceivala .
	Earthworms in waste	Earthworms in waste management: Symbiotic relationship between applied wastes, worms, soil bacteria and plant,	1.5	Abbasi; Arceivala.

	management	Equipment and supplies, Harvesting the worms and compost, Using worm compost.		
Arthropoda (12hrs))	**Classification and Diversity**	Diagnostic characters and basis of classification up to important families with examples.	4	Hyman; Borror and De Long; Cloudsley & Thomson.
	Characteristics and affinities of Onychophora	General description of external and internal features. Affinities: Annelidan characteristics, Arthropodan characteristics, Onychophoran characteristics, Molluscan characteristics.	1	Hyman; Kotpal.
	Crustacea	Economic importance of Crustacea.	1	Jordan & Verma; Kotpal.
	Metamorphosis and Diapause in Insects	Introduction and types of Metamorphosis: No metabolous- Ametabolous, Incomplete metamorphosis- Hemimetabolous and Complete metamorphosis- Holometabolous. Phases of diapause: Induction phase, preparation phase, initiation phase, maintenance phase and termination phase. Regulation of diapause: Environmental and Neuroendocrine	2	Jordan & Verma; Kotpal
	Insect Hormones and Pheromones	Types of Hormone: Prothoracicotropic Hormone (PTTH), Ecdysone, Juvenile Hormone (JH) Types of pheromone: Alarm Pheromone, Trail Pheromone, Queen Pheromone, Sex Attractants.	2	Larry
	Insect control	Types of control: Biological, Mechanical, Physical and Chemical.	1	Larry
	Arthropods of public health and medical importance	Overview of medically important insects and their impact on public health.	1	Kettle
Malacology (10 hrs)	**Classification**	Diagnostic characters and basis (shell and foot) of classification up to important families with examples.	2	Hyman
	Larval forms	Introduction to direct development with no larval form. Indirect development with morphology and significance of	1	Hyman; Kotpal.

		larval forms: Trocophore, Veliger, Glochidium.		
	Digestion, Respiration and Reproduction in Gastropods	Description of organs and glands of each system and their physiology.	3	Hyman; Kotpal.
	Torsion and Detorsion in Gastropoda	Process and significance of Torsion and Detorsion.	1	Hyman; Kotpal.
	Diversity of molluscs in Nepal. Snails as vectors and pests	Diversity and distribution of Mollusca in different ecological regions of Nepal. Snails as vectors of diseases. Invasive and pest species with reference to Nepal.	2	Barker; Runham and Hunter.
	Ammonites and their extinction.	History. General concept of Ammonites life, shell structure, significances , extinction and its causes.	1	Hyman .
Echinodermata (5 hrs)	**Classification**	Diagnostic characters of the phylum, classification up to important families with examples.	2	Hyman; Sedgwick.
	Larval forms and symmetry	Larval forms: Bipinnaria, Brachiolaria, Ophiopluteus, Echinopluteus, Auricularia, Doliolaria; significance of echinoderm larvae, body form and symmetry.	1	Hyman,; Kotpal,; Parker and Haswell.
	Skeletal system	Skeleton in different classes of Echinodermata.	1	Hyman,;Kotpal; Parker and Haswell.
	Origin and Evolution	Origin and evolution of Echinodermata.	1	Kotpal; Parker and Haswell.
Minor Phyla (6 hrs)	**Salient features of Acanthocephala, Nemartina, Nematomorpha, Rotifera, Gastroitricha, Bryozoa (Ectoprocta), Entoprocta,**	Introduction and definition, salient features, examples of Acanthocephala, Nemartina, Nematomorpha, Rotifera, Gastroitricha, Bryozoa (Ectoprocta), Entoprocta, Mesozoa, Ctenophora and Brachiopoda.	6	Hyman; Kotpal.

	Mesozoa, Ctenophora and Brachiopoda.			
Lower Chordates (5hrs)	**Origin, evolution and phylogeny of lower chordate to higher chordate**	Invertebrate relatives of Chordate, Hemichordata, Urochordata, Cephalochordata, Cyclostomata. Formation of chordates.	5	Colbert.

References

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Course Title: Higher Chordates **Credits: 3**
Course No: Zoo 503 **Lecture hrs: 45**
Nature of the course: Theory **Full marks: 75**
Pass marks: 37.5

Objectives

- To identify the taxonomic status of the chordates and discuss the evolutionary model of the group.
- To impart knowledge on ecology of some important fishes, amphibians, reptiles, birds and mammals of Nepal.
- To make able to discuss some of the important phenomena in chordata.
- To know about the conservation and management strategies of the chordate fauna in Nepal.

Unit	Sub-unit	Description of content of the sub-unit (depth)	Lec. hrs.	Text/Ref. for the topics
Ichthyology (9 hrs)	**Origin, Evolution and Adaptive radiation**	Vertebrate cladistic, Fish phylogeny (Placoderms, jawless and jawed fishes), Major trends in fish evolution.	1.5	Khanna; Gupta & Gupta.
	Classification	Classification, Tools of identification and sorting, Using keys: key to orders, sub-orders, families, genus and species. Common name and diagnostic characters .	2.0	Khanna; Gupta & Gupta; Shrestha 1981; Shrestha 2008.
	Distribution and conservation status in Nepal	Distribution of indigenous fishes (warm water and cold water fishes), Exotic fishes introduced in Nepal, Status of indigenous fishes of Nepal, Threats to fishes.	2.0	Shrestha 1981, Shrestha 1994, Shrestha 2008
	Fish sampling techniques	Fine meshed nets, Lift nets or Dip nets, Cast net, Hookline and Loopline, Drift nets (vasa jal), Gill nets, Electro Fishing.	1.5	Shrestha 1994, Shrestha 2008
	Coloration Ecology	Mechanism of coloration in fishes, Significance of coloration.	1.0	Khanna; Gupta & Gupta.
	Importance of fishes (Eel and Snow trout)	Status, significance and importance of Eel and Snow trout.	1.0	Shrestha 2008

Herpetology: **Amphibia (9 hrs)**	**Origin, Evolution and Adaptive radiation**	Earliest amphibia – Labyrinthodontia, palaeozoic amphibia, temnospondyli, lepospondyli, modern amphibian. Adaptations: Aquatic, terrestrial, burrowing, volant, arboreal, and cave adaptations.	1 1	Colbert
	Classification	Extinct amphibian, living amphibia(apoda, urodaela and anura) upto family.	2	Verma; Sedgwick.
	Distribution and conservation status of amphibians in Nepal	Distribution and conservation status of amphibians in Nepal.	1	Shrestha; Shah and Tiwari.
	Amphibian sampling techniques	Recognising individual (toe clipping, skin pattern), Drift fencing, scan searching, netting, trapping, transect and patch sampling, removal studies.	1	Sutherland
	Affinities of Gymnophiona	Introduction, affinities with cyclostomes, pisces, urodela, anura,	1	Sedgwick
	Ecology and importance of amphibian (Himalayan Newt and Paha).	Introduction, habit, habitat, behavior, life history, importance and conservation status of Himalayan newt and Paha	2	Shrestha
Reptilia (9hrs)	**Origin**	Monophyletic and Polyphyletic theory of origin of reptiles, Ancestry through *Seymouria, Limnoscelis and Diadectes.*	1	Jordan & Verma
	Evolution	Stem reptile (Cotylosauria). Evolutionary tree.	1	Young; Kotpal; Dhami & Dhami.
	Adaptive radiaton	Introduction, Various type of adaptations in Reptiles: Aquatic adaptation, Fossorial adaptation, Cursorial adaptation, Climbing adaptation, Aerial or Volant adaptation, Desert adaptation.	2	Kotpal; Verma.
	Classification	Living Orders: Chelonia, Rhynchocephalia, Squamata and Crocodilia. Extinct Orders.	2	Young
	Distribution and conservation status of reptiles in Nepal	Vertical distribution: Lowland Zone, Midland Zone Highland Zone ,Trans Himalayan zone .	1	Shrestha
	Sampling technique		1	Sutherland

	Ecology and Importance of reptiles (Mugger and Cobra).	Habit , Habitat, Distribution , Status and importance of Mugger and Cobra.	1	Shrestha; Verma
Ornithology (9 hrs)	**Origin, Evolution and Adaptive radiation**	Introduction (microevolution, macroevolution, synthetic theory of evolution, gradualism, punctuated evolution, adaptive radiation and successive speciation, cladogenesis and anagenesis), the saurischian dinosaurs and the origin of birds, the Jurassic birds, the origin of flight, the cretaceous birds, modern birds, monophyletic and diphyletic lineage, tendencies in the evolution of birds, adaptive radiation.	2	Colbert; Van Tyne & Berger; Young; Kotpal.
	Classification	Classification of Birds with important families and examples.	1	Young ; Van Tyne & Berger; Kotpal.
	Distribution and conservation status of avian fauna in Nepal	Geographical distribution, historical distribution, macro and micro level distribution, limiting factors, threat to birds, status of birds on the basis of –IUCN threatened categories, CITES status categories, national status, local status, conservation initiatives and research.	1	Baral et al. Shrestha 2001
	Palates in birds	Types and importance of palate.	1	Van Tyne & Berger; Young; Kotpal.
	Bird sampling techniques	Capture –recapture, catch per unit effort, radio tracking, play back methods, distribution studies.	1	Colin et al.; Gregory et al.; Southerland et al.
	Bird hazards	Toxicants, human built structures, industrial pits, open oil pits, chemical spills, aquatic trash, and diseases.	1	Schafer
	Ecology and importance of birds (Pheasants and Birds of prey)	Habitat distribution and importance of Pheasants. Ecological significance of Birds of prey.	2	Shrestha 2001
Mammology (9hrs)	**Origin, Evolution, and Adaptive radiation**	Evolution in different continents, Northern hemisphere, South America. Australia, convergent evolution. Wild mammals in Ecological zones of Nepal. Endemic mammals of Nepal. Adaptive radiation in general.	2	

		Mammals-Dentition and Stomach	2	
	Classification	Classification, status and distribution to 185 wild animals of Nepal. Typical wild animals of Nepal, Himalayan species. Introduction of protected wild animals of Nepal.	2	
	Sampling	Mammal sampling and study techniques and methods	1	
	Ecology and importance of wild animals (Snow Leopard and Elephant)	Distribution, population, habitat, behaviors, conservation efforts of Snow Leopard and Wild Elephant	2	

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Course Title: Comparative Anatomy & Physiology **Credits: 3**
Course No: Zoo 504 **Lecture hrs: 45**
Nature of the course: Theory **Full marks: 75**
Pass marks: 37.5

Objectives

- To impart knowledge in comparative anatomy and development systems of chordates.
- To make familiar with the functions of different organs of human body.
- To provide an understanding of currently established interdisciplinary approaches used in the study of animal physiology.

Units	Sub-units	Detail description of the sub-units	Lec. hrs.	References
Comparative Anatomy of Vertebrates (12 hrs)	**Integument**	Introduction. Integument- structure and function.	2	Prosser &Brown; Kotpal; Jordan & Verma.
	Alimentary canal	Introduction. Alimentary canal, Associated digestive glands- salivary glands, liver, pancreas, etc.	2	Prosser &Brown; Kotpal; Jordan & Verma
	Skin, gills and lungs. Air sacs	Respiratory organs in vertebrates: gills, air bladder, skin, air sacs and lungs.	2	Prosser &Brown; Kotpal; Jordan & Verma

	Hearts and aortic arches. Portal systems	Hearts- structure of hearts in vertebrates. Aortic arches- structure of aortic arches in vertebrates. Portal systems- renal portal and hepatic portal veins.	2	Prosser &Brown; Kotpal; Jordan & Verma
	Kidney and its ducts, gonads and their ducts	Introduction Vertebrate kidneys and their ducts. Gonads and their ducts.	2	Prosser &Brown; Kotpal; Jordan & Verma
	Vertebrate brain, ear and eye	Comparative study of brain, Photoreceptor or eyes and ears in vertebrates.	2	Prosser &Brown; Kotpal; Jordan & Verma
	Urino-genital organs	Introduction Vertebrate kidneys and their ducts. Gonads and their ducts.	2	Prosser &Brown; Kotpal; Jordan & Verma
Animal Physiology: **Gastro-intestinal (3 hrs)**	**Principles of digestion and absorption of nutrients. Gastrointestinal disorders**	Secretary functions of alimentary canal, digestion of various foods, basic principles of absorption, Gastro-intestinal disorders (*very brief*).	3	Guyton and Hall; Eckert & Randall.
Respiratory (7 hrs)	**Respiratory pigments- structure, properties and functions**	Structure and functions of Haemoglobin, Myoglobin *(on the basis of amino acids :invertebrates and vertebrates*) , Hemocyanin (Hcy), Haemoerythrin, Chlorocruorin, Haemovanadium, *Echinochrome, Pinnaglobulin, Molpadian* (invertbrates).	4	Chatterjee; Eckert & Randall; Chaudhary; Guyton & Hall.
	Regulation of respiration	Baroreceptor, chemoreceptor	1	Do
	Respiratory abnormalities (Hypoxia, Dyspnoea, Asthma, Edema, Emphysema)	Causes, sign & symptoms, treatment of Hypoxia, Dyspnoea, Asthma, Edema, Emphysema.	2	Do
Cardio-vascular	**Cardiac cycle, Cardiac output**	Cardiac cycle, regulation of cardiac cycle. Cardiac output, regulation of heart rate and stroke volume.	1	Guyton and Hall; Eckert & Randall.

	Regulation of heart pumping	Intrinsic regulation (Frank-Starling law, heart rate effect and rate induced regulation) & extrinsic regulation (parasympathetic & sympathetic).	1	Guyton and Hall; Eckert & Randall.
	Pacemakers	Concept of natural and artificial pacemaker, types of pacemakers, temporary pacemakers, implanting pacemaker.		Guyton and Hall; Eckert & Randall.
	Regulation of arterial and venous blood flow	Autoregulation of blood flow, neural control of blood flow (baroreceptor & chemoreceptor reflexes), hormones and cardiovascular functions, cardiovascular response to exercise, response to hemorrhage.	1	Guyton and Hall; Eckert & Randall.
	Regulation of arterial blood pressure	Physiological mechanisms to maintain normal blood pressure: autonomic nervous system responses, capillary shift mechanism, hormonal responses, kidney and fluid balance mechanisms.	1	Guyton and Hall; Eckert & Randall.
	Heart valves & heart sounds. Valvular diseases.	Types, causes, symptoms and diagnosis of heart valve diseases.	1	Guyton and Hall; Eckert & Randall.
Neuro-physiology (6 hrs)	**Functional evolution of Fore, Mid and Hind brains**	The spinal cord, the brain stem and cerebellum, the mid brain, the thalamus and hypothalamus, the cerebral hemispheres; hierarchical design in vertebrate brains	1	Walker
	Motor areas of brain	The motor cortex and the association cortex- the Primary Motor Cortex, Premotor Cortex, and Supplementary Motor Area	1	Stanfield & German; Guyton and Hall.
	Vision: Photo-chemistry. Dark and Light adaptations. Colour vision, Neuronal pathways of hearing and vision	Photopigments, opsin and light absorbing molecules, rhodopsin – retinal visual cycle and excitation of the rods, Mechanisms of light and dark adaptation, Factors Affecting light and Dark Adaptation, theory and views of colour vision, neuronal pathways of hearing and vision	2	Stanfield & German; Guyton and Hall.
	Thermal regulation	Factors related to thermal regulation, control of body temperature (physiological and behavioral), mechanism of thermoregulation	1	Stanfield & German; Guyton and Hall.
	Acclimatization	Introduction, acclimatization to heat, cold and altitude.	1	Do

Excretory and Osmoregulatory	**Homeostatic and Osmoregulatory functions of the vertebrate kidney**	Comparative structure, urine formation. Hormonal control of water re-absorption	3	Do
	Abnormalities of micturition	Definition(comparison with normal micturition),conditions	2	Do
	Diuretic and Kidney diseases (Acute Renal Failure)	Causes, clinical symptoms and treatment	1	Do
Reproductive (3 lectures)	**Gametogenesis**	Spermatogenesis and its phases: Multiplication phase, Growth phase, Maturation phase, spermiogenesis Oogenesis and its phases: Multiplication phase, Growth phase and Maturation phase.	1	Chatterjee; Hurkat & Mathur.
	Hormones in Ovulation (Ovarian cycle)	Concept of ovulation and menstruation, Role of hormones in ovulation and menstruation (FSH LH, Oestrogen and Progesterone)	2	Chatterjee; Hurkat & Mathur.
Endocrinology (13 hrs)	**Endocrine glands and their hormones**	Overview of exo- and endocrine glands. Concept of enzyme, hormone & neurotransmitter, neurosecretion, neurotransducer	2	Chatterjee, Eckert & Randall; Chaudhary; Guyton & Hall.
	Regulation of hormones	Feed-back mechanism (Effectors, receptor, target : Short and long loop mechanisms).	2	Chatterjee, Eckert & Randall; Chaudhary; Guyton & Hall.
	Hypothalamo-hypophysial system	Hierarchial organization of endocrine control by the hypothalamus. ADH, Oxytocin, growth hormone	1	Chatterjee, Eckert & Randall; Chaudhary; Guyton & Hall.

	Invertebrate and vertebrate hormones	Name and structure of gland, nature*(proteins ,lipids & amino acids)* and functions of hormones-- Ecdysone, Corpora cardiaca (Hyperglycemic hormone), Adipokinetic hormone (AKH),Corpora Allata (juvenile hormone), Moulting hormone (Prothoracic gland) Pitutary, Adrenal-cortex (more emphasis on cholesterol as source of androgen and estradiol)and medulla , Pancreas, Parathyroid, Thyroid, Pineal,Gonads, Corpus luteum (progesterone & oestrogen), Placenta (Chorionic gonadotrophin, Human placental lactogen) Stomach (gastrin), Duodenum (Secretin, cholecystokinin {pancreozymin}), Kidney (renin).	8	Chatterjee, Eckert & Randall; Chaudhary; Guyton & Hall.

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