FACULTY OF LIFE SCIENCES

Syllabus

For

M. Sc. ZOOLOGY

(SEMESTER : I - IV)
(FOR COLLEGES)

Examinations : 2012–13

Guru Nanak Dev University
Amritsar

.

Eligibility for Admission :

The eligibility for admission to M.Sc. in Life Science Course (Botany, Fermentation & Microbial Technology, Human Genetics, Microbiology, Molecular Biology & Biochemistry, Zoology).

The candidates having passed B.Sc. degree (10+2+3) in any science subject (any combination) with atleast 50% marks from this University or any other examination recognized equivalent thereto by the University.

Note : DETAILED ORDINANCES RELATING TO EXAMINATION FOR THIS CLASS ARE CONTAINED IN THE GURU NANAK DEV UNIVERSITY CALENDAR, VOL.-II. READ WITH SYNDICATE DECISIONS / AMENDMENTS MADE FROM TIME TO TIME.

Scheme of Course

Semester–I

Course No.	***Title***	***Credit hrs***	**Marks**		
			Theory	***Practical***	***Total***
ZooC- 501	Functional Organization of Animals – I	**6**	100	-	100
ZooC- 502	Animal Ecology	**6**	100	-	100
ZooC- 503	Cell Biology	**6**	100	-	100
ZooC- 504	Computer Programming & Data Processing	**3**	50	-	50
ZooC-551	Practical- I (F.O.A. -I)	**3**	-	50	50
ZooC-552	Practical- II (Ecology &Cell Biology)	**3**	-	50	50
Total		27	**350**	**100**	**450**

Semester–II

Course No.	***Title***	***Credit hrs***	**Marks**		
			Theory	***Practical***	***Total***
ZooC-601	Functional Organization of Animals- II	**6**	100	-	100
ZooC-602	Applied Zoology I (Invertebrates	**4.5**	75	-	75
ZooC-603	Evolution	**3**	50	-	50
ZooC-604	Seminar	**2**	50	-	50
ZooC-605	Biostatistics	**3**	50		50
ZooC-651	(Practical- III F.O.A.-II)	**3**	-	50	50
ZooC-652	Practical-IV(Evolution & Applied Zoology-I)	**3**	-	50	50
Total		**24.5**	**325**	**100**	**425**

Semester–III

Course No.	***Title***	***Credit hrs***	**Marks**		
			Theory	***Practical***	***Total***
ZooC- 701	Functional Organization of Animals – III	**6**	100	-	100
ZooC- 702	Developmental Biology	**6**	100	-	100
ZooC- 703	General Biochemistry	**6**	100	-	100
ZooC- 704	Applied Zoology-II (Vertebrates)	**4.5**	75	-	75
ZooC- 751	Practical -V (F.O.A.-III & Applied Zool. II)	**3**	-	50	50
ZooC-752	Practical VI (Developmental Biology &Biochemistry)	**3**	-	50	50
Total		**28.5**	**375**	**100**	**475**

Semester–IV

Course No.	***Title***	***Credit hrs***	**Marks**		
			Theory	***Practical***	***Total***
ZooC- 801	Animal Behaviour and Wildlife conservation	**6**	100	-	100
ZooC- 802	Genetics	**6**	100	-	100
ZooC- 803	Concepts of Immunology	**6**	100	-	100
ZooC- 804	Biosystematics	**3**	50	-	50
ZooC- 851	Practical -VII (Behaviour and Wildlife)	**3**	-	50	50
ZooC- 852	Practical VIII (Genetics & Biosystematics)	**3**	-	50	50
Total		**27**	**350**	**100**	**450**

ZooC– 501: FUNCTIONAL ORGANIZATION OF ANIMALS– I

Examination Time: 3hrs **Max. Marks: 100**

Instructions to the Paper Setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 20 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and its answers should not exceed 6 pages.

Unit - I

Integumentary system

Embryonic origin
General features of the Integument
Phylogeny
Specializations of integument

Unit –II

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.

Unit – III

Transport and circulatory mechanisms

Intracellular transport in Protozoa.
Circulation of external medium of transport within the body of sponges and cnidarians.
Open and closed types of circulatory system. Lymph channels in animals
Characteristics of chordate's cardiac muscle.
Chambered, tubular and ampullary hearts, neurogenic and myogenic hearts.

Unit – IV

Evolution of Skin
Evolution of Respiratory Organs
Evolution of Heart and Cardiovascular system

Suggested Reading Material.

Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.

Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.

Brusca, R. C. and Brusca, G. J. (2003), Invertebrates second edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.

Cooper, G. M. (2004), The Cell: A Molecular Approach IIIrd edition, ASM Press, Washington, D.C.

Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed.) Macmillan, New York.

Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.

Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.

Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.

Karp, G.(2005), Cell and Molecular Biology; concepts and experiments (4^{th} ed.),Hoboken, John Willy and Sons, New York.

Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate Zoology 3^{rd} Ed. Oxford University Press, New York.

Pechenik, A. Jan. (2000), Biology of the invertebrates, Fourth Edition, McGraw HillBook Co. Singapore.

Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books seller & Publishers, Agra.

Purves, W. K., Oriane, G. H., Space, H. C. and Salava, D. (2001), Life – The Science of Biology 6^{th} ed., Sinauer Assoc. Inc., USA.

Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.

Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate Zoology 7^{th} ed. Saunders Publ., Philadelphia.

Willmer, P. . Stone, G. and Johnston, I (2000). Environmental Physiology of Animals, Blackwell Science.

Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, New York.

ZOOC – 502 ANIMAL ECOLOGY

Examination Time: 3hrs **Max. Marks: 100**

Instructions for the Paper Setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 20 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and its answers should not exceed 6 pages.

Unit – I

Introduction and history of Ecology

Structure and Functions of some special types of ecosystems (Grasslands, forests, deserts and aquatic ecosystems)**.**

Weather

Temperature, Moisture, Light, fire, Malentite, pollution

Unit – II

Analysis of Environment

Resource

Food, its distribution, relative and absolute shortages

Place in which to live

Community structure

Population, Ecological Niche, Food chains, Food webs, biomagnifications, succession / temporal changes.

Interactions and Coactions

Between animals of same kind

Between animals of different kind

Predation, Parasitism, Commensalism, Mutualism etc.

Unit- III

Adaptations

Cave, deep sea, arboreal, aerial, and subterrestrial.

Co-adaptations and adaptive resemblances (mimicry, warning colouration, seasonal polymorphism)

Population Ecology

Concept of Population

Biotic potential and carrying capacity, dispersal and distribution, population growth and its regulations

Methods of sampling

Life tables and longevity.

Migration and Ecesis.

Unit – IV

Applied Ecology

Anthropogenic interferences

Bio monitoring of environment using animal species

"Modeling and Use of remote sensing (GIS) in ecology (introduction)".

Ecological basis of pest regulation (in brief)

Bio Geography

Zoo Geographical regions

Island ecology. (endemicity)

Suggested Readings:

Anderwartha, H.G. and Birch, L. C. (1970), The distribution and abundance of animals, University of Chicago Press, Chicago London.

Beeby, A. (1992), Applying Ecology Chapman and Hall Madras.

Begon, M., Harper J. L. and Townsend, C. R. (1995), Ecology – Individuals, populations and communities, Blackwell Science, Cambridge UK.

Brewer, R. (1994), The science of Ecology, Saunders College of Publishing, New York.

Chapman, J. L. and Resis, M. J. (1995), Ecology- Principles and applications, Cambridge University Press, Cambridge UK.

Kaeighs, S. C. (1974), Ecology with special references to animal and Man, Prentice Hall Inc.

Odum, E. P. (1983), Basic Ecology.

Putmann, R. J. and Wratten, S. D. (1984), Principles of Ecology, Crown Helm, London.

Salanki, J., Jeffery E. and Hughes G. M. (1994), Biological Monitoring of the Environment (A manual of Methods) CAB International, Wallingford UK.

ZooC – 503 CELL BIOLOGY

Examination Time: 3hrs **Max. Marks: 100**

Instructions for the Paper Setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 20 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and its answers should not exceed 6 pages.

Unit-I

Introduction

Cell – a unit of structure and function, cell theory.

General properties of the cell

Size, shape, number, life span and death.
Cell types: Prokaryotes and eukaryotes
Stem cells.

Organization of prokaryote cell

Mycoplasma, Bacteria, Cyanobacteria (Blue Green Algae). Structure and importance of their study.

From Prokaryotes to Eukaryotes

Events leading to origin of eukaryotic cells. Endo symbiotic theory and recent views.

Structure of cell membrane

General properties of cell membrane, chemical composition.
The concept of unit membrane.
Various Lipoprotein models including fluid mosaic model.

Unit – II

Golgi complex

Structure and Function of : Cisternae, vacuoles and vesicles.
Functions
Role in secretion, cell wall formation, packaging of intracellular products and other functions
GERL concept.

Mitochondria

Elaboration of the plasma membrane and multi enzyme complex, outer and inner membranes, cristae, matrix, inner and outer compartments,
Location of enzyme complexes of TCA cycle (and ATP generation)
Electron transport chain, semi autonomous nature (mitochondrial DNA, RNA, ribosomes and protein synthesis)

Endoplasmic Reticulum
Extension of cell membrane, cisternae, Site of location
Compartmentalization of enzymes and metabolites and their associated functions.

Unit – III

Ribosomes
A complex of ribonucleoprotiens,
Dynamics of association - disassociation of ribosomes into polysomes, microsomes,
Site of protein synthesis (initiation, elongation, translocation and termination phases of protein synthesis)
Central dogma.

Lysosomes
Polymorphic single membrane structure, site of proteolytic activity for intracellular digestion
Phagocytosis, increase in lysosomal activity with age
Lipofuscin pigments, diseases associated with lysosomes.

Peroxisomes and glyoxisomes
Single membrane structure; site of enzyme complexes involved in hydrogen peroxide, metabolism, gluconeogenesis (conversion of non carbohydrate into carbohydrates)
Glyoxylate pathway, microperoxisomes.

Cytoskeleton
Actin filament, Myosin, Intermediate filament, microtubules.

Unit – IV

Cell surface modifications
Glycocalyx, villi, microvilli, caveolae.

Cytoplasmic inclusions
Inert storage materials, glycogen, starch, lipids, metabolic crystals

Nucleus
Nuclear membrane, pores, chromatin, (euchromatin & heterochromatin), nucleolus,
Eukaryote chromosomes structure (DNA, Histone and other proteins, Nucleosome and solenoid concept).
Kientochore, centromere and gene structure.

Cell continuity
Phases of cell cycles
Mitosis and Meiosis

Suggested Reading:

Alberts, B. Bracy, P. Lewis , J. Raff, M. Roberts K and Watson, J. (eds) (1994). Molecular Biology of the Cell, Garland Publishing , New York.

Avers, C. J. (1976). Cell Biology , Van Nostrand Reinhold, New York.

Cooper, G. M. (2004). The cell, A Molecular Approach ASM press, Washington, D. C.

Chandra Roy, S and DE Kumar, K. (2001) Cell Biology. New Central Book Agency (P) Ltd. Kolkata.

Darnell, J. Lodish, H. and Baltimore, D. (2004). Molecular Cell Biology, 2nd edition, Freeman, New York.

Derobertis, E. D. P. and Derobertis, E.M.F. (1987). Essentials of Cell and Molecular Biology. Hold Saunders – Philadelphia.

Dewitt., W. (1977). Biology of the Cell – An evolutionary approach, Saunders – Philadeophia.

Holtzman, E. and Novikoff, A. B. (1984). Cells and Organelles. Saunder – Philadelphia.

Hopkins, C. L. (1978). Structure and Functions of Cells . Saunders – Philadelphia.

Karp, G. (1984). Cell Biology 4th Edition, McGraw Hill, New York.

Karp G. (1999). Cell and Molecular Biology. Concepts and Experiments, 2nd Editon John Wiley and Sons, Inc. New York, Brisbane, Toronto.

Loewy, A. G. , Siekevitz, P, Menningee, J. R. , and Allant, J. A. N. (1991). Cell Structure and Functions. An integrated Approach 3rd edition . Saunders College Publishing, Philadelphia, London.

Pollard. T.D. and Earnshaw, W.C. (2002) Cell Biology. Saunders, Philadelphia London. New York, St. Luis Sydney, Toronto.

Powar, C. B. (1990). Cell Biology. Himalaya Publishing House, Bombay.

Sadava, D. E. (1993). Cell Biology – Organelle, Structure and Fucntions. H. Jones and Bartlett- Boston.

Sheeler, P. and Binachi, D. E. (1983). Cell Biology, John Wiley, New York.

Smith & Wood (1992). Cell Biology, Chapman & Hall, London, New York.

Wolfe, S. L. (1983). Introduction of Cell Biology, Woodworth Belmont.

ZooC-504: COMPUTER PROGRAMMING & DATA PROCESSING

Examination Time: 3 hrs **Maximum Marks: 50**

Instructions for the Paper Setter:

Eight questions are to be set. Candidates are required to attempt any five. Each question carries equal marks

Unit – I

1. Introduction to computer capability, history and classification of computers.
2. Computer architecture, organization, its components, hardware and software concepts, operating systems, peripherals, I/O devices.
3. Introduction to programming Languages.

Unit – II

4. Problem solving through computers, flow chart systems and software development.
5. Personal Computers, characteristics, capabilities, application packages.
6. Word Processing and desktop publishing.
7. Limitations of computers.

Unit – III

8. Introduction to Basic syntax notation overview.
9. Program structure, elements, basic character set, constants, variables operators and expressions.
10. Basic Statements I/O statements. Edit statements, fill statements, declarative statements, remark statements, arrays.
11. Assignments and controls statements: ON GO TO, IF THEN, ELSE FOR NEXT, WHILE WEND, UNTIL NEXT.

Unit - IV

12. Subroutine functions.
13. Files, basic files organizations, file related statements and key-words.

ZooC-551: PRACTICAL –I (FUNCTIONAL ORGANIZATION OF ANIMALS-I)

Examination Time: 4 hrs. **Max. Marks: 50**

-Study of mouth parts of:
honey bee, housefly, cockroach, butterfly, mosquito, and bug.

-Temporary mounts of salivary glands.

-Study of radula of Pila and jaws of Leech.

-Anatomy of gut in relation to food and feeding habits of detritivores, carnivores, herbivores, omnivores and sanguivores.

-Study of different kinds of Heart and blood vascular system in animals.

-Study of permanent slides:
Blood of animals.
Skin of fish, frog, lizard, bird and mammal.

-Preparation of temporary mount of setae of earthworm.

Minor changes in practical syllabus can be there as per the availability of materials.

ZooC-552: PRACTICAL –II (ECOLOGY AND CELL BIOLOGY)

Examination Time: 4 hrs. **Max. Marks :50**

-Population estimations: Using Mark and Release method and to study the effect of migration on them (Using Moong and Mash beans).

Estimation of population:

a) Insect population using sweep net method.
b) Protozoans
c) Nematodes
d) Soil arthropods

Combined population studies using quadrates.

Intrapopulation distribution and poisson distribution, construction of life table and survivorship curves from given data.

-Microscopy:

Principles of compound, phase contrast electron microscopy and Lens aberrations.
Use and care of Light compound microscope.

-Study of Cells:

Prokaryote cells: *Lactobacillus, E. coli.* Blue green algae.
Eukaryote cells, Testicular material (for studies of spermatogenesis).

-**Microtomy:** Introduction of the instrument – its use, care.

-**Preparation of permanent slides**: Principles and procedures – Section cutting of tissues and staining of tissues with Haematoxylin/Eosin method.
Study of permanent slides of various tissues (gut region, liver, lung, spleen kidney, pancreas, testis, ovary, tongue, skin etc.).

-**Cytochemical techniques:** Study carbohydrates, nucleic acids and proteins, lipids and enzymes.

-**Study of electron micrographs of various cell organelles** – plasma membrane, Mitochondria, Golgi complex, Lysosomes, Endoplasmic reticulum (smooth and granular), Cilia, Centrioles, inclusions like glycogen, lipids etc.

Minor changes in practical syllabus can be there as per the availability of materials.

ZooC-601: FUNCTIONAL ORGANIZATION OF ANIMALS –II

Examination Time : 3hrs. **Maximum Marks :100**

Instructions for the Paper Setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 20 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and its answers should not exceed 6 pages.

Unit–I

Skeletal System

Exo and Endo Skeleton in Invertebrates
Appendicular skeleton in vertebrates
Basic Components
Phylogeny of fishes and tetrapods

Evolution of the Appendicular system
Form and Function
Swimming
Terrestrial locomotion

Unit–II

Muscular system

Organization of Muscles
Classification of Muscles
Structure of Skeletal Muscles
Tendons
Basis of Muscles contraction
Muscle Function
Muscle Fiber
Muscle organs and fibers
Bone-muscle lever systems
Muscle mechanics
Muscle actions and homologies

Unit–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 non-chordates and chordates.

Unit – IV

Osmoregulation and Excretion

Osmotic confirmers and osmotic regulators, hyperosmotic, hypoosmotic and iso-osmotic mediums, Excretion and metabolic waste products – an introduction. Excretory structures and waste disposal in non-chordates, coelom, coelomo ducts, nephridia, antennal / green glands, malpighian tubules.

Osmoregulation in non-chordates, adaptation to different environments / habitats.

Development and adult structural organization of chordate kidney : nephron, the functional unit.

Role of kidney

In body water regulation, in nitrogen excretion; adaptations to environmental stresses.

Adaptations to terrestrial environment and desert living.

Suggested Readings:

Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.

Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.

Brusca, R. C. and Brusca, G. J. (2003), Invertebrates second edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.

Cooper, G. M. (2004), The Cell: A Molecular Approach IIIrd edition, ASM Press, Washington, D.C.

Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed.) Macmillan, New York.

Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.

Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.

Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.

Karp, G.(2005), Cell and Molecular Biology; concepts and experiments (4^{th} ed.), Hoboken, John Willy and Sons, New York.

Meglitsch, P. A. and Schran, F. R. (1991), Invertebrate Zoology 3^{rd} Ed. Oxford University Press, New York.

Pechenik, A. Jan. (2000), Biology of the invertebrates, Fourth Edition, McGraw HillBook Co. Singapore.

Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books seller & Publishers, Agra.

Purves, W. K., Oriane, G. H., Space, H. C. and Salava, D. (2001), Life – The Science of Biology 6th ed., Sinauer Assoc. Inc., USA.

Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.

Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate Zoology 7th ed. Saunders Publ., Philadelphia.

Willmer, P. . Stone, G. and Johnston, I (2000). Environmental Physiology of Animals, Blackwell Science.

Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, New York.

ZooC-602: APPLIED ZOOLOGY- I (INVERTEBRATES)

Examination Time: 3 Hrs **Max. Marks: 75**

Instructions to the Paper Setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 1½ marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages.

Unit – I

Arthropods (Important species and their economic importance) :-

Diplopods and chilopods
Arachnids (other than plant pests).
Insects (other than insect pests of crops, parasite of man and domestic animals).
- As pollinators
- In Biological pest management
- As source of food
- Venomous insects.

Apiculture

History and Introduction
Honey bee and kinds
Social organization and colony nests
Life Cycle
Relation between honeybees and plants
Flora for Apiculture
Honey composition, quality and importance
Bee keeping, selection, methods, precautions
Products of bee keeping
Bee enemies and diseases

Unit - II

Arthropods continued:-

Lac culture

Introduction
Lac insects: species, Life cycle and Host plants
Lac composition, properties & importance
Cultivation and Harvesting of Lac
Enemies of Lac insect and host plants
Lac industry in India

Sericulture

Indian sericulture in industry distribution and prospects
Silkworm moth species and their Life Cycle
Silk composition, kinds and uses
Mulberry cultivation
Rearing of silkworm
Treatment and disposal of cocoons
Silk reeling, twisting and weaving
Diseases & pests of silkworm
Present status of sericulture in India

Unit – III

Crustaceans (Important species and their economic importance) :-

Crab, lobsters, copepods.

Prawn Culture

Introduction to prawns
Prawn: species
Fresh water prawn farming and Marine Prawn farming
Methods of Prawn farming
"Spoilage and its prevention".
"Processing and preservation of prawns"
Future of prawn culture

Molluscans (Important species and their economic importance) :-

Eulamellibranchs
Gastropods
Cephalopods

Pearl Culture

Pearl culture, Historical background
Pearl oyster –species
Pearl formation, composition, quality and commercial value
Artificial culturing, synthetic pearls types and their manufacturing.
Methods of harvesting
Problems of pearl industry

Unit – IV

Other important species and their importance:

Protozoans: Important Parasitic species, diseases caused, prevention and cure.

Annelids: Leeches Vermiculture; species of worms, condition for efficient vermiculture (domestic and commercial level), Economics of Vermiculture

Helminthes: (Important species and their economic importance) :

Liver flukes
Cestodes / tapeworms
Roundworms (Animal and plant parasitic Nematodes)

Echnioderms (Important species and their economic importance):

Sea cucumbers
Star Fish

Suggested Reading:

1. Bhamrah, H. S. & Juneja, K. (2001), An introduction to Mollusca. Anmol publications Pvt,. Ltd. New Delhi.
2. Bhatnagar, R. K. and Palta, R. K. (2003), Earthworm ; Vermiculture and Vermicomposting , Kalyani Publishers India.
3. Carter, G. A. (2004) Beekeeping , Biotech Books, New Delhi.
4. Fenermore, P. G. and Prakash, A. (1992), Applied Entomology, Wiley Eastern Ltd. New Delhi.
5. Ghorai, N. (1995), Lac Culture in India. International Books and Periodicals, New Delhi.
6. Jhingran , V. G. (1991) Fish and Fisheries of India, Hindustan Publishing Company India.
7. Kumar, A. and Nigam, P. M. (1989), Economic and Applied Entomology EMKAY Publishing Co. New Delhi.
8. Mishra, R. C. (1995), Honey Bees & their Management in India. ICAR, New Delhi.
9. Mustafa, S. (1990) Applied and Industrial Zoology. Associated Publishing Company, New Delhi.
10. Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.
11. Sathe, T. V. and Jadhav, A. D. (2001) Sericulture and Pest Management, Daya Publishing House, New Delhi.
12. Shimizu, M. (1972) Handbook of Silkworm rearing (Agricultural Techniques Manual-1) Fuji Publishing Co. Ltd , Tokyo, Japan.
13. Singh, S. (1962), Bee Keeping in India, I. C. A. R. Publications, New Delhi.
14. Sobti, R. C. (1992), Medical Zoology, Nagin Chand & Co. Jalandhar.
15. Srivastava, P. A. (1977), Economic Zoology, Commercial Publication Bureau, Kanpur.
16. Ullal, S.R. and Narsimhanna, M. N. (1981), a Handbook of Practical Sericulture, Central Silk Board, Bombay.
17. Venkatanarasaiah, P. (1992), Sericulture in India, Ashish Publishing House, New Delhi.

ZooC-603: EVOLUTION

Examination Time : 3 hrs. **Maximum Marks :50**

Instructions to the Paper Setters:

The question paper will be divided into 2 sections.

Section A:- (Total weightage 10 marks). This section will have 10 very short answers questions. All questions will be compulsory. Each question will carry 1 mark. Questions are to cover the whole of syllabi.

Section B:- (Total weightage 40 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 10 marks and should not exceed 6 pages.

Unit – I

Origin of Life

Origin of Micro molecules
Origin of Macro molecules
Origin of Viruses
Origin of Genetic code
Origin of Prokaryotes
Origin of Unicellular eukaryotes and multicellularity

Organic evolution

Theories
Evidences
Separation of kingdoms

Unit –II

Variations

Types of variations
Causes of variations
Mutation rates and directions

Natural selection:

Types of selection
Selection forces
Experimental demonstration of Natural selection
Industrial melanism and polymorphism
Sexual selection
Selection and non adaptive character

Unit-III

Speciation

Isolation and its types
Gradual and abrupt
Origin of higher categories

Distribution of species

Island, Ocean and Continental distribution
Theories of continental drift.

Extinction

Kinds of extinction
Causes of extinction
Great extinctions

Unit-IV

Quantative and Molecular aspects of Evolution

Hardy- Weinberg law
Selection pressure
Mutation pressure
Genetic drift
Migration
Meiotic drive
Brief account
Evolution of genome in viruses, prokaryotes and eukaryotes
Evolution of multicellularity and sexual reproduction, molecular clocks

Future course of Evolution

Suggested Reading Material

Avers, C. J.(1989). Evolution Process and Pattern in Evolution Oxford University, Press, New York, Oxford.

Ayala, F. J. and Valentine J. W. (1979). Evolving the theory and Process of Organic Evolution, Benjamin Cumming.

Brookfield, A. P. (1986). Modern aspects of Evolution. Hutchinson London, Melbourne.

Gallow, P. (1983). Evolutionary principles. Chapman and Hall.

Freeman, S. and Herron, Jon C. (2007). Evolutionary analysis Pearson Prentice Hall, New Jersey.

Futuyma, D. J. (1998), Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.

Meglitsch, P. A. (1991), Invertebrate Zoology (3rd edition), Oxford University Press.

Minkoff, E. C. (1983), Evolutionary Biology, Addison Wesley Pub. Co., London.

Wen-Hsiung Li (1997), Molecular Evolution, Sinauer associates Inc.Pub. USA.

ZooC-604: Seminar

Max. Marks: 50

Instructions for the Paper Setters:

The students are required to present a seminar on a topic of relevance and importance from the subject Zoology. The seminar carries 50 marks (10 for material, 15 for presentation, 5 for discussion and 20 for the seminar based paper at the end of the semester).

ZooC-605: BIOSTATISTICS

Examination Time: 3 hrs. **Maximum Marks: 50**

Note: - The question paper will be set as per the pattern given below: -

Section A : **(Very short answer-type)**	It will consist of ten questions. All compulsory. Each question carries 1 mark (total 10 marks).
Section B : **(Short answer-type)**	The candidate will be required to attempt any eight questions out of the given 12 questions. Each question carries 3 marks.(total 24 marks).
Section C : **(Essay type)**	The candidates will be required to attempt any two questions out of the given four questions. Each question carries 8 marks.(total 16 marks).

Statistical Method: Collection of data. Frequency distribution and its graphical representation. Measures of central tendency, dispersion, skewness and kurtosis moments.

Probability: Random experiments, sample space, events. Mathematical definition of probability of an event. Use of permutations and combinations in calculations of probability, Conditional probability, Additive and multiplicfation law of probability, random variables and its pmf, pdf, cdf, mathematical expectation and variances, Distribution of binomial, poisson and normal variables and their fittings only.

Correlation and Regression: Relationship between variables, covariance, Karl-Pearson's correlation coefficient, Spearman's rank correlation coefficient, interpretation of correlation coefficients, Least square technique for regression lines (without proof), regression coefficients, relationship between correlation analysis and regression analysis.

Hypothesis Testing: Sample statistics and parameters, population null hypothesis, level of significance. Definitions of Chi-square test, 't' and 'f' variates and their Pdf[3] only, Application of X^2-t and F in testing of hypothesis.

Analysis of Variance: Meaning of analysis of variance with linear models, Analysis of variance for one-way classified data, analysis of variance for two-way classified data with one observation for cell, analysis of variance for two-way classified data with multiple but equal number of observations per cell (data analysis only).

Suggested Readings:

1. Hussain I. et. al. Mathematics, A textbook for class XI, NCERT.
2. Joshi, D.D. et. al. Mathematics, A textbook for class XII, NCERT.
3. Batschelet, Mathematics for Life Sciences.
4. S. Sokal, R. and James F., Introduction to Biostatistics.

ZooC-651: PRACTICAL –III (FUNCTIONAL ORGANIZATIONS OF ANIMALS-II)

Examination Time : 4hrs **Maximum Marks :50**

-Study of respiratory structures: Gills(Crustaceans, Bivalves, Cephalopods, Fish) Book Lungs (Scorpion); Trachea and spiracles (Cockroach)

-Temporary mount of spicules of Sponges and Herdmania.

-Appendicular skeleton

-Nephridia in annelids (earthworm), green glands in crustaceans, Malphigian tubules in cockroach and Kidney in molluscs.

-Excretory system of frog, lizard, bird and rat.

-Appendages of Prawn and leg modifications of insects.

-Tentorium of grasshopper.

-Study of wing venation, coupling and types of wings of insects.

-Permanent slides of muscle fibers.

-Permanent slides of cartilage and bone.

*** Minor changes in the practical syllabus can be done as per availability of the material.**

ZooC-652: PRACTICAL–IV (EVOLUTION AND APPLIED ZOOLOGY-I)

Examination Time : 4 hrs **Maximum Marks : 50**

-Calculations for regression, correlation and variance of gene frequency and genetic equilibrium (taking pea pods).

-Examination of principle of natural selection as a process related to evolution in a population (using coloured marbles / beads).

-Comparison of skeleton for listing evolutionary trends.

-Comparison of molluscan shells to depict polyphyletic origin.

-Comparison of homologous and analogous structures (e.g. insect antenna, legs, limbs of vertebrate etc.).

-Demonstration of kinds of mimicry in various groups of animals.

-Mapping of geographic distribution of some birds, insects, fish etc.

-Study of various evolutionary phenomenon using slides / photographs.

-Study of fossils.

-Preparation of Phylogenetic tree using some Priory weight characters with the help of 8 – 10 animals from various categories.

-Visit to apiary/vermicomposting unit/ sericulture unit and preparation of report. The report shall carry 5 marks in the practical examination

* Minor changes in the practical syllabus can be done as per availability of the material.

ZooC-701: FUNCTIONAL ORGANIZATION OF ANIMALS –III

Examination Time: 3hrs. **Maximum Marks: 100**

Instructions to the Paper Setters:

The question paper will be divided into 2 sections:

Section A:- (Total weightage 20 marks). This section will have 10 very short answers questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabi.

Section B:- (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and should not exceed 6 pages.

Unit-I

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.
Reproductive processes and their regulation.

Unit – II

Integratory systems

Chemical coordination of body functions through neuro secretion in non-chordates.
Physiology of nerve net and giant fibre system.
Evolution of functional anatomy of brain.

Unit-III

Endocrine system

Endocrine organs
Chemical coordination of body functions through hormones and neuro secretions

Unit-IV

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 organs

Suggested Readings:

1. Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
2. Barth, R. H. and Broshears, R. E (1982), The Invertebrate world. Holt Saunder, Japan.
3. Bekleimishev, W. M. (1969), Principles of Comparative Anatomy of Invertebrates, Vol. I – Morphology, Vol. II – Organology. Chicago University Press, Chicago.
4. Brusca, R. C. and Brusca, G. J. (2003), Invertebrates second edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
5. Engemann, J. G. and Hegner, R. W. (1981), Invertebrate Zoology (3rd ed.) Macmillan, New York.
6. Gardiner, M. S. (1972), The Biology of Invertebrates, McGraw Hill, New York.
7. Goodrich, E. S. (1958), Structure and Development of Vertebrates, Vol. I and II. D. E. Publication , New York.
8. Hildebrand, M. & Goslow. Jr. G. E. (2001), Analysis of Vertebrates Structure John Wiley , New York.
9. Hill, R. W., Wyse, G. K. and Anderson, N. (2004), Animal physiology. Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA.
10. Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, India.
11. Hyman, L. H. The Invertebrates. Vol. I–Protozoa through Ctenophora (1940),Vol. II – Platyhelminthes and Rhynchocoela (1951), Vol. III- Acanthocephala, Aschelminthes and Entoprocta (1951), McGraw Hill, New York.
12. Jollie, M. (1968), Chordate Morphology, Reinhold, New York.
13. Kardong, K. V. (1995), Vertebrates – Comparative Anatomy, Function, Evolution. W.B.C. Pub. , Oxford.
14. Kent, G. C. and Carr, R. K. (2001), Comparative Anatomy of the Vertebrates 9th edition, McGraw Hill Higher Education, New York.
15. Linzey, D. (2001), Vertebrate Biology. McGraw Hill Publishing Company, New York.
16. McGowan, C. (1999), A Practical Guide to Vertebrates Mechanics, Cambridge University Press, UK.
17. Meglitsch, P. A. and Schran , F. R. (1991), Invertebrate Zoology 3rd Ed. Oxford University Press, New York.
18. Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books seller & Puhlishers, Agra.
19. Pough, F. H. , Heiser , J. B. and McFarland, W. N. (1990), Vertebrate Life 3rded. , Macmillan Pub. Co. , New York.
20. Purves, W. K., Oriane, G. H., Space , H. C. and Salava , D. (2001), Life – The Science of Biology 6th ed. , Sinauer Assoc. Inc. , USA.
21. Randall, D., Burggren, K.L. and French, K. (2002), Eckert Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
22. Ruppert, E. E. and Barnes, R. D. (2004), Invertebrate Zoology 7th ed. Saunders Publ. , Philadelphia.
23. Saxena, R. K. and Saxena, S. (2008). Comparative anatomy of Vertebrates. Viva Books Pvt. Ltd. New Delhi.
24. Willmer, P., Stone, G. and Johnston, I. (2000). Environmental Physiology of Animals, Blackwell Science.
25. Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, New York.
26. Young, J. Z. (1982), The Life of Vertebrates, New York.

ZooC-702: DEVELOPMENTAL BIOLOGY

Examination Time: 3 hrs. **Maximum Marks: 100**

Instructions for the Paper Setters:
The question paper will be divided into two sections.

Section A:- (Total weightage 20 marks). This section will have 10 very short answers questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabi.
Section B:- (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and should not exceed 6 pages.

Unit – I

"Gametogenesis and Fertilization"
Spermatogenesis and oogenesis.
Egg and sperm interaction, fertilization, vitellogenesis.
Natural and artificial parthenogenesis.
In vitro fertilization and embryo transplantation.

Unit – II

Cleavage, Gastrulation & Differentiation
Cleavage and its patterns.
Biochemical changes during cleavage, influence of male and female pronuclei during early development.
What determines cleavage pattern.
Gastrulation and morphogenetic movements.
Morphogenesis of germ layers.
Morphogenetic field.
Differentiation.
Determination,transdetermination.

Unit – III

Induction and Maturation
Induction, organization, competence and inductive response, Hierarchies of induction, principles of reciprocal action.
Control of metamorphosis.
Morphophysiology of metamorphosis in insects and frog.
Histomorphological changes in regeneration of tail in Amphibians and Reptiles.
Limb regeneration in amphibians.
Vertebrate lens regeneration.
Regeneration in Platyhelminthes and Coelenterates.
Concept of growth at cellular, subcellular and organ level.

Unit – IV

Genetic Control of Development
Nuclear determination of developmental events.
Molecular basis of early embryonic development.
How is genetic control exercised during development.
Role of extrinsic factors in genetic control.
Nucleus and cytoplasmic interactions during development.

Suggested Readings:

1. Balinsky, B.I. (1981). An Introduction to Embryology, Saunders, Philadelphia.
2. Bellairs, R. (1971). Development Processes in Higher Vertebrates, University of Miami Press, Miami.
3. Berrill. N.J. (1971): Developmental Biology. McGraw Hill, New Delhi.
4. Dawnpart, Developmental Biology.
5. Ebert, J.D. & Sussex, IM. (1970): Interacting Systems in Development, Holt, Rinehart and Winston, New York.
6. Gilbert, F. (1985, 95 & 2000): Developmental Biology, Sinaur.
7. Goel, S.C. (1984): Principles and Animal Developmental Biology, Himalaya, Bombay.
8. Grant, P. (1978): Biology of Developing System.
9. Karp. G. & Berrill, M.J. (1981): Development. McGraw Hill, New Delhi.
10. Oppenheimer, J.M. and Willer, B.H. (1964): Foundation of Experimental Embryology, Prentice-Hall, New Delhi.
11. Pritchard, D.J. (1986): Foundation of Development Genetics, Taylor and Francis, London.
12. Saunders, J.W. (1982): Developmental Biology, Patterns, Principles, Problems, MacMillan, New York.
13. Spratt, N.T. Jn. (1971): Developmental Biology, Wordsworth, Belmont, Co.
14. Waddigton CH. (1966): Principles of Development and Differentiation. MacMillan, New York.
15. Loomis, W.F. (1986) Developmental Biology Macmillan, New York.
16. Miller, W.A. (1997). Developmental Biology Springer Verlag, New York.
17. Browder, L ( ) . Developmental Biology, a Comprehensive Synthesis Plenum, New York.

ZooC-703: GENERAL BIOCHEMISTRY

Examination Time: 3 hrs. **Maximum Marks: 100**

Instructions to the Paper Setters:

The question paper will be dived into 2 sections.

Section A:- (Total weightage 20 marks). This section will have 10 very short answers questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabi.

Section B:- (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and should not exceed 6 pages.

Unit – I

Biomolecules
Biological fitness of organic compounds. Dimension and shape of biomolecules, supramolecular structures and cell organelles.

Water
Physical properties and structure of water, hydrogen bonding, solvent properties of water, ionization of water, fitness of aqueous environment for living organism, pH and buffers.

Proteins
Amino acids as building blocks of proteins, essential amino acids, non-protein amino acids, structure of peptide bond, organizational levels of protein structure. Relationship between primary and higher order structures, Supramolecular assemblies of proteins, solubility denaturation, functional diversity and species specificity of proteins, protein classification, chemical synthesis and sequencing of polypeptides.

Unit – II

Enzymes
As catalyst specificity, enzyme substrate complex, active sites. Michaelis – Menton kinetics, Vmax and Km and their significance, Reversible and Irreversible inhibition, Regulatory enzymes.

Carbohydrates
Definition, families of monosaccharides, structure of carbohydrates, stereoisomerism, trisaceharides and polysaccharides (starch, glycogen, cellulose, dextrins), sugars of bacterial cell wall.

Unit – III

Lipids

Definition and Classification of lipids, fatty acids and essential fatty acids, General structure and functions of major lipid subclasses, acylglycerols, phosphoglycerides, Sphingolipids, terpenes, steroids and prostaglandins.

Biological Membranes

Common features, structural components, phospholipids, glycolipids and cholesterol.

Lipid bilayer and membrane proteins, Fluid mosaic model and membrane asymmetry, Transport across membranes.

Unit – IV

Generation and Storage of Metabolic Energy.

Bioenergetics, Metabolic Pathways

Glycolysis, pentose phosphate Ed., glyoxalate. Citric acid cycle. Oxidative phosphorylation, Gluconeogenesis, oxidation of fatty acids, biosynthesis of saturated fatty acids, general reactions and metabolism of amino acids.

Nucleic Acid Structure:

Watson and Crick model of double DNA helix, synthesis of Nucleotides, Chemical Synthesis of Nucleic acid.

Suggested Readings:

1. Lehninger A.D. Nelson D.L. & Cox M.M. (1993) & (2000), Principles of Biochemistry, 2nd and 3rd ed. Worth Publishers, New York.
2. Conn, E.E., Stump. P.K. Bruening, S. and Doi R.H. (1987) Outlines of Biochemistry 5th edition John Wiley and Sons Inc., New York.
3. Stryer, L. (1988). Biochemistry, 3rd edition San Francisco W.H. Freeman
4. Rawn, J.D. (1989). Biochemistry, Niel Patterson Publication U.S.A. North Carolina.
5. Lehninger, A (2000). Principles of Biochemistry. 3rd Edition.
6. Fischer, J. and Arriold, J.R.P. (2001). Instant notes in Chemistry for Biologists Viva Books Pvt. Ltd.
7. Harper, H.A. (2000): Harper's Biochemistry 25th ed.
8. Holde, K.E.V., Johnson, W.C. and Shing, P. (1998). Principles of Physical Biochemistry Prentice Hall, Inc., USA.
9. Morris, H. Best, L.R., Pattison, S., Arerna, S. (2001). Introduction to General Organic Biochemistry. 7th Ed. Wadsworth Group.
10. Sheehon, D (2000). Physical Biochemistry: Principles and Applications – John Wiley & Sons Ltd., England.

ZooC-704: APPLIED ZOOLOGY-II (VERTEBRATES)

Examination Time: 3hrs **Maximum Marks: 75**

Instructions to the Paper setters:
The question paper will be divided into 2 sections.

Section A: (Total weightage 15 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 1½ marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 60 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 15 marks and its answers should not exceed 6 pages.

Unit-I

Pisciculture

Economically important fresh water and marine fishes
Fish culture: aims and evolution
Fish farming Technology
Factors affecting fish culture
Problems of seed collection from natural resources (in brief)
Induced breeding methods

Poultry

Nomenclature and breeds of poultry birds
Poultry products
Egg structure and quality, nutritive values, abnormalities in eggs, factors affecting size and egg processing
Broilers, meat processing and meat products
Poultry Rearing / Farming
- Nutritional Requirements
- Housing and equipment
- Problems in poultry production
- Poultry diseases

Poultry by products

Unit - II

Fur Industry

Fur producing animals
Fur farming, dressing, processing and dyeing
Fur industry in India

Leather Industry

Animals of leather industry
Processing of skin, flaying, Curing, salting and tanning
Enemies of skin industry

Unit-III

Dairy Farming

Milching animals, Breeds, Housing and raising and Tools of management
Artificial insemination and IVF for improvement of stock
Milk composition and dairy products

Wool Industry

Animals of wool industry
Types of wool, structure and their physicochemical properties
Removal of wool
Processing of wool, clearing, drying, bleaching, dyeing, spinning and twisting.

Unit -IV

Piggery

Characteristics of swine and their products
Breed selection, management and housing and nutritional needs
Products (Pork, Bristles, Lard, Sausages) and by products
Diseases of Pigs

Other Utilities of Animals

Pharmaceuticals from animals (in brief)
Immunization (Introduction)

Suggested Readings:

1. Banarjee, G. C. (1982), Poultry. Oxford and IBH Pub. New Delhi
2. Banarjee, G. C. (1991), Text book of Animal Husbandry. Oxford and IBH Pub, New Delhi.
3. Jawal, P. L. (1977), Handbook of Animal Husbandry, I. C. A. R., Pub. New Delhi.
4. Jhingaran, V. G. (1991), Fish and Fisheries of India, Hindustan Pub. Co. India.
5. Khanna, S. S. (1986), An introduction to fishes, Central Book Depot, Allahabad.
6. Mustafa, S. (1990), Applied and Industrial Zoology, Rastogi publications, Meerut.
7. Sarkar, K. T. (1991), Theory and Practice of Leather manufacture. The Author, Madras.
8. Shami, Q. J. and Bhatnagar, S. (2002) Applied Fisheries . Agrobios India.
9. Shukla, G. S. & Upadhaya, V. B. (1991-92), Economic Zoology, Rastogi Publications, Meerut.
10. Srivastava, P. A. (1977), Economic Zoology, Commercial Publication Bureau, Kanpur.
11. Toor, H. S. and Kaur, K. (1996), Fish Culture manual. PAU, Ludhiana.
12. Yadav, M. (2003) Economic Zoology , Discovery Publication House, New Delhi.

ZooC-751: PRACTICAL - V (FUNCTIONAL ORGANIZATION OF ANIMALS –III & APPLIED ZOOLOGY –II)

Examination Time : 4 hrs **Maximum Marks : 50**

-Histology of ovary, oviduct, uterus, testis and placenta in different groups of invertebrates and vertebrates.

-Reproductive organs in Hydra, Flatworm, Earthworm, Cockroach, Pila, Fish,Frog, Lizard, Bird and Rat.

-Comparative anatomy of nervous system in Earthworm, Cockroach, Pila, Sepia and Fishes.

-Preparation of temporary mount of internal ear of fish.

-Study of eye muscles of fish.

-Permanent slides of endocrine glands of vertebrates.

-Modification of antenna in arthropods.

-Sting of honeybee.

-Visit to poultry/piggery/dairy/rabbit/sheep/fish farm/meat processing/leather industry and preparation of report. The report shall carry 5 marks in the practical examination

ZooC-752: PRACTICAL VI
(DEVELOPMENTAL BIOLOGY AND BIOCHEMISTRY)

Examination Time: 4hrs. **Maximum Marks: 50**

- Study of Gametes.
  a) Spermatogenesis in rat/frog/grasshopper.
  b) Study of testis (rat/frog/grasshopper).
  c) Study of Ovary (rat/frog/grasshopper).

- Ovariectomy on female rats.

- Castration on male rats (tubectomy).

- Preparation of permanent stained different stages of chic embryo. (24, 36, 48, 72 and 96 hours).

- Study of permanent stained slides of different stages of chick embryo.

- Study of permanent stained slides of different embryonic stages of frog.

- Study of permanent stained slides of mammalian embryo (pig).

- Quantitative analysis of proteins by Lowry/ Bradford method.

- Qualitative analysis of proteins by polyacrylamide gel electrophoresis.

- Estimation of lipids.

*** Minor changes in the practical syllabus can be there as per availability of the live materials.**

ZooC-801 : ANIMAL BEHAVIOUR AND WILDLIFE CONSERVATION

Examination Time: 3hrs **Max. Marks: 100**

Instructions to the Paper setters:

Section A: (Total weightage 20 Marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabus.

Section B: (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and its answers should not exceed 6 pages.

Unit - I

Introduction

Ethology as a branch of biology

Animal Psychology – classification of behavioural patterns, analysis of behaviour (ethogram)

Neural and Hormonal Control of Behaviour

Genetic and environmental components in the development of behaviour

Communication:

Chemical,Visual tactile and Audio communication

Functions of communication

Song specificity in birds

Evolution of language (primates)

Host-parasite relations

Unit-II

Social Behaviour

Aggregations-schooling in fishes, flocking in birds, herding in mammals, Advantages and disadvantages of living in groups.

Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness

Social organization in insects and primates

Reproductive Behaviour

Evolution of sex.

Mating and Courtship behaviour

Sperm competition

Sexual selection and Parental care

Learning and Memory

Conditioning, Habituation, Associative learning, Reasoning and Cognitive skills

Unit – III

Wild Life in India

Wild life as resource and its value.
Causes of depletion of wildlife.
Wild life ecology, ecological sub regions, distribution of wildlife in India.
Methods of studying wildlife and census of wildlife.
National and state animals of India.
Red data book, endangered, vulnerable, rare, threatened and intermediate species.
Wildlife sanctuaries, National parks, Biosphere reserve.
Organization and management of Wildlife sanctuaries and parks.

Wild Life Conservation

Role of Zoos, parks and sanctuaries for conservation of some wild animals.
Laws, legislation and statuary bodies for protecting wildlife.
Measures for wildlife conservation.
Problems of wildlife management.

Unit – IV

Status of wildlife in Punjab.
Wildlife conservation and Human conflict

Special Projects for Endangered Species and Concerns
Projects:

Project: Tiger
Project Hangul
Project Rhino
Project Elephant
Gir Lion Sanctuary Project
Project Great Indian Bustard
Crocodile breeding Project
Ecology & Conservation of the Himalayan Musk deer.
The Manipur Brow antlered deer – a case history, Wildlife and its conservation.

Suggested Readings:

1. Aggarwal, (2000), Biodiversity.
2. Aggarwal, (2000), Wildlife of India.
3. Alcock, J. (1998), Animal behaviour, An evolutionary approach Sinauer Assoc., Sunderland, Mass , USA.
4. Ali, S. (1971), The Books of Indian Birds, Bombay Natural History Society, Bombay.
5. Burton, L. D. (2003), Fish and Wildlife: Principles of Zoology and Ecology. Delmar Thompson Learning Pb.
6. Dasmann, R. F., (1982), Wildlife Biology, Wiley Eastern, New Delhi.
7. Drickamer, L. C. and Vessey, S. H. (1986), Animal Behaviour - Concepts, Processes and Methods. (2nd ed.), Wordsworth Publ. Co., California.
8. Fulbright, Timothy, E. and Hewitt, D. G. (2008). Wildlife Science: Linking Ecological Theory and Management Applications. CRC Press, Taylor and Francis : BocaRaton, F L.
9. Giles, R. H. (1984), Wildlife Management Techniques, Natraj Publishers, Dehradun.
10. Gopal, R. (1992), Fundamental of Wildlife management Justice Home Allahabad.
11. Goodenough, J., McGurie and Wallace, R. A. (2001), Perspective on animal behaviour. John Wiley & Sons, Inc. New York.
12. Hosetti, B. B. (1997), Concepts in Wildlife Management, Chawla Press, Delhi.
13. Huntingford F. (1984), The study of animal Behaviour, Chapman and Hall, London.
14. Manning, A. and Dawkins, M. S. (1992 & 1998), An Introduction to Animal Behaviour, 4th ed. (Cambridge low price editions). Cambridge University Press, Cambridge.
15. Manning, A. (1979), An Introduction to Animal Behaviour, 3rd Edition. The English Language Book Society and Edward Arnold Publishers Ltd.
16. McFarland, D. (1985 & 1999), Animal Behaviour. Pitman Publishing Ltd. London.
17. Majupuria T. C. (1990), Wildlife Wealth of India (Resources and Management), ISBN, Tecpress Services, Thailand.
18. Moulton, M. P. and Sanderson, J. (1997), Wildlife issues in a changing world. St. Luice Press Florida.
19. Negi, S. S. (1995), Hand Book of National Park, Sanctuaries and Biosphere Reservoirs in India, Indus publishing Co., New Delhi
20. Prater, S. H. (1980), The Book of Indian Animals, Bombay Natural History Society, Bombay.
21. Saharia, V. P. (1982), Wildlife in India, Natraj Publisher, Dehradun.
22. Samways, M. J. (1994), Insect Conservation Biology, Chapman and Hall, New York.
23. Sharma, B. D. (1994), High Altitude Wildlife of India, Oxford IBH, New Delhi.
24. Sharma, B.D. (1999), Indian Wild Life Resources Ecology and Development . Daya Publishing House, Delhi.
25. Sharma, B.D. (2002), Man environment and wildlife animal. IBH Publishing Co., Pvt . Ltd. New Delhi.
26. Teague, R. D. (1987), A manual of Wildlife Conservation, Natraj Publishers, Dehradun.
27. Tikadar, B. K. (1988), Threatened Animals of India, Publications of Zoological Survey of India, Calcutta.
28. Tirvedi, P.R. and Singh , U. K. (1996), Environmental Laws of Wildlife.

ZooC-802: ANIMAL GENETICS & BIOTECHNOLOGY

Max. Marks: 100

Examination Time: 3 hrs.
Instructions for the Paper Setters:

The question paper will be divided into two sections.
Section A: (Total weightage 20 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabi.
Section B: (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and should not exceed 6 pages.

Unit–I

DNA : Properties and Replication
DNA The genetic material.
DNA Structure
Semiconservative replication of DNA.
Prokaryote nucleoid structure.
Chemical composition of eukaryote chromosomes.
Packaging DNA into chromosomes.
Euchromatin, Heterochromation and banding pattern.
Repetitive DNA and sequence organization.
Replication of eukaryotic chromosomes.
Protein synthesis.

Linkage, Crossing over and Chromosome Mapping
Linkage and crossing over
Cytological basis of crossing over.
Chromosome Mapping.
Two factors crosses, Three factor crosses and interference.
Somatic Cell hybirdization.

Unit–II

Mutations
Introduction and classification of mutation.
Molecular basis of mutation.
Radiation and chemical inducted mutation
DNA repair
Correlation between mutagenicity and carcinogenicity.
Mutation Frequency.
Practical applications of Mutations.
Gene Concepts
Classical versus molecular concepts of Gene.
Complementation test for functional allelism.
Gene Regulation in Prokaryotes.
Regulation of gene expression in Eukaryotes.

Unit–III

Bacterial Genetics
Transformation, transduction and conjugation.
F mediated sex-duction.
Mechanism of recombination in bacteria.
Plasmid, Episome, IS elements and Transposons.

Genetics of Viruses
Bacteriophage genomes.
Organisation and its expression.
Viruses of eukaryotes.
Structure and infection cycles.
Animal viruses and cancer.

Unit–IV

Recombinant DNA technology
Gene cloning and Sequencing.
Restriction endonuclease.
Vectors.
cDNA cloning.
Identification of Specific clone with a specific probe.
Techniques: Southern, Northern, Western Blotting, PAGE, PCR, DNA finger printing, DNA foot printing.
In situ hybridization, RFLP.
Practical applications of gene cloning.

Extranuclear inheritance
Criteria for extranuclear inheritance
DNA in plastids, chlroplast DNA and drug resistance.
Mitochondrial DNA and genetic diseases.
Mechanisms of sex determination.
Sex differentiation.
Sex linked inheritance.

Books Recommended:

1. Ayala, F.J. & Kiger, Jr. J.A. (1980) Modern Genetics. The Benjamin Cummings Publishing Co. Inc.
2. Brown T.A. (1992). Genetics- A Molecular Approach, 2nd ed. Van Nostrand Rainhold (international).
3. De-Robertis, F.D.P. and De-Robertis Jr., E.M.E. (1987). Essentials of Cell and Molecular Biology, Saunders, Philadelphia.
4. De-Robertis, F.D.P. and De-Robertis Jr., E.M.E. (1987). Cell and Molecular Biology, Saunders, Philadelphia.
5. Freifelder, D. & Malacinski. G.M. (1993) : Essentials of Molecular Biology, Jones & Bartlett Publishers, Boston.
6. Gardener, E.J., Simmons, M.T.J. & Sunstad, D.P. (1999) : Principles of Genetics, 8th ed. John Wiley & Sons, New York.
7. Miglani, G.S. (2000). Basic Genetics Narosa Publishing House, New Delhi.
8. Sambrook, J., Fritisch, E.F. and Maniatis, J. (1989). Molecular Cloning. A lab manual.
9. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (1999) Instant notes in Genetics. New Delhi
10. Satson, J.D. et. al. (1987) : Molecular Biology of Gene, 4th ed. Vol. I & II. The Benjamin / Cummings Publishing Co., Inc.
11. Weaver, R.F. and Hedrick, P.W. (1992). Genetics Wm. C. Brown Publishers Dubuque.
12. Zubay. U.G. (1987), Genetics. The Cummings Publishing Co., Inc.

ZooC-803: CONCEPTS OF IMMUNOLOGY

Examination Time: 3 hrs. **Max. Marks: 100**

Instructions to the Paper Setters:
The question paper will be divided into two sections.

Section-A: (Total weightage 20 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 2 marks. Questions are to cover the whole of syllabi.
Section-B: (Total weightage 80 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 20 marks and should not exceed 6 pages.

Unit–I

Introduction
Types of immunity-innate and adaptive. Features of immune response-memory, specificity and recognition of self and non-self. Terminology and approaches to the study of immune system. Immunity to viruses bacteria, fungi and tumours.

Cells and Organs of the Immune System
Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells, Monocytes, polymorphs; primary and secondary lymphoid organs-thymus, Bursa of fabricius spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphocytes traffic.

Unit–II

Humoral Immunity*:*
Antigen-antibody interactions, affinity and avidity, high and low affinity anti-bodies. Immunoglobulins, classes and structure. Molecular mechanism of generation of antibody diversity. Complement fixing antibodies and complement cascade.

Cell Mediated Immunity
T-cell subset and surface markers. T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC, structure of
T – cell antigen receptors.

Unit–III

Immunological Disorders
Types of Hypersensitivity reactions, autoimmune disorders, their underlying molecular mechanism, actiology, diagnostic, prognostic and prophylactic aspects, Immunodeficiency disorders, Aids.
Immuno biotechnology:
Hybridoma Technology
Immunization of animals, isolation of stimulated spleen cells, Myeloma cell lines used as fusion partners. Fusion methods, Detection and applications of monoclonal antibodies, Vaccines: conventional vaccines, Viral vaccines, Bacterial vaccines, peptide vaccines, genetically engineered vaccines, Production and application of lymphokines.

Unit–IV

Immunodiagnostic Procedures

Various types of Immunodiffusion and immunoelectrophoretic procedures, Immunoblot, ELISA, RIA, Agglutination of pathogenic bacteria, haemagglutination and inhibition.

Books Recommended:

1. Kuby, J., Immunology W. H. Freeman and Company, New York, (1992).
2. Roitt, I. M. Brostoff, J and Male, D., Immunology, 2nd edition, Gover Medical Publishing, New York. (1989).
3. Roitt, I. M., Essential Immunology, 6th edition, Blackwell Scientific Publications, Oxford. (1988).
4. Paul, W.E., Fundamental Immunology, 2nd edition, Raven Press, New York. (1989).
5. Playfair, J.H.L.: Immunology at a glance, 5th edition, Blackwell Scientific Publications, Oxford. (1992).
6. Paul, W.E.: Immunology; recognition and response. W.H. Freeman, New York. (1991).

ZooC-804: BIOSYSTEMATICS

Examination Time: 3hrs. **Maximum Marks: 50**

Instructions for the Paper Setters:

The question paper will be divided into 2 sections.

Section A: (Total weightage 10 marks). This section will have 10 very short answer type questions. All questions will be compulsory. Each question will carry 1 mark. Questions are to cover the whole of syllabus.

Section B: (Total weightage 40 marks). This section will have eight questions. Two questions from each unit. The student will have to attempt four questions, one from each unit. Each question will carry 10 marks and its answers should not exceed 6 pages.

Unit-I

Introduction

Terms / Definitions
Historical development of theories / kinds of classifications.
Importance of Biosystematics

Material Basis of Biosystematics

Different attributes or evidences
Character kinds
Character weighing
New aspects of Biosystematics
Cytotaxonomy
Chemotaxonomy
Molecular taxonomy

Unit-II

Taxonomic Procedures

Taxonomic collections
Preservation
Identification
Taxonomic keys (Different kind, salient features, merits and demerits)
Nomenclature – International code of Zoology
Nomenclature Principles, important rules, their interpretation and application in the formation of scientific nomenclature.

Unit –III

Taxonomic Publications

The Scientific publications
Systematic publications
Contents of publications

Taxonomic Hierarchy

Species category and various concepts of species
Hierarchy of categories
Lower and higher categories
Subspecies and other sub specific categories
Decision at species and sub species level
Theories of biological classification

Unit-IV

History of Kingdom Systems (Resume of Whittakar's System and other Recent Systems of Classification)

An outline of classification of kingdom Animalia
Salient features of minor phyla.

Suggested Readings:

1. Gote, H.E. (1982), Animal Taxonomy, Edward Arnold.
2. Jaffery, C. (1973), Biological Nomenclature, Edward Arnold.
3. Kapoor, V.C. (1987), Theory and Practice of Animal Taxonomy, IPH Pb., New Delhi.
4. Mayer, E. (1969), Principle of Systematic Zoology, McGraw Hill Book Co., London.
5. Mayer, E. & Aschhok (1991), Principles of Systematics, McGraw Hill Book Co., London.
6. Minell, A. (1993), Biological Systematics, The State of Art. Chapman & Hall, London.
7. Quicke, D.L.J, (1996), Principles & Techniques of Contemporary Taxonomy, Blacky Academic & Professional, London, New York, Madras.
8. Kitching, I.J., Forey, P.L. Humpheries, C.J. & William, D. 1998. Cladistics: Theory and Practice of Parsimony Analysis, Oxford University Press.
9. Sebuh, Randall T. 2000, Biological Systematics: Principles & Applications Cornell University Press 256 pp.
10. Winston, J. 1999. Describing Species Practical Taxonomic Procedure of Biologists. Columbia University Press, Lincoln, R.J. Dictionary of Ecology, Evolution and Systematics.

ZooC-851: PRACTICAL VII (BEHAVIOUR AND WILD LIFE)

Examination Time: 4 hrs **Maximum Marks: 50**

To study the influence of temperature on development and population built up of Tribolium/Rhizopertha/Callosobruchus.

To Study the Food Preference in Different Animals.

a) *Tribolium /Rhizopertha*
b) *Pieris brassicae.*

To Investigate the Locomotive, Explorative Withdrawal and Habituation Behaviours in Earthworm.
Slug

To study the latent and operant learning in rat.
To study the thigmotaxis response in *Callosobruchus*/ *Tribolium/ Rhizopertha*

To Study the Geotaxis Responses in

a) *Tribolium*
b) Ant
c) Pieris brassicae Larvae
d) Slug

To Study the Humidity Preference in

a) *Drosphila* / *Zaprionus*
b) *Tribolium*
c) *Callosobruchus*
d) *Pieiris brassicae* Larvae

To Study the Phototaxis to Point Source and Different Colours of Light.

a) Earthworm
b) Zaprionus.
c) Tribolium
d) Callosobruchus
e) Pieiris brassicae Larvae

To study the

a) Grooming and righting behaviour in cockroach.
b) Tarsal response in butterfly/housefly.
c) Equilibrium study on housefly.

To Investigate the Chemosensory Responses in *Zaprionus* / *Bactrocera*.

To Investigate the Influence of Temperature on Developmental Rate in

a) *Callosobruchus* / *Tribolium*.

To Study the Influence of Temperature on

a) Heart beat of *Periplaneta americana*.
b) Gill movement in fishes.

Study of body rhythms in human beings.
Animal behaviour patterns using photostat sheets.
Wildlife project as assignment.

*** Minor changes in the practical syllabus can be done as per availability of the live materials.**

ZooC-852: PRACTICAL VIII (GENETICS AND BIOSYSTEMATICS)

Examination Time: 4 hrs **Maximum Marks: 50**

1. To prepare and study the karyotype of human cell.
2. To study the pedigree analysis of family.
3. To study blood groups in human beings.
4. Demonstration of Barr body in the oral epithelium of human beings.
5. To study different stages of mitosis in root tips of A*llium cepa*.
6. To study mitosis in bone marrow cells of rat.
7. To study stages of meiosis in testis of rat.
8. To study meiotic stages in testis of grasshopper.
9. To study polytene chromosomes in third instar larvae of *Zaprionus paravittiger*.
10. To study meiotic stages in buds of *Allium cepa*.
11. To study dermatoglyphics with palms of hands and fingertips.
12. To study some inherited morphogenetic human characters.
13. Isolation of DNA from animal tissues.
14. Isolation of DNA from plant tissues.
15. Numericals on Mendelian laws of inheritance.
16. Numericals on Linkage.
17. Demonstration of various kinds of equipment required for collection and preservation of animals.
18. Methods of collection and preservation
19. Kinds of keys and their use at higher and lower category levels.
20. ELISA and RIA Rocket immuno–electrophoresis
21. Serum extraction from blood

*** Minor changes in the practical syllabus can be done as per availability of the live material.**