ETERNAL UNIVERSITY
BARU SAHIB

SYLLABUS

MASTER OF SCIENCE - ZOOLOGY

(TWO YEAR FULL TIME PROGRAMME)

(FOUR SEMESTER COURSE)

(Effective from session 2022-23 onwards)

DEPARTMENT OF ZOOLOGY

AKAL COLLEGE OF BASIC SCIENCES

PROGRAMME STRUCTURE
M.Sc. Zoology (Without Thesis)
(Effective from session 2022-23 onwards)

Semester	Course Code	Course	L	T	P	C
I	ZOO-511	Biosystematics	2	0	1	3
	ZOO-512	Structure & Functional Organization of Animal -I	2	0	1	3
	BIOCHEM-511	General Biochemistry	3	0	0	3
	ZOO-514	Evolutionary Biology	2	0	1	3
	MICRO-511	General Microbiology	3	0	0	3
	ZOO-515	Comparative Vertebrate Endocrinology and Reproduction	2	0	1	3
		Sub Total	**14**	**0**	**4**	**18**
II	ZOO-521	Structure & Functional Organization of Animal -II	2	0	1	3
	ZOO-522	Embryology	2	0	1	3
	ZOO-523	Endocrinology	2	0	1	3
	ZOO-524	Limnology	2	0	1	3
	BT-507	Plant and Animal Biotechnology	3	0	0	3
	MICRO-524	Molecular Biology & Genetic Engineering	3	0	0	3
	ZOO-525	Insect and Environment	2	0	1	3
	ZOO-591*	Project Seminar	1	0	0	1
		Sub Total	**17**	**0**	**5**	**22**
III	ZOO-531	Cytogenetics	3	0	1	4
	RM-599	Research Methodology	3	1	0	4
	ZOO-532	Tools & Techniques in Biology	3	0	1	4
	BT-505	Computational Biology and Biostatistics	3	0	0	3
	ZOO-534	Parasitology	3	0	1	4
	ZOO-535	Entomology	3	0	1	4
	ZOO-536	Credit Seminar	1	0	0	1
		Sub Total	**19**	**1**	**4**	**24**
IV **(Without Dissertation)**	**Elective Papers (Any One):**					
	ZOO-541*	Insect Diversity and Physiology	3	0	0	3
	ZOO-542*	Biology of Parasites				
	ZOO-543*	Animal Physiology				
	Compulsory Papers:					
	ZOO-544*	Animal Behaviour	3	0	0	3
	ZOO-545*	Wild life and its Management	3	0	1	4
	ZOO-500*	Project Work	0	0	10	10
		Sub Total	**9**	**0**	**11**	**20**
		Grand Total	**59**	**1**	**24**	**84**
Total Credits: 59+1+24=84						

***Students pursuing M.Sc. Zoology with "Project Work" can opt one elective paper along with two compulsory papers. Students will receive "Satisfactory" result on obtaining ≥ 55% marks in these courses. Result will be satisfactory or non-satisfactory.**

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II	ZOO-521	Structure & Functional Organization of Animal -II	2	0	1	3
	ZOO-522	Embryology	2	0	1	3
	ZOO-523	Endocrinology	2	0	1	3
	ZOO-524	Limnology	2	0	1	3
	BT-507	Plant and Animal Biotechnology	3	0	0	3
	MICRO-524	Molecular Biology & Genetic Engineering	3	0	0	3
	ZOO-525	Insect and Environment	2	0	1	3
	ZOO-591*	Synopsis Seminar	1	0	0	1
		Sub Total	**17**	**0**	**5**	**22**
III	ZOO-531	Cytogenetics	3	0	1	4
	RM-599	Research Methodology	3	1	0	4
	ZOO-532	Tools & Techniques in Biology	3	0	1	4
	BT-505	Computational Biology and Biostatistics	3	0	0	3
	ZOO-534	Parasitology	3	0	1	4
	ZOO-535	Entomology	3	0	1	4
	ZOO-536	Credit Seminar	1	0	0	1
		Sub Total	**19**	**1**	**4**	**24**
IV	ZOO-600*	Thesis (Experiments, Results Analysis, Thesis Submission)	0	0	20	20
		Sub Total	**0**	**0**	**20**	**20**
Grand Total			**50**	**1**	**33**	**84**
Total Credits: 50+1+33=84						

*** Non- credit courses**

ZOO-511: BIOSYSTEMATICS
(Semester I)

L+T+P :	2+0+1	Mid-Sessional exam	: 20
Credits :	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Microtaxonomy: Phenon, Taxon,Category, type; stages of taxonomy; Aims and tasks of Taxonomists; Importance of taxonomy in Biology. Macrotaxonomy: Theory and practice of Biological classification; Basic principles, Rules for the classification of organisms, Identification criteria, Taxonomic characters, Classification and phylogeny, is classification a Theory? The functions of a classification.	5
II	Concept of Species: Typological species concept, Nominalistic species concept, Biological species concept, Evolutionary species concept; other kinds of species; Polytypic species, Subspecies, Infraspecies and Superspecies.	5
III	Newer Systematics: Morphological approach, Immature stages and Embryological approach, Ecological approach, Behavioural approach, Cytological approach, Biochemical approach, Numerical systematics, Differential systematics.	5
IV	Molecular Systematics Immunological aspect, chromatographic aspect, Electrophoresis, Infrared spectrophotometry, Histochemical studies, genetic complement, DNA hybridization, Karyological studies.Macromolecular & Micromolecular Systematics: based on DNA, RNA, Protein, amino acids, fatty acids and phenols.	5
V	Role of Systematics in applied Biology: Agriculture & Forestry, Biological control, wild life management, National defence, Environmental problems, soil fertility, Mineral prospecting, Quarntine measure, Commercial application.	4
VI	Systematics and Public Health Management.	5

S. No.	Particulars of practical
1	Demonstration of various kinds of equipment required for collection and preservation of animals.
2	Methods of collection and preservation. Kinds of keys and their use at higher and lower category levels.

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	Principles of Systematic Zoology Mayr, E.	Tata McGraw -Hill	1st ed./ 1969
2	Principles of Systematic Zoology Mayr, E. & Ashlock, P. D.	McGraw-Hill	2nd ed./ 1991
3	Theory and Practice of Animal Taxonomy and Biodiversity Kapoor, V.C.	Oxford and LBH	8th ed./ 2019

ZOO- 512: STRUCTURE AND FUNCTIONAL ORGANIZATION OF ANIMAL– I
(Semester I)

L+T+P:	2+0+1	Mid-Sessional exam	: 20
Credit:	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Nutrition & Digestion. Ingestion of soluble food and particulate food in relation to habitat and habits. Symbiotic nutrition. Mechanism of digestion and regulation of secretion in non-chordates and chordates. Transport and circulatory mechanisms Intracellular transport in Protozoa.	5
II	Circulation of external medium of transport within the body of sponges and cnidarians. Open and closed types of circulatory system, Chambered, tubular and ampullary hearts, neurogenic and myogenic hearts Evolution of Heart and Cardiovascular system.	5
III	Respiratory System: Respiratory organs in aquatic animals and aquatic respiration. Respiratory organs and aerial mode of respiration. Distribution and brief chemistry of respiratory pigments and their function in nonchordates and chordates.	5
IV	Reproduction: Pattern of reproduction in non-chordates and larval forms, Evolution of the urino-genital system in chordates with special reference to the separation of the two systems.	5
V	Osmoregulation and Excretion: Osmoconformers and osmoregulators, hyperosmotic, hyposmotic and isosmotic mediums, Excretion and metabolic waste products – an introduction., Excretory structures and waste disposal in non-chordates, coelom, coelomic ducts, nephridia, antennal / green glands, malpighian tubules., Osmoregulation in non-chordates, adaptation to different environments / habitats.	4
VI	Development and adult structural organization of chordate kidney: nephron, the functional unit.	6

S. No.	Particulars of practical
1	Study of mouth parts of: honey bee, housefly, cockroach, butterfly, mosquito, and bug.
2	Malpighian tubules in Cockroach.
3	Study of different kinds of Heart and blood vascular system in animals
4	Study of permanent slides: Blood of animals.
5	Study of respiratory structures: Gills (Crustaceans, Bivalves, Cephalopods, and Fish) Book Lungs (Scorpion); Trachea and spiracles (Cockroach).

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Invertebrates Zoology** Barnes, R.D.	W.B. Saunders Co. Philadelphia	6th ed./ 1982
2	**The Invertebrates** Hyman, L.H.	McGraw Hill Co., New York	1st ed./ 1940
3	**Invertebrate structure and function** Barrington, E.J.W	Thomas Nelson anmd Sons Ltd., London	1st ed./ 1979
4	**Parker and Haswell Textbook of Zoology | Invertebrates** Rastogi, V.B.	Medtech Science Press	8th ed./ 2021

BIOCHEM – 511: GENERAL BIOCHEMISTRY
(Semester I)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Particulars	No. of lectures
I	Fundamental principles governing life; structure and biological functions of water; acid base concept and buffers; pH; hydrogen bonding; hydrophobic, electrostatic and Vander Waals forces	7
II	Classification, structure and function of carbohydrates, lipids and nucleic acids. Primary, secondary and tertiary structures of proteins. Protein folding and stability. Protein sequencing. Structure and biological functions of vitamins	12
III	Enzymes classification and mechanism of action, regulation, factors affecting enzyme action. Hormones and their mode of action. Bioenergetics, oxidative phosphorylation.	8
IV	Photosynthesis and respiration. General metabolism of carbohydrates, proteins and lipids	9
V	DNA replication, transcription and translation. Recombinant DNA technology.	7

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1.	**Lehninger: Principles of Biochemistry** Nelson, D.L., Lehninger, A.L. & Cox, M.M.	WH Freeman & Co	5th ed. / 2008
2.	**Biochemistry** Berg, J.M., Tymoczko, J.L. & Stryer, L.	WH Freeman & Co	6th ed. / 2006
3.	**Biochemistry** Voet, D. & Voet, J.G.	Wiley & Sons Inc	3rd ed. / 2004
4.	**Harper's illustrated biochemistry** Botham, K., Mayes, P., Murray, R.K. & Granner, D.K.	McGraw-Hill Companies	27th ed. / 2006

ZOO-514: EVOLUTIONARY BIOLOGY
(Semester I)

L+T+P:	2+0+1	Mid-Sessional exam	: 20
Credit:	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Evolutionary Biology: Importance of evolutionary biology: Structure of evolutionary biology, major points of evolutionary synthesis and evolutionary biology since the synthesis	5
II	Brief idea regarding Darwin's contribution and evolution after Darwin	5
III	Evolutionary Processes in population and species : significance of Hardy-Weinberg principle, factors in evolution, evolution by genetic drift and relationship between inbreeding and genetic drift, natural selection, strength of natural selection and its analysis in present pretext	8
IV	Speciation, modes of speciation, allopatric speciation and alternatives to allopatric speciation, role of polyploidy and hybrid speciation, rates of speciation and consequences of speciation	5
V	Phylogeny and cladistics, phylogenetic hypothesis, molecular data in phylogenetic analysis, advancements in phylogenetic estimations	5

S. No.	Particulars of practical
1	Study of organisms with reference to their evolutionary significance such as adaptations and structural modifications.
2	Study of organisms with reference to their evolutionary significance as connecting links, missing links and living fossils.
3	Phylogenetic analysis in context with phenetics and cladistics

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Evolution** Ridley, M.	Blackwell Publishing	3rd ed./2004
2	**Evolution** Stearns, S.C. & Hoeskstra, R.F.	Blackwell Science Ltd.	2nd ed./ 2005
3	**Evolution** Barton, N.H., Briggs, D.E.G., Eisen, J.A., Goldstein, D.B. & Patel, N.H.	CSHL Press	2nd ed./ 2007
4	**Strickberger's evolution** Brain, K.H. & Benedikt, H.	Jones & Bartlett	4th ed./ 2007
5	**Introduction to Evolutionary Biology** Mandal, F.B.	Oxford & LBH	1st ed./2015

MICRO-511: GENERAL MICROBIOLOGY
(Semester I)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Particulars	No. of lectures
I	History of microbiology, Scope and importance of microbiology, Three domain system of Carl Woese. Differences between prokaryotic and eukaryotic cell. Bacterial cell structure, shapes and arrangements. Structure and functions of cell membrane, cell wall, flagella, capsule, pili, endospores, magnetosomes.	9
II	Morphology, habitat, life cycle, nutrition and classification of archaea, fungi (yeats and molds), algae, protozoa and viruses. Mycoplasma and rickettsia. Principles of microscopy, brightfield, darkfield, fluorescence, phase contrast and electron (transmission and scanning) microscopy.	8
III	Reproduction and growth of microorganisms. Microbial growth measurement, Effect of pH, temperature, oxygen on growth of bacteria. Batch and continuous culture, diauxic growth, synchronous culture, Anaerobic cultures. Extremophiles, Methanogens.	9
IV	Control of microbes by physical (radiation, temperature, pH, pressure) and chemical methods. Sterilization, decontamination, pasteurization and tyndallization. Biosafety levels in microbiological laboratories. Disposal of microbial wastes.	8
V	Antibiotics: types, properties, mode of action, drug resistance and its significance. Mechanism of antibiotic resistance. Nosocomial infections and drug resistance. Antibiotic susceptibility tests (Kirby-Bauer disc diffusion, broth dilution and E-test).	8

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Microbiology: An Introduction** Tortora, G., Funke, B. & Case, C.	Pearson Education	9th ed. / 2008
2	**Prescott, Harley & Klein's Microbiology** Willey, J., Sherwood, L. & Woolverton, C.	McGraw-Hill Education	10th ed. / 2016
3	**Brock's Biology of Microorganisms** Madigan, M.T., Martinko, J.M., Bender, K.S., Buckley, D.H. & Stahl, D.A.	Benjamin Cummings	14th ed. / 2014
4	**A Textbook of Microbiology** Dubey, R.C. & Maheshwari, D.K.	S. Chand Publishing	3rd ed. / 2013

ZOO-515: COMPARATIVE VERTEBRATE ENDOCRINOLOGY AND REPRODUCTION
(Semester I)

L+T+P:	2+0+1	Mid-Sessional exam	: 20
Credit:	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Concept of endocrinology: Introduction to the endocrine system, classes of hormones, modes of hormone secretion. Neuroendocrine regulation, structure, secretion and functions of endocrine glands.	5
II	Mechanisms of hormone action.	5
III	Reproductive patterns and their evolution in vertebrates. Environmental regulation of reproductive cycle and sex determination.	5
IV	Hormonal regulation of gametogenesis and ovulation.	5
V	Gamete maturation, fertilization, implantation, pregnancy, parturition, lactation, fertility and its regulation.	8

S. No.	Particulars of practical
1	Study of different endocrine glands and reproductive organs.
2	Demonstration of methods of hormone assay.
3	Qualitative and quantitative study of steroid biosynthesis (key enzymes, lipids, cholesterol).
4	Determination of sperm concentration and motility.
5	Induction of sperm capacitation *in vitro*.

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Mammalian endocrinology** Boral, A.K.	Rastogi Publication	2011
2	**General Endocrinology** Turner, J., Bagnara, T. & Donnnell, C.	New Central Book Agancy (P) Ltd	2012
3	**Endocrinology and Reproductive Biology** Shastry, K. V.	Rastogi Publication	2005
4	**Williama Textbook of Endocrinology** Melmed, S., Auchus , R.J. et al.	Elsevier	14th ed./ 2020

ZOO-521: STRUCTURE & FUNCTIONAL ORGANIZATION OF ANIMAL – II
(Semester II)

L+T+P:	2+0+1	Mid-Sessional exam	: 20
Credit:	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Integumentary system- Embryonic origin, General features of the Integument Specializations of integument Evolution of Skin.	4
II	Muscular system**-** Classification of Muscles, Structure of Skeletal, Smooth & Cardiac muscle, Tendons Muscle mechanics, Muscle Function Basis of Muscles contraction, Muscle Fiber and Muscle organs, Bone-muscle lever systems.	5
III	Skeletal System- Exo and Endo Skeleton in Invertebrates. Appendicular skeleton in vertebrates, Basic Components Phylogeny of fishes and tetrapods,	4
IV	Evolution of the Appendicular system Form and Function, Swimming, Terrestrial locomotion. Integratory systems**-** Chemical coordination of body functions through neuro-secretion in chordates.	5
V	Physiology of nerve net and giant fibre system. Evolution of functional anatomy of brain. Endocrine system- Endocrine organs, Chemical coordination of body functions through hormones and neuro secretions.	5
VI	Sensory system-General sensory organs Free sensory receptors, Encapsulated sensory receptors Associated sensory receptors Mechanisms of perceiving stimuli, Special sensory organs (Mechano, Radiation, Chemo. and Electroreceptors) Additional special sensory organ	5

S. No.	Particulars of practical
1	Study of permanent slides: Skin of fish, frog, lizard, bird and mammal.
2	Preparation of temporary mount of: setae of earthworm, spicules of Sponges and *Herdmania*. And internal ear of fish.
3	Appendages of Prawn. Permanent slides of muscle fibers, cartilage and bone.
4	Tentorium of grasshopper.
5	Study of wing venation, coupling and types of wings of insects.

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/ Year
1	**The Invertebrates: A New Synthesis** Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & Spicer, J.I.	Blackwell Science.	3rd ed. /2002
2	**The life of vertebrates** Young, J.Z.	Oxford university press.	3rd ed. /2004
3	**Vertebrates Comparative Anatomy, Function and evolution.** Kardong, K.V.	McGraw-Hill Higher Education	4th ed. /2005
4	**A Text Book of Zoology** Dhami, P.S. & Dhami,J.K.	Pradeep Publications - Jalandhar	42nd ed. /2010
5	**Modern Text Book of Zoology, Invertebrates** Kotpal, R. L.	Rastogi Publications - Meerut	11thed. /2014

ZOO-522: EMBRYOLOGY
(Semester II)

L+T+P:	2+0+1	Mid-Sessional exam	: 20
Credit:	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Sex determination and differentiation: Mechanism of Sex determination, differentiation of gonad and the genital tract. , Stem cell renewal in testis, Spermatogenesis: structural and molecular events, Seminiferous epithelial cycle, Spermiogenesis.	5
II	Sertoli cell: structure and function; Leydig cell: generation of Leydig cell, steroidogenesis; Leydig and Sertoli cell proliferation during foetal and postnatal development; Regulation of testicular functions., Epididymal maturation of spermatozoa; Capacitation, Signal transduction pathway in acrosome reaction	5
III	Male sterility: azoospermia, oligozoospermia, asthenozoospermia, varicocele; Genetic basis for male infertility, Mutational analysis in genes for hormones, receptor and gamete development.	4
IV	Follicular development, Role of extra-and intra-gonadal factors in folliculogenesis; Oocyte maturation and its regulation; Ovulation: factors involved in follicular rupture; Luteinization and luteolysis; Follicular atresia.	5
V	Regulation of reproductive cycle in female: menstrual cycle in human, estrous cycle in rat, Female reproductive disorder: amenorrhea, polycystic ovary. , Fertilization: A comparative account on pre-fertilization events in oviparous animals (echinoderms-amphibians) and mammals, activation of egg, candidate molecules involved in fertilization, prevention of polyspermy.	7
VI	Contraception: surgical, hormonal and immunocontraception.	3

S. No.	Particulars of practical
1	Histology of amphibian testis and ovary to understand the sequence of events related to spermatogenesis and oogenesis.
2	Histology of mammalian testis and ovary to understand the sequence of events related to spermatogenesis and folliculogenesis.
3	To study permanent slides of frog embryology.
4	To study permanent slides of Chick embryology, whole mount of different hours embryonic stages.
5	Sperms count by haemocytometer.

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/ Year
1	**Modern Text Book of Zoology: Vertebrates** Kotpal, R.L.	Rastogi Publications	12^{h} ed. / 2019
2	**A Textbook of Zoology** Dhami , P.S. & Dhami, J.K.	Pradeep Publications	29th ed. / 2017
3	**Developmental Biology** Gilbert, S.F.	Sinauer Associates, Inc., Publ, Sunderland	8th ed./2006
4	**Morphogenesis: The cellular and Molecular Processes of Developmental Anatomy** Bard, J.B.L.	Cambridge University Press, Cambridge	1st ed./ 1990

ZOO-523: ENDOCRINOLOGY
(Semester II)

L+T+P:	2+0+1	Mid-Sessional exam	: 20
Credit:	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Phylogeny of endocrine system. Endocrine control of various physiological mechanisms in nemerteans, annelids, mollusks, arthropods (Insects and crustaceans) and echinodermates., Comparative aspects of endocrine physiology in vertebrates.	5
II	Evolution of pituitary gland; Physiological actions of pituitary hormones. Urophysis and action of its hormone(s). Evolution of adrenal gland; Synthesis of corticosteroid, structural diversity of glucocorticoids among vertebrates, role of glucocorticoid in gluconeogenesis; Evolution of renin-angiotensin system, hormonal control of water and electrolyte balance; Catecholamine biosynthesis, its storage and release mechanism, physiological actions of adrenal medullary hormones; Importance of adrenocortical and adrenomedullary interaction.	5
III	Evolution of thyroid gland. Thyroid hormone synthesis and its regulation, paradigms of thyroid hormone action in poikilotherms and homeotherms.	5
IV	A comparative account of parathyroid gland and ultimobranchial body/C cells, synthesis of parathyroid hormone, calcitonin and of vitamin D3; benthic organisms and source of vitamin D; hormonal regulation of calcium and phosphate homeostasis. , Hormonal control of feeding behaviour and gastrointestinal tract functioning including acid release, gall bladder contraction and relaxation, pancreatic enzyme secretion, and GI tract motility.	8
V	Pancreatic hormones and glucose homeostasis; hormones, vitellogenesis and the evolution of viviparity	5

S. No.	Particulars of practical
1	Dissection of retro-cerebral complex (endocrine system) in insects (e.g., cockroach/any other insect).
2	Effect of hormone mimic on the metamorphosis and other bio-characteristics of lepidopteran insect (e.g., *Spodoptera litura*). Dissection of endocrine system in crustaceans (neurohaemal organ).
3	Pituitary cytology: a comparative study following histology, histochemistry and immunocytochemistry.
4	Annelids (Earthworm brain/CNS).

Suggested books/readings

S. No	Title and authors	Publisher	Edition/Year
1.	**Gardner: Basic and Clinical Endocrinology** Francis. S. Greenspan & David G.	MC graw Hill Co	7th ed./ 2003
2.	**Review of medical physiology** William F. & Ganong, M.C.	Graw Hill companies	21st ed./2003
3.	**Text book of Medical Physiology** Guyton & Hall	Saunders Pb.	11th ed./ 2006

ZOO-524: LIMNOLOGY
(Semester II)

L+T+P:	2+0+1	Mid-Sessional exam	: 20
Credit:	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Limnology – Definition, Historical development and Scope of Limnology. Types of freshwater habitats and their ecosystem – Ponds, Streams and rivers. Lakes – Origin and classification. Morphometry – Use of various morphometric parameters and Zonation.	4
II	Physico – Chemical Characteristics. Light and Temperature-, (a) Light as an ecological parameter in freshwater. (b) Temperature- Radiation, Stratification and Heat Budget. Dissolved Solids – Carbonate, Bicarbonates, Phosphate and Nitrate., Physico – Chemical characteristics of freshwater with special reference to different parameters-Turbidity, dissolved gases (Oxygen, Carbon dioxide, Hydrogen Sulphide), Seasonal changes in dissolved gases and pH.,	6
III	Study of Biota, (a) Phytoplankton, Zooplankton and their inter-relationship., (b) Aquatic insects, birds and their environmental significance. Ecological classification of aquatic fauna, higher aquatic plants and their significance. Bioindicators- Aquatic flora and fauna in relation to water quality in an aquatic environment.	9
IV	Resource Conservation – Aquatic pollution, Causes, management and conservation; control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.	4
V	Use and misuse of inland waters, Methods of water quality testing BOD and COD. Sewage – Definition, composition and its treatment.	5

S. No.	Particulars of practical
1	To prepare and maintain a culture of *Paramecium*, *Daphnia* and *Hydra*.
2	Study of aquatic and semiaquatic adaptations in amphibians and reptiles.
3	Study of locomotory and respiratory adaptations in aquatic insects and their larvae.
4	Estimation of Chlorides in given sample of water.
5	Identification of commercially important freshwater fishes and crustaceans.
6	Study of Bioindicators of pollution by insects, rotifers, algae, diatoms.
7	Determinations of LC_{50} using fish/insect larvae for known pollutant like Heavy metal/any Pesticide/industrial effluent.
8	Water analysis with regadrs to hardness (Total and Calcium).
9	Visit to freshwater body for the study of aquatic ecosystem.

Suggested books/readings

S. No	Title and authors	Publisher	Edition/Year
1	**Textbook of Aquatic Ecology** Oakenfold, S.	Syrawood Publishing House, USA	2016
2	**Fresh Water Ecology: Principles & Application** Jafferies, M. & Mills, Q. D.	CBS Publishers, New Delhi.	1992
3	**Biology of Fresh Water** Maitland, P.S.	Published by Chapman and Hall., New York, USA	1990

BT- 507: PLANT AND ANIMAL BIOTECHNOLOGY
(Semester II)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Particulars	No. of lectures
I	Historical perspectives, laboratory organization and tissue culture media. Production of virus free plants by meristem culture and micropropagation of disease free plants, callus induction and plant regeneration, somatic embryos and synthetic seeds.	8
II	Protoplast isolation, culture and applications, somatic hybrids and cybrids and their applications in crop improvement. Somaclonal variation, production of haploid plants, embryo rescue and wide hybridization, cell suspension culture, production of secondary metabolites, biotransformation, cryopreservation.	9
III	Vectorless and vector mediated transformation, development of insect, herbicide, salt and drought resistant plants, edible vaccines, some successful examples (transgenic papaya, Bt cotton, flavr savr tomato, golden rice). Molecular markers and construction of maps, molecular breeding and DNA fingerprinting, genomics.	8
IV	Structure of animal cell and history of animal cell culture. Different types of culture media and cell cultures, development, characterization, maintenance and cryopreservation of cell lines, application of animal cell culture. In vitro fertilization, embryo transfer technology and animal cloning.	8
V	Stem cells- applications in medicine and tissue engineering, transgenic animals, methods and applications of transgenic animals.	7

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1.	**Textbook of Animal Biotechnology** Singh, B.	The Energy and Resources Institute (TERI)	1st ed./2005
2.	**Introduction To Plant Biotechnology** Chawla, H.S.	Oxford and IBH Publishing	3rd ed./2009
3.	**Biotechnology: Expanding Horizons** Singh, B.D.	Kalyani Publications	4th ed./2012

MICRO-524: MOLECULAR BIOLOGY AND GENETIC ENGINEERING
(Semester II)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Particulars	No. of lectures
I	Nucleic acids: structure of DNA, functions, replication, DNA damage and repair, isolation and sequencing. Transcription; types of RNA and their role in gene expression.	8
II	Translation; components involved, t-RNA as adapter, genetic code and its salient features. Regulation of gene expression: Operon theory, *lac* operon, *trp* operon, attenuation, positive and negative control, catabolite repression, regulation of transcription by cAMP and CRP.	10
III	Molecular cloning; techniques and their importance, cloning vectors; properties and uses of phage vectors. Plasmids, Cosmids and Phasmids.	8
IV	Cloning strategies: cloning of genomic DNA, cDNA cloning, selection and characterization of clones, gene probes, labeling.	8
V	PCR: principle, types and role in molecular biology,blotting techniques (Southern, northern and western blotting).	10

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1.	**Lewin's Genes X** Krebs, J., Goldstein, E. & Kilpatrick, S.	Jones & Bartlett Learning	10th ed. / 2011
2.	**Gene Cloning and DNA Analysis : An Introduction** Brown, T.A.	Wiley-Blackwell	6th ed. / 2010
3.	**Principles of Gene Manipulation and Genomics** Primrose, S.B. & Twyman, R.M.	Wiley-Blackwell	7th ed. / 2014
4.	**Molecular Biology and Biotechnology** Gupta, P.K.	Rastogi Publications	1st ed. / 2015

ZOO-525: INSECT AND ENVIRONMENT
(Semester II)

L+T+P:	2+0+1	Mid-Sessional exam	: 20
Credit:	3	Quiz +Assignment + Attnd	: 05
Contact Hours:	28+28	End-semester exam (Practical + Theory)	: 35+40

Units	Particulars	No. of lectures
I	Insects as manageable resource: Apiculture, Sericulture, Lac culture	5
II	Insects as biological control agent, insects as pollution indicator, insects as food, insects as scavengers, insects as pollinators.	5
III	Insects and their role in Pharmacy, insects and their role in forensic investigations, insects as vectors of human pathogens.	5
IV	Introduction to high altitude entomology.	5
V	Adaptations (Morphological, Ecological, Physiological) of Insects at high altitude.	4
VI	Origin of endemism in Insects at high altitude.	4

S. No.	Particulars of practical
1	To study the life history of honey bee.
2	To study the life history of lac insect
3	To study the life history of silk worm (*Bombyx mori*).
4	To study the life history of *Musca domestica* To study the wing venation in different insects.
5	To study the life history *Anopheles* / *Culex*
6	To study the different types of mouthparts in insects.
7	To study the genitalic features in insect.
8	Visit to apiary /vermicomposting unit and preparation of report

Suggested books/readings			
S. No.	**Title and authors**	**Publisher**	**Edition/Year**
1	**Insect Pest Management: Techniques for Environmental Protection** Rechcigl, J.E. & Rechcigl, N.A.	CRC Press Library Call	2000
2	**Insect Pest Management and Ecological Research** Walter, G. H.	Cambridge University Press	2003
3	**Economic Zoology** Shukla & Upadhaya	Rastogi Publications	2009
4	**Text Book of Applied Entomology** Srivastava, K.P.	Rastogi Publications	2005
5	**The Insects, an outline of Entomology** Gullan, P.J. and Cranston, P.	Blackwell Publishing Ltd., USA.	2005

ZOO-591*: PROJECT SEMINAR
(Semester II)

L:T:P:	:	**1+0+0**	Write-up	:	**25**
Credits:	:	**1**	Viva-voce	:	**25**
Contact hours	:	**14**	Presentation	:	**50**

Description
An advisor will be allocated to the students in the start of second semester by the Dean of the college. Students will be assigned the project work by their respective advisor. Students have to make a PowerPoint Presentation on the topic assigned to them which will be notified by the office of the Dean. The students will be evaluated by advisory committee members and faculty of the discipline and then average marks will be awarded to the student. Satisfactory grade will be awarded on securing minimum 60 marks out of 100. Four copies of the project work outline duly approved by the departmental committee will be submitted by the student in the office of Dean for its final approval before the start of the third semester.

The criteria of seminar evaluation proforma are given below:

Sr. No.	Evaluation Criteria	Max Marks
1.	Originality and creativity	15
2.	Organization and logical presentation of ideas	25
3.	Presentation (Oral presentation and delivery)	25
4.	Knowledge and familiarity with subject matter	15
5.	Quality and neatness of slides, charts and graphs	10
6.	Response to the questions/queries	10
Total		**100**

OR

ZOO-591*: SYNOPSIS SEMINAR
(Semester II)

L:T:P:	:	**1+0+0**	Write-up	:	**25**
Credits:	:	**1**	Viva-voce	:	**25**
Contact hours	:	**14**	Presentation	:	**50**

Description
The Major Advisor will be allocated to the students in the start of second semester by the Dean of the college. Students will be assigned the research topic by their respective advisor. Students have to make a PowerPoint Presentation on the research topic assigned to them which will be notified by the office of the Dean. The students will be evaluated by advisory committee members and faculty of the department/college and then average marks will be awarded to the student. Satisfactory grade will be awarded on securing minimum 60 marks out of 100. Four copies of the synopsis duly approved by the advisory committee will be submitted by the student in the office of Dean for its final approval before the start of the third semester.

The criteria of seminar evaluation proforma are given below:

Sr. No.	Evaluation Criteria	Max Marks
1.	Originality and creativity	15
2.	Organization and logical presentation of ideas	25
3.	Presentation (Oral presentation and delivery)	25
4.	Knowledge and familiarity with subject matter	15
5.	Quality and neatness of slides, charts and graphs	10
6.	Response to the questions/queries	10
Total		**100**

ZOO-531: CYTOGENETICS
(Semester III)

L+T+P:	3+0+1	Mid-Sessional exam	: 25
Credit:	4	Quiz +Assignment + Attnd	: 05
Contact Hours:	42+28	End-semester exam (Practical + Theory)	: 25+45

Units	Particulars	No. of lectures
I	Physical basis of heredity – Mendelism, interaction of genes, multiple alleles, chromosome structure and function in Eukaryotes (except in chemistry, models and concepts).	8
II	Polytene chromosomes, lampbrush chromosomes, Cell division, Mitosis & Meiosis, Sex determination- Sex chromosomes & sex chromatin, different types of sex mechanisms.	8
III	Chromosome changes - Structural aberrations and its significance. Numerical changes, polyploidy and its types.	8
IV	Nature of genes - Double helix structure of DNA, mechanisms of DNA replication. Changes in genes-Spontaneous mutations and induced Mutations, physical and chemical mutagens.	8
V	Linkage of genes, crossing over, sex linkage in Drosophila and man, criss-cross inheritance, colour blindness and haemophilia. Cytoplasmic inheritance. Human Genetics-Normal and abnormal karyotypes.	10

S. No.	Particulars of practical
1	Study of various stages of mitosis and meiosis from permanent stained slides.
2	Preparation of temporary mount of stained onion root tip by squash method to study stages of mitosis.
3	Stained preparation of chromosomes of onion flower buds to study stage of meiosis.
4	Study of permanent stained slides of giant chromosomes and Barr body.

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/ Year
1	**Principles of Genetics** Gardner, E.J., Simmons, M.J. & Snustad, D.P.	John Wiley & Sons	8th ed./ 2006
2	**Principles of Genetics** Snustad, D.P. & Simmons, M.J.	John Wiley and Sons Inc	5th ed./ 2009
3	**Concepts of Genetics** Klug, W.S., Cummings, M.R. & Spencer, C.A.	Benjamin Cummings	9th ed./ 2009
4	**Genetics- A Molecular Approach** Russell, P. J.	Benjamin Cummings	3rd ed./ 2009
5	**Molecular Biotechnology- Principles and Applications of recombinant DNA** Glick, B.R. & Pasternak, J.J.	ASM Press, Washington	2003

RM-599: RESEARCH METHODOLOGY
(Semester III)

L+T+P:	3+1+0	Mid-Sessional exam	: 30
Credit:	4	Quiz +Assignment + Attnd	: 10
Contact Hours:	42+14	End-semester exam	: 60

Units	Particulars	Lectures + Tutorials
I	Research: need, importance, types of research -fundamental v/s applied and impact of research. Research prioritization – objectives, process of research. Qualitative and quantitative research. Ethics with respect to science and research. Committee on Publication Ethics (COPE). Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals.	10+3
II	Qualities of a good research worker. Research as career, current status and future prospects of research. Process of selecting research problem; survey of literature; allied and critical literature, research infrastructure. Good Laboratory Practicals (GLPs). Sampling design; types of sampling & their advantages/disadvantages, recording of observations; measurement and scaling techniques.	7+2
III	Measures of central tendencies and relationships, sources and collection of primary & secondary data, storage and analysis of data. Pie chart, histogram and figures plotting. Formulation and types of hypotheses & their testing. Chi ($\chi 2$) test, Z - test, t- test, F-test. Correlation, rank correlation and regression analysis, ANOVA- test of significance and error analysis. Absolute error, relative error, percentage error.	10+4
IV	Computer and informatics: Introduction, word processing, excel, power point presentation. Information resources and various databases. Introduction to statistical software(s). LATEX. Impact factor and indexing data base. Different search engines in Library for research articles. Web of science, web browsing. Scopus organization of reference material using endnote; bibliography. Scientific misconduct: Falsification, fabrication and plagiarism (FFP), IPR and patent application. Entrepreneurship.	7+2
V	Selecting research problem and preparation of synopsis as per guidelines of university. Research paper and thesis writing. Compilation and presentation of results, writing & publication of research paper. Multidisciplinary and multi-institutional research; writing research proposal for external funding. Demonstration of departmental research activities through pictures, charts, research project reports and instrumentation. PG scholarship funding agencies Govt. of India. Post Doctoral Fellowships (PDFs).	9+3

Suggested books/readings

1. Gupta D. D, A.M. Moon and M.K. Gupta. An Outline of Statistical Theory (Vol. I/II).
2. Gupta S.P. Statistical Methods. Sultan Chand Publications.
3. Gurumani N. Research Methodology: For Biological Sciences. MJP Publisher.
4. Kothari C.R. Research Methodology: Methods and Techniques. New Age International.
5. Kothari C.R.and K.F. Hatt. Methods in Social Research.
6. Kumar Pranesh, Daroga Singh and Padam Singh. Handbook of Sampling. IASRI Publications.
7. Kumar R. Research Methodology: A Step-by-Step Guide for Beginners. Sage Publications Limited.
8. Laake P, Benestad HB, Olsen BR, (Editors). Research Methodology in the Medical and Biological Sciences. Academic Press.
9. Murthy C. Research Methodology, Vrinda Publication Pvt. Ltd. New Delhi.
10. Sharma Jai Narain. Research Methodology. Deep & Deep Publications.

ZOO-532: TOOLS AND TECHNIQUES IN BIOLOGY
(Semester III)

L+T+P:	3+0+1	Mid-Sessional exam	: 25
Credit:	4	Quiz +Assignment + Attnd	: 05
Contact Hours:	42+28	End-semester exam (Practical + Theory)	: 25+45

Units	Particulars	No. of lectures
I	Microsocopy, principle & applications, Light microscope and phase contrast microscope, Fluorescence microscope, Electron microscope, Confocal microscopy. General Principle and applications of Colorimeter, Spectrophotometer, Ultra centrifuge, Flame photometer, Beer and Lambert's law.	8
II	Histological techniques: Principles of tissue fixation, Microtomy, Staining, Mounting, Histochemistry.	7
III	Cryotechniques, Cryopreservation of cells, tissues, organs and organisms. Cryosurgery, Cryotomy, Freeze fracture and freeze drying. Separation techniques. Chromatography, principle type and applicants. Electrophoresis, Principles, types and applications PAGE and agarose gel electrophoresis. Polymerase chain reaction (PCR). Organelle separation by centrifugation. Radioisotope and main isotope techniques in biology, Sample preparation for radioactive counting, Autoradiography, Immunological techniques, Immunodiffusion (Single & Double), Immuno electrophoresis.	7
IV	Techniques 20mmune detection: Immunocyto/ histochemistry, Immunoblotting, immunodetection, immunofluroscence. Surgical techniques: Organ ablation (eg. Ovariactomy, adrenalectomy) – Perfusion techniques, Stereotaxy, Indwelling cathethers, Biosensors.	7
V	Microbial assays- Microbial identification (cytological staining methods for bacterial and fungal strains) –Use of fermenters, Cell culture, media preparation and sterilization, Inoculation and growth monitoring. Design and functioning of tissue culture laboratory, Culture media, essential components and Preparation, Cell viability testing and	7
VI	Computer aided techniques for data presentation data analysis, statistical techniques.	6

S. No.	Particulars of practical
1	Spectrophotometer – Estimation of biomolecules.
2	Centrifugation – Demonstration and working.
3	Separation Techniques - Paper chromatography.
4	Electrophoresis – Demonstration and usage.
5	Demonstration and working of a) Atomic Absorption Spectrophotometer b) High Pressure Liquid Chromatography c) ELISA Reader, d) Liquid Scintillation counter. pH meter-Prep. of Phosphate buffer.
6	Microscope – a) Demonstration of oil immersion – WBC & RBC b) Preparation of tissue for SEM & TEM procedure.
7	Biological application of computer techniques.
8	Cell culture - a) Preparation of media b) Inoculation.

Suggested books/readings

S. No	Title and authors	Publisher	Edition/Year
1	**Experimental Biochemistry** Clark Jr, J.M., Switzer, R.L. & Garrity, L.	W. H. Freeman & Co. Ltd	3rd ed./1999
2	**Modern Experimental Biochemistry** Boyer, R.F.	Dorling Kindersley Pvt. Ltd.	3rd ed./2002
3	**The Cell-A Molecular Approach by** Cooper, G.M.	Oxford University	6th ed./2013

BT-505: COMPUTATIONAL BIOLOGY & BIOSTATISTICS
(Semester III)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Particulars	Lectures
I	Introduction and definition of biostatistics, concept of variables in biological systems, collection, classification, tabulation, graphical and diagrammatic representation of numerical data, measure of central tendency, measure of dispersion, correlation and regression, linear and quadratic regressions, concept of standard errors. Hypothesis testing (null & alternative hypothesis).	8
II	Test of significance based on Z, χ2, t and F statistics, correlation and regression, curve fitting by least squares methods.	7
III	Introduction, biological and chemical databases- Database models, storage, mining and retrieval, Laboratory Information management systems (LIMS) .	5
IV	Protein and gene information resources- PIR, SWISSPROT, PDB, Genebank, DDBJ, protein structures and drug discovery.	5
V	Introduction to sequence comparison, global and multiple sequence alignment, multiple sequence alignment using FASTA, sequence alignment using CLUSTAL W, BLAST and PSI BLAST, Use of sequences to determine phylogenetic relationship.	7
VI	DNA microarrays, databases, data management cluster analysis.	3
VII	Gene finding algorithms and softwares, Hidden Markov Models (HMM), annotation of genomic and protein sequences prediction of protein secondary and tertiary structures.	4
VIII	Protein-Protein interactions, proteomics, protein microarrays chips and data analysis.	3

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1.	**Bioinformatics-Sequence, Structure and Databanks** Higgins, D. & Taylor, W.	Oxford University Press	2003
2.	**Bioinformatics – Managing Scientific Data** Lacroix, Z. & Critchlow, T.	Morgan Kaufmann Publishers	2003
3.	**Structural Bioinformatics** Bourne, E.P. & Weissig, H.	John Wiley and Sons	2003
4	**Fundamentals of Biostatistics** Rosner, B.	Thomson and Brooks/Cole	2006
5	**Methods in Biostatistics** Mahajan, B.K.	Jaypee Publishers	2002

ZOO-534: PARASITOLOGY
(Semester III)

L+T+P:	3+0+1	Mid-Sessional exam	: 25
Credit:	4	Quiz +Assignment + Attnd	: 05
Contact Hours:	42+28	End-semester exam (Practical + Theory)	: 25+45

Units	Particulars	No. of lectures
I	Protozology: Brief history of protozology, ecology and host parasite relationship (parasitism and symbiosis): Basis of host cell parasite interactions with special reference to autoimmune response and pathogenesis of protozoan diseases in general, zoonotic potentiality of protozoa.	10
II	Morphology, life cycle, pathology, symptomatology, laboratory diagnosis and treatment of following: *Amoeba*: Nonpathogenic and pathogenic *Giardia* (*G. lamblia*) (a) Blood flagellates: *Leishmania* and *Trypanosoma*. (b) Flagellates of gential tract: *Trichonmonas* (*T. tenax, T. hominis T. vaginalis*). (c) Malaria parasite (*Plasmodium vivax*, *P. falciparum, P. malariae, P. ovale*) general life cycle of malarial parasite in man and *Anopheles* mosquite, sequalae of malaria.	15
III	Morphology, life cycle, pathology, symptomatology, laboratory diagnosis and treatment of following: (a) *Toxoplasma gondi* and (b) *Cryptosporadium parvum.*	6
IV	Helminthology: General introduction of helminths their classification and medical importance:- Trematodes: *Fasciola hepatica, Schistosoma haematobium, S. japonicum* and *S. manosnii.* Cestodes: *Taneia solium*, *T. saginata* and *Echinococcus granulosis.* Nematodes: *Ascaris lumbricoides, Ancylostome duodenale, Strongyloides stercoralis, Enterobius, Wuchereria bancrofti, Brugia malayi* and *Dracanculus medinensis.*	15
V	Medical Entomology: - Role of arthropods in the spread and causation of parasitic disease. Classification and general characteristics of important insect vectors. Mode of transmission of various diseases.	10

S. No.	Particulars of practical
1	Methods of collection, preservation and identification of protozoan and helminth parasites and arthropod vectors.
2	Diagnosis of parasitic infections - conventional and immunological methods.

Suggested books/readings

S. No	Title and authors	Publisher	Edition/Year
1	**Parasitology** Chatterjee, K.D	Chatterjee Medical Publisher	1st ed./ 1995
2	**Parasitology and Vector Biology** Marquardt, W.C. Demaree, R.S. & Gruieve, B.	Harcort A.P.	1st ed. / 2000
3	**Medical Parasitology** Arora, D.R and Arora, B.	CBS Publications and Distributers	3rd. ed./ 2001
4	**Preventive and social medicine** Park, K	B.B Publisher.	16th ed./ 2007
5	**General Parasitology** Cheng, T.C.	Academic Press	2nd ed./ 2012

ZOO- 535: ENTOMOLOGY
(Semester III)

L+T+P:	3+0+1	Mid-Sessional exam	: 25
Credit:	4	Quiz +Assignment + Attnd	: 05
Contact Hours:	42+28	End-semester exam (Practical + Theory)	: 25+45

Units	Particulars	No. of lectures
I	History of entomology in India. Factors for insect's abundance. Classification of phylum arthropoda upto classes. Relationship of class insecta with other classes of arthropoda.	10
II	Morphology: Structure and functions of insect cuticle and moulting. Body segmentation, structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts and legs. Wing venation, modifications and wing coupling apparatus. Structure of male and female genetalia.	10
III	Sensory organs. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (endocrine) and reproductive system in insects. Types of reproduction in insects.	9
IV	Systematics: Taxonomy, importance, history, development and binomial nomenclature. Definitions of biotype, sub-species, species, genus, family and order.	10
V	General characters of class –Insecta and classification upto orders.	5

S. No.	Particulars of practical
1	Methods of collection and preservation of insects including immature stages.
2	External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus.
3	Types of insect larvae and pupae.
4	Dissection of digestive system & reproductive system in insects (Grasshopper).
5	Study of characters of orders orthoptera, dictyoptera, odonata, Isoptera, thysanoptera, hemiptera, lepidoptera, neuroptera, coleoptera, hymenoptera, diptera and their families of agricultural importance

Suggested books/readings

S. No	Title and authors	Publisher	Edition/Year
1	**The Insects: Structure and Function** Chapman, R.F.	Edward Arnold Publishing Limited , London	5th ed./2013
2	**An Introduction to Entomology** Srivastava, P.D. & Singh, R.P.	Concept Publishing Company, New Delhi	1st ed./1997
3	**Introduction to General and Applied Entomology** Awasthy V.B	ELBS, London	3rd ed./2009
4	**Principles of Insect Morphology** Snodgrass R.E	CBS Publishers & Distributors Pvt. Ltd., New Delhi	3rd ed./2004

ZOO- 536: CREDIT SEMINAR
(Semester III)

L:T:P:	:	**1+0+0**	Write-up	:	**25**
Credits:	:	**1**	Viva-voce	:	**25**
Contact hours	:	**14**	Presentation	:	**50**

Description
The course covers the current and emerging concepts in various sub-disciplines of basic and applied Zoology. Class teacher/Course Instructor will be allocated to the students in the start of the semester and the topics will be assigned to each student by the class teacher. Students will collect the information (research articles, reviews, books, thesis etc.) related to assigned topic and will submit the printed copy of the assignment/topic to the class teacher. Students will have to make a powerpoint presentation on the topic as notified by concerned Incharge/HOD/Dean well in advance. The seminar should be delivered before the commencement of end-term examination. The students will be evaluated by three faculty members and then average marks will be awarded to the student.

The criteria of seminar evaluation proforma are as given below:

Sr. No.	Evaluation Criteria	Max Marks
1.	Originality and creativity	15
2.	Organization and logical presentation of ideas	25
3.	Presentation (Oral presentation and delivery)	25
4.	Knowledge and familiarity with subject matter	15
5.	Quality and neatness of slides, charts and graphs	10
6.	Response to the questions/queries	10
Total		**100**

Result of Credit Seminar (marks out of 100) will be submitted along with necessary documents to the Controller of Examinations office for declaration of the semester result.

ZOO-541*: INSECT DIVERSITY AND PHYSIOLOGY
(Semester IV)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Contents	Lectures
I	Insect Diversity: An introduction to insect classification including historical development, basis of insect classification; Classification of insect's upto orders with focus on local examples. Newer trends in insect taxonomy.	5
II	Insect Morpohology:- Comparative morphology of head, thorax, abdomen and their appendages. Functional morphology of mouth parts and genitalia.	5
III	Anatomy and Physiology: Anatomy and elementary physiology of the following systems of Insects: Integumentary system, Digestive system, Excretory system, Respiratory system, Nervous system and Reproductive system.	5
IV	Receptors and Stridulatory organs: Insects growth and metamorphosis. Insect pheromones and diapause.	4
V	Insects of commercial Importance and their culture; Honeybees, Silkworm and Lac insect.	5
VI	Insects as vectors of human diseases, Insects in the service of Forensic Science. Brief idea about chemical and biological control of insect pests.	4

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Modern Text Book of Zoology: Invertebrates** Kotpal, R.L.	Rastogi Publications	12th ed. / 2019
2	**Modern Text Book of Zoology: Vertebrates** Kotpal, R.L.	Rastogi Publications	12h ed. / 2019
3	**A Textbook of Zoology** Dhami, P.S. & Dhami J.K.	Pradeep Publications	29th ed. / 2017
4	**Essentials of Animal Physiology** Rastogi, S.C.	New Age International	4th ed. / 2019
5	**The Insects: Structure and Function** Chapman, R.F.	Edward Arnold Publishing Limited , London	5th ed./2013

ZOO-542*: BIOLOGY OF PARASITES
(Semester IV)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Contents	Lectures
I	General introduction, origin and evolution of parasitism. Morphology, life cycle, pathogenicity and prophylaxis of Protozoan parasites: *Leshmania* sp., *Trypanosoma* sp., *Plasmodium* sp., *Balantidium* sp. and *Eimeria* sp.	10
II	Morphology, life cycle, pathogenicity and prophylaxis of Trematode parasites: *Fasciola* sp., *Fasciolopsis* sp., *Dicrocoelium* sp., *Paragonimus* sp., *Schistomoma* spp., *Clonorchis* sp. and *Polystoma* sp.	11
III	Morphology, life cycle, pathogenicity and prophylaxis of Cestode parasites:- *Taenia solium*, *Diphyllobothrium* sp., *Echinococcus* sp., *Hymenolepls* sp. and *Dipylidium* sp.	11
IV	Morphology, life cycle, pathgenicity and prophylaxis of Nematode parasites:- *Ascaris* sp., *Trichinella* sp., *Enterobius* sp., *Stronglyoides* sp., *Necator* sp., *Ancylostomia* sp. and *Wuchereria* sp.	10

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Modern Text Book of Zoology: Invertebrates** Kotpal, R.L.	Rastogi Publications	12th ed. / 2019
2	**A Textbook of Zoology** Dhami, P.S. & Dhami, J.K.	Pradeep Publications	29th ed. / 2017
3	**Essentials of Animal Physiology** Rastogi, S.C.	New Age International	4th ed. / 2019
4	**Parasitology** Chatterjee, K.D	Chatterjee Medical Publisher	1st ed./ 1995
5	**Parasitology and Vector Biology** Marquardt, W.C. Demaree, R.S. & Gruieve, B.	Harcort A.P.	1st ed. / 2000

ZOO-543*: ANIMAL PHYSIOLOGY
(Semester IV)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Contents	Lectures
I	Digestive system: Types of nutrition, Feeding mechanism, Digestion of dietary constituents, Gut movements, Regulation of digestive processes and absorption.	4
II	Respiratory system: Respiratory tract, transport of O2 and CO2, oxygen dissociation curve of haemoglobin, Bohr effect, Haldane shift and Chloride shift.	5
III	Excretory system: Kidney structure, Juxtaglomerular apparatus, urine formation and Renin angiotensin system.	6
IV	Circulatory system: Origin and conduction of heart beat, cardiac cycle, cardiac output, blood pressure and micro-circulation. Blood: Composition and functions of blood, haematopoiesis, blood groups and Rh factor, structure of haemoglobin, lymph and lymphatic system.	4
V	Musclular system: Ultra structure of skeletal muscle, contractile proteins, mechanism of muscle contraction, isotonic and isometric contraction, tetanic contractions and fatigue.	5
VI	Neural integration: Structure of neuron, resting membrane potential, action potential, Na+-K+ transport system, origin and propagation of nerve impulse, neurotransmitters, structure of chemical synapse, myoneural junction and saltatory conduction.	4

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Modern Text Book of Zoology: Invertebrates** Kotpal, R.L.	Rastogi Publications	12th ed. / 2019
2	**Modern Text Book of Zoology: Vertebrates** Kotpal, R.L.	Rastogi Publications	12h ed. / 2019
3	**A Textbook of Zoology** Dhami, P.S. & Dhami, J.K.	Pradeep Publications	29th ed. / 2017
4	**Essentials of Animal Physiology** Rastogi, S.C.	New Age International	4th ed. / 2019
5	**Textbook of Medical Physiology** Guyton & Hall	Elsevier	14th ed./ 2020

ZOO-544*: ANIMAL BEHAVIOUR
(Semester IV)

L+T+P:	3+0+0	Mid-Sessional exam	: 30
Credit:	3	Quiz +Assignment + Attnd	: 10
Contact Hours:	42	End-semester exam	: 60

Units	Contents	Lectures
I	Animal Psychology: Classification of behavioral patterns, analysis of behaviour (ethogram) and innate behaviour.	6
II	Behavioral Genetics: Genes and behavior, evaluation of behavior and co-evolution. Control of behaviour: Neural and hormonal.	6
III	Communication: Chemical, visual, audio and evolution of language (primates).	6
IV	Social Behaviour: Aggregation, schooling in fishes, flocking in birds, group selection, kin selection, altruism, social organization in insects and primates.	6
V	Reproductive Behaviour: Mating systems, courtship, sperm competition, parental care. Biological rhythms: Circadian and circeannual rhythms, orientation and navigation. Migration of fishes, birds and butterflies.	6
VI	Learning and memory: Insight learning, association learning, reasoning and cognitive skills.	5

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Animal Behaviour** Mathur, R.	Rastogi Publications	6th ed. / 2018
2	**Animal Behaviour** Agarwal, V.K.	S. Chand Limited	13th ed. / 2018
3	**Animal Behaviour and Evolutionary Prospective** Kappeler, P.M.	Springer	1st ed. / 2020

ZOO-545*: WILD LIFE AND ITS MANAGEMENT
(Semester IV)

L+T+P:	3+0+1	Mid-Sessional exam	: 25
Credit:	4	Quiz +Assignment + Attnd	: 05
Contact Hours:	42+28	End-semester exam (Practical + Theory)	: 25+45

Units	Contents	Lectures
I	Introduction to wild life. Wild life management principles: Food, cover, predators and diseases. Important wild animals of India (mammals and birds).	5
II	Factors important in wild life management: Water, soil and exotic animals.	5
III	Wild life protection act: Hunting of wild animals. Sanctuaries and National parks. Central Zoo authority. Trade in wild animals.	6
IV	Conservation biology, Conflict between man and wild life. Wild life conservation projects of India. Modern Practicals in wild life conservation.	6
V	Concept of sustainability: Sustainable development and Sustainable Development Goals (SDGs).	5

Practical	Practical description
1	To deliver a seminar on a topic related to wild life conservation.
2	To submit an assignment on a topic concerning wild life in India.
3	To prepare a report on the latest events concerning wild animals at the National and International level.
4	To observe the behaviour of one wild animal and to write a report on it.
5	To visit a wild life National Park and to submit a report on it.

Suggested books/readings

S. No.	Title and authors	Publisher	Edition/Year
1	**Textbook of Wildlife Management** Singh, S.K.	International Book Distributing Company	2nd ed. / 2005
2	**Wildlife Habitat Management** Mccomb, B.C.	CRC press	3rd ed. / 2007
3	**Wildlife Ecology Conservation and Management** Sinclair, A.R.E. & Fryxell, J.M.	Wiley	1st ed. / 2009

ZOO-500*: PROJECT WORK
(Semester IV)

L+T+P: 0+0+10
Credit: 10
Contact hours: 280

Objectives:
This course is designed to provide practical exposure to the students about ongoing research in basic and applied areas of Zoology and different research techniques and methods. It will impart skills on planning, performing, analyzing and data interpretation of experiments. Students will also acquire proficiency in reading research articles, preparing PowerPoint presentations and giving oral presentations.

Guidelines:

1. In the second semester, student will be given an orientation about the aim and objectives of the project work. The student will develop the outline of the project work for approval by Advisor, HoD of respective department and the Dean of the college.

2. The student will perform the assigned project work in the fourth semester under the supervision of the assigned Advisor.

3. The student will prepare the final project work report and will submit to the Dean of the College through HoD of department.

4. The student will make a presentation at Department/College level before the Evaluation Committee comprising of faculty members of the department and/or other allied departments of the college.

5. The student will submit five hard copies of the report in spiral-bound / comb-bound form along with the soft copy to the Advisor.

6. The final result of student either as **Satisfactory** or **Unsatisfactory** will be submitted to the office of Controller of Examinations by the Advisor. Satisfactory grade will be awarded on securing minimum 60% marks as per evaluation criteria mentioned below:

Marks given by Advisor: 40 marks

S/N	Particulars	Marks
(a)	Attendance	**10**
(b)	Experimental work performance	**10**
(c)	Data presentation and quality	**10**
(d)	Data analysis and interpretation	**10**

Marks given by Evaluation Committee: 60 marks

S/N	Particulars	Marks
(e)	Evaluation of submitted project report	**30**
(f)	Presentation of project report	**20**
(g)	Response to the questions	**10**

Note: To get satisfactory grade in the Project Work course, the student must obtain minimum 60% marks.

ZOO-600*: THESIS
(Semester IV)

L+T+P:	0+0+20
Credit:	20
Contact hours:	560

Description

Students are required to start working on their thesis during semester III and will finish the assigned research work in semester IV. Students will work on a research topic assigned to them by their Major Advisor with a purpose to develop a collective approach to study, analyze and solve the problem. Students are required to submit their thesis in hard-bound form at the end of the semester.

Thesis will be forwarded by the Dean of the College to one of the external expert/examiner out of the panel of experts submitted by the major advisor. The suggestions made by the external expert will be incorporated in the thesis by the student and five hard copies will be submitted in the office of Dean. Thereafter, the Dean of the College will arrange internal viva-voce examination to be conducted by the advisory committee of the student under the chairmanship of the Dean. Result of viva-voce in **Satisfactory** or **Unsatisfactory** form will be submitted along with necessary documents to the Controller of Examinations office for declaration of the result.

Suggested Journals/Resources/Databases

Research journals

- Nature
- Annual Review of Animal Biosciences
- Frontiers in Zoology
- Journal of Nematology
- Indian Journal of Experimental Biology
- Current Science
- PLOS One
- Journal of Plant protection
- Indian Journal of Nematology
- Journal of Applied Biology and Biotechnology
- Annual Review of Entomology
- Biocontrol
- Biological Control
- Crop Protection
- Egyptian Journal of Biological Pest Control
- Zootaxa
- Annual Review of Animal Biosciences
- Journal of Entomology and Zoology Studies
- Indian Journal of Fisheries
- Journal of Asia Pacific Entomology
- Journal of Entomology
- Plant Science Today

Research databases

- Pubmed/Medline
- ScienceDirect
- J-stage
- SpringerLink
- IngentaConnect
- Google Scholar
- Current Contents
- Scopus
- Biological Abstracts

Examination Evaluation Scheme
&
Tentative Marks Distribution

CREDITS L+T+P	THEORY			PRACTICALS		
	Total	Mid-Sessional	End Term	Total	Mid-Sessional	End Term
1+0+0 **2+0+0** **3+0+0** **4+0+0** **5+0+0** **6+0+0**	100	40 (30+10#)	60	-	-	-
0+0+1	0	0	0	100	50	50
1+0+1	50	20 (15+5#)	30	50	-	50
2+0+1	65	25 (20+5)	40	35	-	35
3+0+1	75	30 (25+5)	45	25	-	25
4+0+1	80	35 (30+5)	45	20	-	20
0+0+2	0	0	0	100	50	50
1+0+2	35	15 (10+5#)	20	65	-	65
2+0+2	50	20 (15+5)	30	50	-	50
3+0+2	60	25 (20+5)	35	40	-	40
0+0+3	0	0	0	100	50	50

#Assignment