COURSE CURRICULUM
M.Sc. ZOOLOGY
2020-2023

Academic Council
Meeting- 29-02-2020
Approved for the Year,
2020 to 2023

Outline of the draft syllabus for M. Sc. Programme in Zoology-2020-2023

Semester I

THEORY COURSE			
	Course code	**Course title**	**Credits**
Core courses	Zol-170	Principles of Animal Taxonomy	02
	Zol-171	Animal Resources and their utilization	02
	Zol-172	Invertebrates: structure and function	04
	Zol-173	Cell Biology	02
	Zol-174	Molecular Biology	04
	Zol-175	Elements of Toxicology	02
LAB COURSE			
	Zol-180	Lab course on Animal Taxonomy & Animal Resources	02
	Zol-181	Lab course on Elements of Toxicology & Cell Biology	02
	Zol-182	Lab course on Invertebrates & Molecular Biology	04
		Total Credits	**24**

Semester II

THEORY COURSE			
	Course code	**Course title**	**Credits**
Core courses	Zol-270	Vertebrates: Structure and Function	04
	Zol-271	Ecology and Environmental Biology	02
	Zol-272	Fundamentals of Biochemistry	04
	Zol-273	Bioinformatics and Biostatistics	02
Open courses	Math-231	Mathematical Tools for Real World Problems	04
	IT- 232	IT Soft Skills	04
	Bio-233	Fundamentals of Biotechnology	04
	Bot-234	Mysteries of Green Plants	04
	Bot-235	Botany in Rural Development	04
	Zol-236	Nutrition, Health & Hygiene	04
	Arb-237	Fundamentals of Arabic Lang.	04
	UR-238	Fundamentals of Urdu Lang. & Lit.	04
	IS-239	Intro. to Islamic Religious Sciences	04
	EVS-240	Environment & Social Issues	04
	Eng-241	Applied English	04
	Edu-242	Higher Education	04
	Eco-243	Principles of Banking	04
	MCA-244	Computer Appl. & Operations	04
	HT-245	Basics of Tourism and Travel Agencies	04
	Mgt-246	Business Communication	04
	ECG-247	Introduction to Gogri Lang. & Lit.	04
	ECP-248	Introduction to Pahari Lang. & Lit.	04
	ECK-249	Introduction to Kashmiri Lang. & Lit.	04

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		LAB COURSE	
	Zol-280	Lab course on Vertebrates & Bioinformatics and Biostatistics	04
	Zol-281	Lab course on Fundamentals of Biochemistry & Ecology and Environmental Biology	04
		Total Credits	**24**

		Semester III	
		THEORY COURSE	
Core courses	**Course code**	**Course title**	**Credits**
	Zol-370	Animal Biotechnology	02
	Zol-371	Animal Resources, Threats and conservation	02
	Zol-372	Biology of Immune system	04
	Zol-373	Cytology and Cytogenetics	04
	Zol-374	Embryology and Histology	02
Elective courses	Zol-375	Principles of Parasitology	02
	Zol-376	Insect Morphology and Physiology	02
	Zol-377	Elements of Ichthyology	02
		LAB COURSE	
	Zol-380	Lab course on Animal Biotechnology, Embryology and Histology & Biology of Immune system	04
	Zol-381	Lab course on Elective course, Animal Resources, Threats and conservation & Cytology and Cytogenetic	04
		Total Credits	**24**

		Semester IV	
		THEORY COURSES	
Core courses	**Course code**	**Course title**	**Credits**
	Zol-470	Genetic Engineering	02
	Zol-471	Animal Physiology	04
	Zol-472	Fundamentals of Endocrinology	04
	Zol-473	Dissertation .	04
Elective courses			
	Zol-474	Fundamentals of Nematode Genomics	02
	Zol-475	Human Genetics	02
	Zol-476	Wildlife Biology, Conservation and Management	02
		LAB COURSE	
	Zol-480	Lab course on Genetic Engineering & Elective paper	04
	Zol-481	Lab course on Animal physiology & Endocrinology.	04
		Total Credits	**24**

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Semester – I

List of courses
For the years 2020-2023

Course Code	Course Title	Credits	Scheme of Examination			
			Duration	Marks		
			Hours	SA	UE	Total
Zol 170	Principles of Animal Taxonomy	02	02	20	30	50
Zol 171	Animal Resources and their Utilization	02	02	20	30	50
Zol 172	Invertebrates: Structure & function	04	03	40	60	100
Zol 173	Cell Biology	02	02	20	30	50
Zol 174	Molecular Biology	04	03	40	60	100
Zol 175	Elements of Toxicology	02	02	20	30	50
	Total A			160	240	400

Laboratory Courses

Zol 180	Lab course on Animal Taxonomy & Animal Resources	02	02	25	25	50
Zol 181	Lab course on Cell Biology and Elements of Toxicology	02	02	25	25	50
Zol 182	Lab course on Invertebrates & Molecular Biology	04	03	50	50	100
	Total B			100	100	200

Grand Total = A + B = 400+200 = 600

SA – Sessional Assessment
UE – University Examination

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Course Code: Zol-170
Course Title: Principles of Animal Taxonomy
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

The course is designed to make students aware of the great diversity displayed by animals around us and to prepare them theoretically and practically to study and analyze this diversity scientifically. The theoretical background of systematics and taxonomy will go long way in elucidating the natural grouping of animals which exists in the biodiversity around us and also help in sustained utilization of bioresources for human welfare.

Unit 1: Taxonomy and its bases

1.1 Taxonomy and Systematics; aims of taxonomy; importance of taxonomy in biology; taxonomy in the service of society.

1.2 Variation and taxonomy: continuous and discontinuous variation; intra- and inter-population, and intra- and inter-specific variation; developmental, environmental and genetic variation.

1.3 Museums- concept, procedures and role; Zoological Parks- concept and role; major Indian museums and Zoological Parks; Zoological Survey of India (ZSI)- brief history, organization and role.

1.4 Molecular taxonomy: modern trends, achievements made in animal taxonomy using different molecular markers.

Unit 2: Fundamental components of taxonomy

2.1 Taxonomic procedures; taxonomic collections, their preservation and curation; taxonomic characters- their nature, kinds and relative value; essentials of a good taxonomic description.

2.2 Identification: methods of identification; taxonomic keys, their purpose and types and merits and demerits..

2.3 International Code of Zoological Nomenclature (ICZN) – objectives, brief history, operative principles, criteria of publication and availability.

2.4 Classification: taxonomic hierarchy; approaches to classification - artificial, natural, phyletic, phenetic, and cladistic approaches (general account).

Unit 3: Species concept and speciation

3.1 Species as the basic unit of taxonomic hierarchy; sibling species and species complexes.

3.2 Species concept; taxonomic, biological, evolutionary and phylogenetic species concepts.

3.3 Speciation: abrupt and gradual speciation; phyletic and additive speciation; modes of additive speciation - allopatric, parapatric and sympatric speciation.

3.4 Isolation and speciation: geographical and ecological isolation; reproductive isolation - pre-zygotic mechanisms (temporal, behavioral, mechanical, and gametic), and post-zygotic mechanisms (hybrid inviability, hybrid sterility and hybrid breakdown).

Note for the paper setter:

The question paper will have two sections. Section A carrying 6 compulsory Objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will carry 6 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 8 marks.

Books recommended:

1. Avise J. C. (1994). Molecular Markers, Natural History and Evolution, 3rd Edition, Chapman & Hall, New York.
2. Cole, A.J. (1969) Numerical Taxonomy, Academics Press, London
3. Davis, P.H and Heywood, V.H (1973) Principles of Angiosperm Taxonomy, Robert E. Kreiger Pub. Co., New York
4. Grant, V. (1971) Plant Speciation, Columbia University Press, New York.
5. Grant, W.F (1984) Plant Biosystematics, Academic Press, London
6. Harrison, H. J (1971) New Concepts in Flowering Plant Taxonomy, Hieman & Co-Educational Books Ltd., London
7. Heslop-Harrison, J. (1967) Plant Taxonomy, English Language Book Soc. and Edward, Pub .Ltd., U.K.
8. Heywood , V.H and Moore, D.N (1984) Current Concepts in Plant Taxonomy, Academic Press, London.
9. Jones, A.D. & Wilkins, A.D. (1971) Variations and Adaptations in Plant Species, Hieman & Co, Educational Books Ltd., London.
10. Jones, S.B; Jr. and Lunchsinger, A.E. (1986) Plant Systematics, 2nd Edition, McGraw Hill Book Co; New York.
11. Kato M. (2002). The Biology of Biodiversity, latest Edition, Springer, Tokyo.
12. Mayr, Ernst (1969). Principles of Systematic Taxonomy, TMH Edition, Tata Mc Graw – Hill Publishing Company, New Delhi.
13. Nordenstam, B; El Gazaly, G and Karsas, M. (2000) Plant Systematics for 21st Century, Portland Press Ltd.; London
14. Radford, A.E. (1986) Fundamentals of Plant Systematics, Harper & Row Publications, U.S.A.
15. Simpson G. G. (1969), Principles of Animal Taxonomy, 3rd Edition, Oxford IBH Publishing Company.
16. Solbrig, O.T. (1970) Principles and Methods of Plant Systematics, The MacMillan Co. Collier – MacMillan Ltd, London
17. Solbrig, O.T. and Solbrig,O.J. (1979) Population Biology and Evolution, Addison – Wesley Publications Co. Inc; U.S.A.
18. Stace, C.A. (1989) Plant Taxonomy and Biosystematics, 2nd Edition, Edward Arnold Ltd., London
19. Stebbins, G.L. (1974) Flowering Plant Evolution above Species Level, Edward Arnold Ltd., London.
20. Takhtajan, A.L. (1997) Diversity and Classification of Flowering Plants, Columbia University Press, New York.
21. Tikader B.K. (1983). Threatened Animals of India, Illustrated Edition, ZSI Publication, Calcutta.
22. Wilson E. O. (1999). The Diversity of Life (The College Edition), Illustrated Edition, W. W. Northern & Co.
23. Wilson E. O. (1998). Biodiversity, Academic Press, Illustrated Edition, Washington.
24. Woodland, D.W. (1991) Contemporary Plant Systematics, Prentice Hall, New Jersey

Course code: Zol-171
Course title: Animal resources and their Utilization
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

Since the dawn of civilization, humankind realized the importance of animals, domesticated them and utilized their services in one way or the other. The present course is designed to acquaint students with the biology of these animals, their management and judicious utilization based on scientific principles.

Unit 1: Animal diversity and its assessment

1.1 Diversity and classification of animals; theories of classification, phenetic and cladistic approaches to classification, classification and phylogeny.

1.2 Characterization of animal resources; salient morphological features of one well documented representative sample of major animal orders.

1.3 Zoogeography – concepts and importance, Zoogeographical regions of India and their characteristic fauna; endemism – concept and importance; endemic fauna of India and Jammu and Kashmir

1.4 Faunal diversity of Jammu and Kashmir state; present status and future needs/prospects, threatened fauna of the state and the strategies adopted to conserve this fauna, economic importance of the fauna of Jammu and Kashmir state

Unit 2: Aquatic animals, insects and earth worms

2.1 Edible species of fishes, fish culture: sources of fish seed, types of culture practices, selection of species. Indian and exotic cultivable species.

2.2 Types of fish ponds, layout of a typical fish pond, management techniques, maturing, supplementary and artificial feeding. Control of aquatic weeds and predators.

2.3 Edible species of aquatic invertebrates, prawn, lobster, mollusks and crabs; shell fish prawn and pearl oyster farming.

2.4 Sericulture, apiculture, lac culture, vermiculture, milliculture, diseases associated with various cultures, advances in insect based industries in India.

Unit 3: Animal products and management

3.1 Pharmaceuticals from animals; (sea food): value addition and export, role of Marine Product Export Development Authority (MPEDA) in promoting production and export of marine products.

3.2 Meat, leather and wool industries and their production with special emphasis on their export potential; poultry farming (chicken, duck and quail); commercial breeds in India, major poultry diseases, egg industry (eggry); present status in India.

3.3 Dairy farming in India, breeds of cattle and buffalo, role of assisted reproduction in breed improvement, milk production and pasteurization techniques.

3.4 Animal waste recycling: biogas and its production; types of biogas plants, slaughter house wastes and their utilization / management, fish byproducts; fish meal: methods of processing and uses.

Note for the paper setter:

The question paper will have 2 Sections. Section 'A' will be compulsory having six questions of one mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having 4 options each or fill in the blanks type.

Section' B' will contain six long answer questions of 08 marks each, two from each Unit. The candidates will be required to answer one question from each Unit.

Books recommended:

1. Blackwelder. E. Richard. (1996): Taxonomy: A Text and Reference book, 3rd Edition, Jhon Wiley and Sons INC, NewYork, London, Sydney.
2. Jabde V. Pradip. (2005): Text book of Applied Zoology, 1st Edition, Discovery Publishing House, New Delhi.
3. Malhotra P. (2008): Economic Zoology, 5th Edition, Adhyayan Publishers, New Delhi.
4. Shukla G.S. and Upadhay (2001): Economic Zoology, 4th Edition, Rastogi Publications, Meerut.

Course Code: Zol-172
Course Title: Invertebrates: structure and function
Credits: 04

Maximum Marks: 100
Internal Assessment: 40
External Examination: 60
Duration of Exam: 3 hours

Objectives:

In keeping with the enormous diversity of form in animals, the course has been designed to provide the students with sufficient information about how the structure of organs and organ systems is correlated with their function. The course has been designed to provide understanding of structure-function complementarities of invertebrates which will build edifice for undertaking studies on their biology and utilization.

Unit 1: Movement and Locomotion

1.1 Hydrostatic skeleton in invertebrates: A basic concept.
1.2 Locomotion based on hydrostatic skeleton in:
- 1.2.a- Coelentrates
- 1.2.b- Nemertins

1.3 Mechanism & significance of hydrostatic skeleton in movements:
- 1.3.a Wing structure and its modification.
- 1.3.b Mechanism of flight in insects

1.4 Coelom: Origin & development
- 1.4.a Acoelomates
- 1.4.b Pseudocoelomates
- 1.4.c Coelomates

Unit 2: Food & Feeding

2.1 Structure related to food intake and their evolution (Protozoa- Echinodermata)
2.2 Mechanism of food intake:
- 2.2.a Fluid feeding
- 2.2.b Particulate solid feeding

2.3 Filter feeding mechanism in:
- 2.3.a Polychaetes
- 2.3.b Crustaceans
- 2.3.c Mollusca

2.4 Digestive Mechanisms:
- 2.4.a Intra-cellular digestion
- 2.4.b Extra-cellular digestion
- 2.4.c Mechanism of digestion in invertebrates

Unit 3: Respiration & Circulation

3.1 Respiration – Comparative morphology of respiratory organs and mechanism of respiration:
- 3.1.a Branchial respiration (Bivalves)
- 3.1.b Tracheal respiration (Insects)
- 3.1.c Pulmonary respiration (Arachnida)

3.2 Mechanism of respiration in Mollusca
3.3 Circulation- Comparative morphology of circulatory organs in:
- 3.3.a Annelida
- 3.3.b Arthropoda

3.4 Circulation- Comparative morphology of circulatory organs in:
- 3.4.a Mollusca
- 3.4.b Echinodermata

Unit 4 Urinogenital system and Ionic regulation

4.1 Excretory organs in:
- 4.1.a Pseudocoelomates:
- 4.1.b Nematohelminthes
- 4.1.c Platyhelminthes

4.2 Excretory organs in:
- 4.2.a Annelida
- 4.2.b Arthropoda

4.3. Excretory organs in:
- 4.3.a Mollusca
- 4.3.b Echinodermata

4.4 Osmotic & Ionic regulation in marine, fresh water and land invertebrates

Unit 5: Reproduction, larval forms and Nervous system

5.1 Reproduction:
- 5.1.a. Asexual reproduction (Fission, budding, regeneration and conjugation)
- 5.1.b. Sexual reproduction (Annelida to Echinodermata)

5.2 Larval forms:
- 5.2.a. Larval forms & their functions in: Crustacean, Insecta and Echinodermata

5.3 Primitive nervous system:
- 5.3a Nerve net in Coelentrates
- 5.3.b Nervous system in Echinodermata

5.4 Advanced nervous system:
- 5.4.a Metameric nervous system in Annelida
- 5.4.b Nervous system in Arthropoda
- 5.4.c Nervous system in Mollusca

Note for the paper setter:

The question paper will have 2 Sections. Section 'A' will be compulsory having ten questions of 01 mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having four options each or fill in the blanks type. Section' B' will contain ten long answer type questions of 10 marks each, two from each Unit. The candidates will be required to answer one question from each Unit.

Books recommended:

1. Barnes, R. D. (1974) Invertebrate Zoology, 3rd edition. W. B. Saunders Co., Philadelphia.
2. Barrington, E. J. W. (1979) Invertebrate Structure and Function. 2nd edition, Thomas Nelson and Sons Ltd., London.
3. Hyman, L. H. (1973) The Invertebrates. Vol. I. Protozoa through Ctenophora, McGraw Hill Co., New York.
4. Hyman, L. H. (1951)The Invertebrates. Vol. 2. McGraw Hill Co., New York.
5. Hyman, L. H. (1980) The Invertebrates Vol. 8. McGraw Hall Co., New York and London.
6. Hyman, L. H. (1967) The Invertebrates: smaller coelomate groups, Vol. 5. McGraw Hill Co., New York.
7. Jagerstein, G. (2012) Evolution of Metazoan Life Cycle, Academic Press, New York & London.
8. Russel-Hunter, W. D. (1970) Biology of Higher Invertebrates The McMillan Co., Ltd., London.
9. Ruppert Edward E. Richard S. Fox Robert D. Barnes (2003) Invertebrate Zoology, 7th edition, Cengage Learning Publishers.

Course Code: Zol 173
Course Title: Cell Biology
Credits: 02

Maximum Marks: 50
Sessional Assessment: 20
University Examination: 30
Duration of Exam: 2 hrs

Objectives:

The present course has been devised to familiarize students with the basic unit of life, the cell and its different organelle, particularly with structural and functional aspects. Knowing the components of cells and how they work is fundamental to all biological sciences

Unit 1: Structure of cells and its organelles

1.1 Structure and diversity of prokaryotic and eukaryotic cells; characteristics that distinguish prokaryotic and eukaryotic cells. An outline of their ultra-structure.

1.2 Subcellular fractionation: concept, principle and isolation of plasma membrane, nuclei, mitochondria, microsomes and cytosol, applicability of the technique in contemporary researches in cell biology. Chemical organization of the cell- a general account.

1.3 Structure and functions of mitochondria, Golgi complex, vacuoles, lysosomes, microbodies, nuclear envelope and nucleolus.

1.4 Cytoskeleton: structure, composition and functions of microtubules, microfilaments, cilia and flagella.

Unit 2: Cell membrane: structure and functions

2.1 Basic structural elements of membrane- lipid bilayer, micelles and vesicles; characteristics and composition of cell membrane; membrane turnover.

2.2 Membrane structure and assembly: fluid mosaic model; membrane proteins-integral, peripheral and lipid anchored; membrane lipids- structure and asymmetry.

2.3 Membrane dynamics: ordering of acyl group in bilayer; transbilayer movement of lipids- catalysed and uncataysed movement.

2.4 Membrane transport: passive mediated- inophores, porins, ion channels, aquaporins; active transport- Na^{+}-K^{+} ATPase, Ca^{+2} ATPase, and ABC transporters.

Unit 3: Cell communication, cell cycle and techniques in cell biology

3.1 Signal transduction: general features, G protein coupled receptors and their role.

3.2 Cell cycle: mitosis, meiosis (general account); control of cell cycle, role of kinases and kinase inhibitors, check points: concept and role.

3.3 Principles and working of light microscopy, phase contrast; electron (TEM and SEM) and florescence microscopy.

3.4 Programmed cell death (Apoptosis)- pathways involved, role in normal and diseased state, various markers of apoptosis. Role of FAS ligand.

Note for the paper setter:

The question paper will have two sections. Section A carrying 6 compulsory Objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will carry 6 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 8 marks.

Books recommended:

1. Albert B; Bray D; Raff M; Roberts K and Watson JD. (2004). Molecular Biology of the Cell, Garland Publishing Inc., New York. 6th Ed.
2. Cooper, G. M. and Hausman R.E. (2006). The Cell: A Molecular Approach, ASM Press, Washington DC. 4th Ed.
3. Evans, J. and Manson, A. L. (2008). Cell Biology and Genetics. Mosby Publishers.
4. Goodman, S. R. (2008). Medical Cell Biology. Elsevier Inc.
5. Karp, G. (2007). Cell and Molecular Biology, John Wiley and Sons Inc. 5th Ed.
6. Kleinsmith L. J. and Kish V. M. (1995). Principles of Cell and Molecular Biology, Harper Collins College Publishers, New York, USA. 2nd Ed.
7. Lodish H; Berk A; Zipursky Sl; Matsudaira P; Baltimore D and Darnell J. (2004). Molecular Cell Biology, W. H. Freeman and Company, 5th Ed
8. Nelson, D. D. L., Lehninger, A. L. and Cox, M. M. (2013). Lehninger Principles of Biochemistry. W.H. Freeman Publishers.
9. Sako, Yasushi, Ueda, Masahiro (Eds.) (2011). Cell Signaling Reactions. Springer.

Course code: Zol-174
Course Title: Molecular Biology
Credits: 04

Maximum Marks: 100
Sessional Assessment: 40
University Examination: 60
Duration of Exam: 3 hours

Objectives:

The course has been devised to familiarize students with various macromolecules (DNA, RNA) within the cell: their structure, regulation and interactions.

Unit 1: Nucleic acid structure and functions

1.1 Introduction to central dogma of molecular biology. Structure of nucleic acid molecules- purines and pyrimidines, Watson and Crick model of DNA and Stability of DNA, structural features of different types of DNA; B-DNA, A-DNA and Z-DNA.

1.2 Experimental proof for DNA as genetic material. Structural features of tRNA, rRNA and catalytic RNA.

1.3 Genome complexity: concept of gene, Unique DNA sequences, Repetitive DNA sequences; Highly and moderately repetitive sequences, Transposons (Mobile DNA); IS elements (insertional sequences), composite transposons and retrotransposons.

1.4 Denaturation and Renaturation: hyper and hypo-chromic effect, Denaturation curve, Melting temperature of DNA (Tm), DNA supercoiling and concept of linking number.

Unit 2: DNA replication

2.1 Concept of semi-conservative replication: demonstration by Meselson and Stahl experiment, concept of bidirectional and semi-discontinuous DNA replication.

2.2 Process of DNA replication in *E.coli* (Prokaryotes): Structural features of OriC, initiation, elongation, termination of replication and enzymes, accessory proteins involved in the process.

2.3 Process of DNA Replication in eukaryotes; Structural features of ARS, initiation, elongation, termination of main DNA and enzymes, accessory proteins involved in the process.

2.4 Replication of telomeres: structural features of telomerase and the process of telomeric replication, link between telomeres and ageing.

Unit 3: DNA repair and recombination

3.1 DNA repair mechanism; mismatch repair, base excision, nucleotide excision and direct repair.

3.2 Homologous recombination: Site specific recombination- tyrosine recombinases, Cre-loxP mechanism of recombination.

3.3 FLP-FRT recombination: mechanism of action and its applications.

3.4 CRISPR/Cas9: mechanism and its application as a tool for genome editing.

Unit 4: Transcription

4.1 Transcription in prokaryotes; factors involved in transcription, mechanism of initiation, elongation and termination.

4.2 Operon concept; lac, trp and ara operons; post –transcriptional modifications.

4.3 Transcription in eukaryotes; general and specific transcription factors,

4.4 Post –transcriptional modifications.

Unit 5: Translation

5.1 Genetic code- concept, degeneracy, triplet nature, deviation from universality and Wobble hypothesis.
5.2 Translation in prokaryotes; mechanism of initiation, elongation and termination.
5.3 Translation in eukaryotes; mechanism of initiation, elongation and termination.
5.4 Post translational modification of proteins.

Note for the paper setter:

The question paper will have two sections. Section A carrying 10 compulsory, objective – cum – short answer type questions, two from each unit. Each part will carry 01 mark. Section B will have 10 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 10 marks.

Books recommended

1. Albert, B., Bray, D., Raff, M., Roberts, K and Watson, J. D. (2004). Molecular Biology of the Cell, Garland Publishing Inc., New York. 6th Ed.
2. Brown, T.A (Ed.) (1991). Molecular Biology. Bios Scientific Publishers Ltd, Oxford.
3. Clark, D. P. (2005). Molecular Biology: Understanding the Genetic Revolution. Elsevier Academic Press, UK.
4. Friefelder, D. (1990). Molecular Biology. II Ed. Narosa Publishing House, Delhi.
5. Karp, G. (2007). Cell and Molecular Biology, John Wiley and Sons Inc. 5th Ed.
6. Kornberg, A. and Baker, A.T. (1992). DNA Replication, W.H. Freeman & Company. 2nd Ed.
7. Krebs E, J., Goldstein S, E., Kilpatrick T. S. (2011) Lewin's Gens X, Jones and Bartlett publishers, Inc.
8. Lodish H; Berk A; Zipursky Sl; Matsudaira P; Baltimore D and Darnell J. (2004). Molecular Cell Biology, W. H. Freeman and Company, 5th Ed.

Course Code: Zol-175
Course Title: Elements of Toxicology
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives

The course is designed to help students in understanding influence of toxic elements on the environment and human health.

Unit-1 Introduction to toxicology and Air pollution

1.1 Toxicology: Definition, scope and classification of toxicants.
1.2 Pollution: Definition and types.
1.3 Air pollution: Definition, primary and secondary air pollutants, their chemistry and sources.
1.4 Effects of air pollution on human and animal health, acid rains and possible remedies to control air pollution.

Unit-2 Water and Noise pollution

2.1 Water pollution: Definition, types of water pollution and sources (Sewage, Industrial, Thermal, Surface Run off and Oil Spills).
2.2 Effects of water pollution on human and animal health.
2.3 Bio-indicators of water pollution and remediation of water pollution.
2.4 Noise pollution: Introduction, decibel scale, sources of noise pollution and its control.

Unit-3 Pesticides, Carcinogens and Radiations

3.1 Pesticides: Types of pesticides and their formulations.
3.2 Characteristics of pesticides, pesticide residues in environment.
3.3 Pesticides with reference to human health (harmful and beneficial aspect).
3.4 Environmental carcinogens: Introduction, categories, examples and exposure.
3.5 Radiations, their sources and impact on environment, animal and human health.

Note for the paper setter:

The question paper will have two sections. Section A carrying 6 compulsory Objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will carry 6 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 8 marks.

Books Recommended:

1. Sharma P. D. (2007). Ecology and Environmental, 7th Edition, Rastogi Publications.
2. Rana S. V. S. (2006). Environmental Pollution: Health and Toxicology, Alpha Science International Limited.
3. Cremlyn R. J. W. (1978). Pesticides: Preparation and Mode of action, John Wiley & Sons Ltd.
4. Kaloyanova F. P. and El Batawi M. A. (1991). Human Toxicology of Pesticides, CRC Press.
5. Appropriate online available material.

Course code: Zol 180
Course Title: Lab course on Animal Taxonomy and Animal resources
Credits: 02

Maximum Marks: 50
University Examination: 25
Sessional Assessment: 25

1. Exploration, collection and identification of a few economically important animal taxa. *Meloidogyne incognita* (Nematode), *Periplanata americana* (Cockroach), *Schizothorax richardsonii* (Fish), *Apis dorsata* (Hony bee). *Coccinella septempunctata* (Ladybug).

2. Introduction to intraspecific variability against the back drop of the concept of invariability of a species: *Clarkus pappilatus* (Nematode), *Bubalus bubalis* (Buffalo), *Bos indicus* (Cow), *Ovis aries* (Sheep), *Capra hircus* (Goat), *Canis familiaris* (Dog), *Felis catus* (Cat). Use live material, photographs.

3. Variability beyond the level of species
   (i) Intra-generic variation. *Pellodera* spp. (Nematode), *Anisoptera* (Dragonfly) spp. *Gallus spp.* (Chicken), *Equus spp* (Horse).
   (ii) Intra-familial variability. Felidae, Canidae.

Lesson: Quantum of variability determines phylogenetic distance and vice-versa.

4. Collect, describe, identify and classify wild bioresources, including wild relatives of *Gallus* sp. *Canis* sp, *Capra* sp., *Equus* sp. *Bubalus* sp.

Lessons:

i. Domesticated animals are gifts of incessant human selection and agronomic practices.

ii. Wild relatives are reservoirs of genes and genotypes that may be useful for improvement of domesticated animals.

5. Variability introduced in domesticated animals to suit human fancy, taste and need, through classical methods - selection, hybridization: *Gallus* sp. *Canis* sp, *Capra* sp., *Equus* sp. *Bubalus* sp.
6. Tailoring of animal bioresources through biotechnology interventions -Transgenic animals (Fishes, Sheep, Goat, Chickens and Mice).
7. Study the body structure of worker honey bee (*Apis mallifera*) and bee hives.
8. Study the structure of mouth parts of honey bee.
9. Study the body structure of silk moth (*Bombyx moori*).
10. Study the structure of mouth parts of grasshooper (*Locusta* sp.).
11. To check the purity of honey by using household techniques.
12. Study the structure of different types of wool (Pashmina, Sheep).
13. Study the structure of different types of feathers (quill, down, contour and filoplume).
14. Study the morphology of prawn.
15. Study the morphology of insect pests.
16. Study the distinguishing features of different types of fishes.
17. Visit to fish farm, to study fish culture and farming. The report prepared will be evaluated.
18. Learn making an aquarium for domestic use.
19. Study life cycle of silk moth.

Course code: Zol-181
Course Title: Lab course on Cell Biology and Elements of Toxicology
Credits: 02

Maximum Marks: 50
University Examination: 25
Sessional Assessment: 25

1. Microscopy (structure, principle, working): Light Microscope, Fluorescence Microscope, Confocal Microscope and Scanning Electron Microscope.
2. Eukaryotic cell: shape, size, arrangement: Chick liver, sheep liver and blood cells.
3. Preparation of the stained permanent slide of given specimens (*Paramecium, Euglena,* infected blood) using Leishman's stain..
4. Lymphocyte chromosome preparation using DAPI dye and visualizing under the fluorescent microscope.
5. The structure of somatic chromosomes and the salient features of the human karyotype and to prepare idiograms.
6. Structure of salivary gland chromosomes of *Chironomus* larva.
7. Identify, enlist and sort out the different household hazardous waste.
8. Identify and enlist the different types of contaminants and their sources that pollute ground water.
9. Identify and enlist the different types of contaminants and their sources, that pollute the air.
10. Prepare a case report on environmental issues discussed or reported in the printed media (min 05 pages, Times new roman, font 12, line space 1.5) during the last 30 days.

Course code: Zol - 182
Course Title: Lab course on Invertebrates: Structure & Function and Molecular Biology
Credits: 04

Maximum Marks: 100
University Examination: 50
Sessional Assessment: 50

1. Surveying ponds, ditches, lakes and other water bodies for living protozoans.
2. Raising laboratory cultures of Nematodes, *Drosophila*, Tapeworm and Liver fluke.
3. Use and Calibration of microscopes.
4. Study museum specimens of *Physalia, Porptia, Velella, Aurelia, Tubipora.*
5. Dissection of *Neris, Earthworm, Cockroach and Echinus.*
6. Making permanent stained preparations of Parapodium.
7. Fixing, dehydration and mounting of nematodes.
8. Studying *Sertularia, Plumularia, Gargonia, Tubipora and Hydra* from prepared slide.
9. External morphology of *Scorpion, Cockroach, Grasshopper, Wasp* and *Honey bee.*
10. Biochemical calculations based on Molarity, Molality, Normality and preparation of buffers.
11. Isolation of human genomic DNA from blood.
12. To carry out the electrophoresis of the genomic DNA isolated from the human blood.
13. Quantification of genomic DNA by electrophoresis and spectrophotometric analysis.
14. Isolation of RNA using Trizol method.
15. Demonstration of Blotting techniques (Northern and Southern).

Semester – II

List of courses
For the years 2020-2023

Course Code	Course Title	Credits	Scheme of Examination			
			Duration	Marks		
			Hours	SA	UE	Total
Zol 270	Vertebrates: Structure and function	04	03	40	60	100
Zol 271	Ecology &Environmental Biology	02	02	20	30	50
Zol 272	Fundamentals of Biochemistry	04	03	40	60	100
Zol 273	Bioinformatics and Biostatistics	02	02	20	30	50
	Open Course	04	03	40	60	100
			Total A	160	240	400

Laboratory Courses

Zol 280	Lab course on Vertebrates & Bioinformatics and Biostatistics	04	03	50	50	100
Zol 281	Lab course on Fundamentals of Biochemistry and Ecology & Environmental Biology	04	03	50	50	100
			Total B	100	100	200

Grand Total = 400+200 = 600

SA – Sessional Assessment
UE – University Examination

Academic Cour.
Meeting- 29-02-2
Approved for the Y.
2020 to 2023

Course Code: Zol-270
Course Title: Vertebrates: structure and function
Credits: 04

Maximum Marks: 100
Internal Assessment: 40
External Examination: 60
Duration of Exam: 3 hours

Objectives:

In keeping with the enormous diversity of form in animals, the course has been designed to provide the students with sufficient information about how the structure of organs and organ systems is correlated with their function. The course has been designed to provide understanding of structure-function complementarities of Vertebrates which will build edifice for undertaking studies on their biology and utilization.

Unit 1: Integumentary and Skeletal System

1.1 Structures derived from integuments viz; Glands-unicellular and multicellular, comparative anatomy of glands.
1.2 Structures derived from integuments viz; epidermal and dermal scales, beaks, claws, nails, hoofs, horns and antlers.
1.3 Comparative anatomy of vertebral column and girdles.
1.4 Appendicular and dermal musculature. Electric organs in vertebrates

Unit 2: Food and Feeding

2.1 Comparative anatomy of gastrointestinal tract in vertebrates, Jaw suspension.
2.2 Comparative account of digestive glands in vertebrates.
2.3 Dentition in mammals.
2.4 Mechanism of digestion.

Unit 3: Respiratory and Circulatory system

3.1 Aquatic respiration: comparative anatomy of gills. Mechanism of gill respiration.
3.2 Terrestrial respiration: comparative anatomy of lungs and air ducts. Mechanism of lung respiration.
3.3 Comparative anatomy of heart. arterial and venous system.
3.4 Comparative account of lymphatic system.

Unit 4: Urinogenital system

4.1 Evolution of kidneys in vertebrates.
4.2 Urinogenital system in anamniotes.
4.3 Urinogenital system in amniotes.
4.4 Mechanism of excretion (urine formation) and osmoregulation in aquatic and terrestrial vertebrates.

Unit 5: Nervous system and sense organs

5.1 Elements of nervous system and comparative account of Central Nervous System (brain and spinal cord).
5.2 Comparative account of Peripheral nervous system.
5.3 Comparative account of Autonomous nervous system.
5.4 Sense organs: Ampullae of Lorenzini, Lateral line system, auditory organs, visual organs, organs of olfaction and taste.

Note for the paper setter:

The question paper will have 2 Sections. Section 'A' will be compulsory having ten questions of 01 mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having four options each or fill in the blanks type. Section 'B' will contain ten long answer questions of 10 marks each, two from each Unit. The candidates will be required to answer one question from each Unit.

Books recommended:

1. Charles K., Weichert (1997) Elements of Chordate Anatomy, 3rd Edition, Tata McMgraw Hill Publication Company Limited, New Delhi.
2. Fishbeck Dale W (2008) Comparative Anatomy, 2nd edition, Morton Publishing Company.
3. Kardong Kenneth (2011) Vertebrates: Comparative Anatomy, Function, Evolution 6th edition, McGraw-Hill Publishers.
4. Kardong Kenneth , Edward J Zalisko (2014) Comparative Vertebrate Anatomy: A Laboratory Dissection Guide, 7th edition, McGraw-Hill Higher Education.
5. Marvalee H. Wake (1992) Hyman's Comparative Vertebrate Anatomy, 1st edition University of Chicago Press.
6. Stuart, Ira Fox. (2010): Vanders Human Physiology (A mechanism of body function), Twelfth edition Mc GrawHill Publication.

Course Code: Zol- 271
Course Title: Ecology & Environmental Biology
Credits: 02

Maximum Marks: 50
Sessional Assessment: 20
University Examination: 30
Duration of Exam: 2 hours

Objectives

The course is designed to help students in understanding principles of ecology, environmental biology, and the relationship between man and nature.

Unit 1: Ecology: Autecological and Synecological concepts

1.1 Ecology: definition, history, scope and subdivisions. Role of ecology in sustainable development.

1.2 Characteristics of Populations – size, density, dispersion, age, structure, natality and mortality; factors affecting population growth.

1.3 Intra–specific and inter–specific interactions; competition, coexistance, mutualism, commensalism and prey-predator interactions.

1.4 Genecology–ecological amplitude, ecads, ecotone, ecotypes, ecospecies, coenospecies, k– selection and r–selection populations.

Unit 2: Ecosystem Ecology

2.1 Concept of ecosystem – structure and function; Primary productivity (methods of measurement, global patterns, controlling factors).

2.2 Energy dynamics; trophic organization; energy flow pathways; ecological efficiency.

2.3 Ecosystem stability: concept (resistance and resilience); ecological perturbations (natural and anthropogenic).

2.4 Major vegetations and soil types of the world.

Unit 3: Community Dynamics

3.1 Succession – concept, definition and reasons; classification of succession: changes – autogenic and allogenic, primary and secondary, autotrophic and heterotrophic.

3.2 Retrogressive changes, concept of Climax or stable communities, ecological balance and survival thresholds.

3.3 Concept of limiting factors: Liebig and Shelford's laws of limiting factors.

3.4 Biogeochemical cycles: concept, gases and sedimentary cycles.

Note for the paper setter:

The question paper will have 2 sections. Section 'A' will be compulsory having 06 questions of one mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having 4 options each or fill in the blanks type. Section 'B' will carry 6 questions, two from each unit. The candidates will attempt 1 question from each unit. Each question will carry 8 marks.

Books recommended:

1. Ali, M. (2012). Diversity of Ecosystems, In Tech
2. Douglas, J. Futuyma (1998). Evolutionary Biology (3rd Edition), Sinauer Associates.
3. Eldon, D., Enger, Bradley, Smith, F. (1995). Environmental Science. W C Brown publications.
4. Grant, W. E. and Swannack, T. M. (2008). Ecological Modelling. Blackwell.
5. Kormondy, E. J. (Ed.) (1999). Concepts of Ecology. Prentice Hall.

6. Michael, P. (1984). Ecological methods of field and laboratory investigations. Tata McGraw Hill.
7. Miller, G. Tyler, Jr. (2005). Sustaining the Earth, 7th edition. Brooks/Cole- Thomson Learning, Pacific Groove, California.
8. Odum, E. P. (III Edn) (1991). Fundamentals of Ecology. Saunders and Com.
9. Ramade, F. (1981) Ecology of natural resources. John Wiley and Sons.
10. Wilkinson, D. M. (2007). Fundamental Processes in Ecology: An Earth system Approach. Oxford.

Course code: Zol- 272
Course title: Fundamentals of Biochemistry
Credits: 04

Maximum Marks: 100
Sessional Assessment: 40
University Examination: 60
Duration of Exam: 3hours

Objectives:

The course is designed to make students learn the chemical nature of biomolecules and their involvement in chemical reactions in living cells in order to maintain homeostasis.

Unit – 1: Carbohydrates and lipids

1.1 Carbohydrates: classification, basic chemical structure, monosaccharides – aldoses and ketoses, cyclic structure of monosaccharides, anomers and epimers.

1.2 Polysaccharides, structural polysaccharides - cellulose and chitin; storage polysaccharides- starch and glycogen; glycosaminoglycans and glycoproteins.

1.3 Heterocyclic compounds and secondary metabolites in living systems- nucleotides and pigments.

1.4 Lipids – properties, classification and structure; phospholipids, glycolipids, glycerophospholipids, steroids; metabolic roles of lipids - isoprenoids and eicosanoids.

Unit - 2: Protein structure, classification and function

2.1 Amino acids –structure, classification, chemical reactions and physical properties; proteins-general structure: characteristics of peptide bond.

2.2 Enzymes: classification, nomenclature, mechanism of action.

2.3 Hierarchy in structure: primary, secondary, tertiary and quaternary structures, protein folding. Proteomics- an introduction.

2.4 Protein sequencing (N-terminal sequencing, C-terminal sequencing Edmann degradation)and Ramachandran plot.

Unit-3: Carbohydrate metabolism

3.1 Principles of bioenergetics: energy transformation, laws of thermodynamics, spontaneity of a process, life and thermodynamics.

3.2 Carbohydrate metabolism: aerobic and anaerobic pathways, glycolysis, citric acid cycle, oxidative phosphorylation and electron transport chain.

3.3 Alternate pathways of glucose metabolism-pentose phosphate pathway, glyoxalate cycle, and glucuronic acid cycle.

3.4 Gluconeogenesis, glycogen synthesis and breakdown.

Unit –4: Lipid metabolism

4.I Oxidation of lipids: beta oxidation, oxidation of unsaturated and odd chain fatty acids and formation of ketone bodies.

4.2 Biosynthesis of fatty acids: carbon sources, acetyl CoA carboxylase and reactions of fatty acid synthase complex, synthesis of odd chain and unsaturated fatty acids.

4.3 Lipoproteins: low density lipoproteins (LDL), very low density lipoproteins (VLDL), high density lipoproteins (HDL).

4.4 Biosynthetic pathways of cholesterol.

Unit - 5: Protein metabolism

5.1 Oxidative degradation of amino acids: transamination, oxidative deamination, urea cycle and ammonia excretion.

5.2 Biosynthesis of essential (leucine, isoleucine and valine) and non-essential (alanine, asparagine and glutamine) amino acids.
5.3 Regulation of amino acid biosynthesis, genetic defects in amino acid metabolism.
5.4 Biosynthesis of purine and pyrimidine nucleotides, regulation of nucleotide synthesis.

Note for the paper setter:

The question paper will have two sections. Section A carrying 10 compulsory, objective – cum – short answer type questions, two from each unit. Each part will carry 01 mark. Section B will have 10 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 10 marks.

Books recommended:

1. Cox Michael M. and Nelson. D. L. (2008): Principles of Biochemistry, W. H. Freeman and Company, New York, 5th Ed.
2. Heldt Hans-Walter and Piechulla Birgit (2010): Plant Biochemistry, Academic Press. 4th Ed.
3. Plummer, T. David. (2004): An Introduction to Practical Biochemistry, Tata McGraw-Hill Publishing Co. 4th Ed.
4. Stryer. L. (2005): Biochemistry, 6th Edition, W.H. Freeman and Company, San Francisco.
5. Voet. Donald, Voet Judith., W. Pratt. Charlotte. (2008): Fundamentals of Biochemistry, John Wiley, New York, 3rd Ed.
6. Wilson K., and J. Walker, (2010): Principles and Techniques of Biochemistry and Molecular Biology Techniques, Cambridge Univ. Press. 7th Ed.

Course Code: Zol-273
Course Title: Bioinformatics and Biostatistics
Credits: 02

Maximum Marks: 50
Sessional Assessment: 20
University Examination: 30
Duration of Exam: 2 hours

***Objectives*:**

Mathematics and statistics are making deep in - roads into biology and it is therefore necessary to provide sound foundations of these subjects to students who can build on these later in life.

Unit 1: Introduction to computer and its applications

1.1 Evolution of computers; different generations of computers; classification of computers; basic computer organization (input/output unit), storage unit, control unit, Central Processing Unit.

1.2 Number systems (Binary number system, octal number system, hexadecimal number system); converting from one number system to another.

1.3 Basic units of computers (CPU, ALU); primary and secondary memory (RAM, ROM, PROM, EPROM, EEPROM, hard disk, compact disk and flash drives).

1.4 Computer softwares (definition, relationship between software and hardware, types of softwares); what is an operating system and main functions of an operating system, some popular operating systems (Microsoft Windows); internet: definition and practical utility. Use of Word processing and Excel sheet.

Unit 2: Bioinformatics

2.1 Introduction to bioinformatics, skills, application and uses.

2.2 Databases:- introduction, sequence and structure databases, information retrieval from biological databases, NCBI, EMBL, DDBJ, PIR, Swiss-Prot.

2.3 Sequence Alignments: introduction, pairwise alignment, significance of sequence alignment, multiple Sequence alignment, FASTA, BLAST.

2.4 Phylogenetic Analysis: introduction, elements of phylogenetic models, phylogenetic data analysis, tree building methods, Phylogenetic softwares.

Unit 3: Basics of biostatistics

3.1 Statistics: definition, history, applications and limitations; concept of Biometry, population and sample.

3.2 Data collection and tabulation, primary and secondary data, methods of collecting primary data, sources of secondary data, editing of primary and secondary data, rule of tabulation, parts and types of tables and role of tabulation of data.

3.3 Frequency distribution: classification of data, histogram, frequency polygon, cumulative frequency curves, designs and limitations of graph.

3.4 Measures of central tendency: arithmetic mean, median, mode; measures of dispersion: standard deviation, standard error and coefficient of variation, tests of significance: t-test, F-test and X^2 test and Correlation (types, methods; Karl Pearson's coefficient) and regression (linear) analysis and their uses, ANOVA.

Note for the paper setter:

The question paper will have two sections. Section A carrying 6 compulsory Objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will carry 6 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 8 marks.

Books recommended

1. M Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics II Edition. Benjamin Cummings
2. Gupta, S.P. (2005). Statistical Methods, Sultan Chand and Sons, New Delhi.
3. Gupta, C.B. and Gupta, V. (2005). An Introduction to Statistical Methods, Vikas Publishing House Pvt Ltd, New Delhi.
4. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
5. Gun, A.M., Gupta, M.K. and Dasgupta, B (2005). Fundamentals of Statistics, The World Press Pvt. Ltd, Kolkata.
6. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
7. Sinha, P.K. and Sinha, P. (2005). Computer Fundamentals, BPB Publication.
8. Rajaraman, V. (2004). Fundamentals of Computers, Prentice-Hall of India Pvt. Ltd., New Delhi.

Course code: Zol-280
Course Title: Lab course on Structure & Function of Vertebrates & Bioinformatics and Biostatistics.

Maximum Marks: 100
University Examination: 50
Sessional Assessment: 50

Credits: 04

1. Visit to study fish and trout culture in and around Rajouri.
2. Study museum specimens of *Balanoglosus, Herdmania and Amphioxus, Ichthyophis,* Axolotl larva, *Amphiuma, Pipa, Xenopus, Rhacophorus.*
3. Mounting of Placoid, Cycloid and Ctenoid scales.
4. Dissection of *Scolidon* to study the cranial nerves and Waberian ossicles of *Mystus,* dissection of heart and afferent and efferent branchial vessels of a bony fish (*Mystus/Cirrhinus*)
5. Making permanent stained preparations of intestine, liver, spleen kidney and pancreas of chick.
6. Comparative study of skeletal system of *Mystus, Rana, Varanus, gallus,* rabbit
7. *Calculation of central tendencies: mean, median and mode from the data provided.
8. *Drawing frequency distribution curve and frequency polygons from the data provided.
9. *Calculation of Standard Deviation and Standard Error from given data.
10. *χ^2 analysis of the available data and comparison of the mean values by applying t-test.
11. Studying the alignment of DNA and protein sequences by using bioinformatics tools.
12. Construction of phylogenetic tree of available data (protein and DNA sequences) by using available softwares.
13. Studying the structure of different proteins to appreciate differences and similarities among them using available software's.
14. Analysis of Variance (ANOVA) one way & two ways.

* will be evaluated during Sessional examinations.

Course Code: Zol-281
Course Title: Lab course on Biochemistry & Ecology and Environmental Biology
Credits: 04

Maximum Marks: 100
University Examination: 50
Sessional Assessment: 50

1. Biochemical calculations and reagent preparation.
2. Estimation of pH using pH meter.
3. Study reactions of amino acids, sugars and lipids.
   - Tests for sugars:
     Molish's test, Fehling's test, Seliwanoff's test, Osazone test, Barrfoed's test.
   - Tests for amino acids:
     Ninhydrin test, Xanthoproteic test, Morner's test, Lead sulphide test, Hopkin's test
   - Test for lipids:
     Solubility test, Emulsification test, Saponification test, Unsaturation test
4. Quantification of proteins from hen's egg by Lowry's method.
5. Undertake separation techniques - Centrifugation, Chromatography (TLC and paper chromatography).
6. Estimation of glucose.
7. Estimation of urea.
8. Cholesterol estimation.
9. Determination of pH of soil samples.
10. Determination of organic content of soil.
11. Determination of carbonate and nitrate in samples of soil.
12. Determination of free CO_2 and salinity in ponds.
13. Estimation of population density.

Semester – III

List of courses
For the years 2020-2023

Core course / Course code	Course Title	Credits	Scheme of Examination			
			Duration	Marks		
			Hours	SA	UE	Total
Zol 370	Animal Biotechnology	02	02	20	30	50
Zol 371	Animal Resources, threats and conservation	02	02	20	30	50
Zol 372	Biology of Immune system	04	03	40	60	100
Zol 373	Cytogenetics	04	03	40	60	100
Zol 374	Embryology & Histology	02	02	20	30	50
Elective courses Zol 375	Principles of Parasitology	02	02	20	30	50
Zol 376	Insect Morphology & Physiology	02	02	20	30	50
Zol 377	Elements of Ichthyology	02	02	20	30	50
Total A				160	240	400

Laboratory Courses

Zol 380	Lab course on Animal Biotechnology, Biology of Immune system & Embryology and histology	04	03	50	50	100
Zol 381	Lab course on Elective course, Animal resources, threats and conservation & Cytogenetics	04	03	50	50	100
	Total B			100	100	200

Grand Total = A + B = 400+200 = 600

SA – Sessional Assessment
UE – University Examination

Academic Council
Meeting- 29-02-2020
Approved for the Year,
2020 to 2023

Course Code: Zol-370
Course Title: Animal Biotechnology
Credits: 04

Maximum Marks: 100
Sessional Assessment: 40
University Examination: 60
Duration of Exam: 3 hours

Objectives:

Human population is increasing at fast rate. The resources required to sustain the ever increasing population are not increasing at the same pace. Conventional methods for animal improvement are not able to deliver fully. Therefore, to adopt high throughput technologies is need of the hour. Manipulation of genome by incorporating desirable genes is the option available. This course is intended to give some idea to students how animal bioresources can be improved through biotechnology.

Unit 1: Animal markers used for characterization of transgenic livestock

1.1 Introduction to animal genomics, marker based methods for characterization of animal genomes- RFLP, RAPD, SNP and ITS.

1.2 Immunology based methods for identification of domestic and wild animal species, detection of meat adulteration using DNA-based methods.

1.3 Production of transgenic livestock: production of pharmaceuticals, production of donor organs and disease-resistant livestock.

1.4 Transgenic Livestock: transgenic animals for food and improved traits-improving milk quality.

Unit 2: Animal cell culture and scaling up

2.1 Culture media: natural- serum based media and artificial media, suspension cultures, initiation of cell cultures.

2.2 Primary animal cell cultures: methods of tissue disaggregation: mechanical and enzymatic methods- trypsin and collagenase mediated action, establishment of cell line cultures.

2.3 Measurement of viability and cytotoxicity of cultured cells, manipulation and cell synchronization.

2.4 Scaling up of animal cell cultures: scale up in suspension cultures and monolayer cultures and organ cultures.

Unit 3: Stem cell biology and Nano-biotechnology

3.1 Introduction to stem cells, stem cell systems: basic principles and methodologies.

3.2 Animal stem cells: Embryonic stem cells and bone marrow derived stem cells of animal models in preclinical research.

3.3 Stem cells and Neurodegenerative diseases, Stem Cells from early mammalian embryos.

3.4 Nano-biotechnology: Introduction, types, DNA and protein based applications, nano-biosensors and risk potential of nanomolecules.

Note for paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective cum-short answer type questions, two from each unit. Each question will carry 01 mark. Section B will have 10 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 10 marks.

Books recommended:

1. Brown, T. A (2007). Genomes. BIOS Scientific Publishers Ltd.
2. Clark, D. P (2005). Molecular Biology: Understanding the Genetic Revolution. Academic press.
3. Das, H. K (2010). Textbook of Biotechnology. Wiley India Pvt. Ltd.
4. Daniel R. Marshak, Richard L. Gardner and David Gottlieb (2014). Stem Cell Biology, Cold Spring Harbor Laboratory Press.
5. Freshney, R. I (2010). Culture of Animal Cells. John Wiley and Sons Inc.
6. Malacinski, G. M (2006). Essentials of Molecular Biology. Narosa Publishing House. 4th Ed.
7. Primrose, S. B and Twyman, R. M (2007). Principles of Gene Manipulation and Genomics. Blackwell Publishing, Oxford, UK.
8. Singh, B. D. (2007). Biotechnology: Expanding Horizons. Kalyani Publishers.

Course code: Zol-371
Course title: Animal Resources: Assessment, Threats and Conservation
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 Hours

Objectives:

The present course is based on the realization of the importance of domesticated and wild animals for meeting various needs of mankind.

Unit 1 Animal resources and control

1.1 Economic importance of fishes; larvivorous fishes and public health; important cold water fish resources.

1.2 Dams as threat to fish population, assessment of pollution hazards to fishes: control of unwanted fishes and aquatic weeds.

1.3 Overview of some important rat species, rats as threat to food grain resources; control of rats: chemical and biological measures, use of traps and integrated techniques for rat control.

1.4 Insect Pest Management; various measures including mechanical and chemical measures, biological control measures, pest surveillance, use of pheromones, attractants and repellants.

Unit 2 Wildlife and its management

2.1 Wild life: significance, scope of wild life studies, conservation and management; values of wildlife: positive and negative, status of wildlife in India.

2.2 Important wild life species in different regions of India, endangered and endemic wildlife species of India.

2.3 Population estimation; fecal analysis of ungulates and carnivores - fecal samples, Pug marks and census method, wild life conservation projects of government of India, habitat management.

2.4 Concept and Scope of Remote Sensing with respect to wild life management, definitions, Process and Characteristics of Remote Sensing System, advantages and limitations; GIS.

Unit 3 Biodiversity and Conservation

3.1 Biodiversity-its measurement, assessment and conservation, Major threats to biodiversity: Habitat loss, poaching of wildlife, biological invasions.

3.2 Conservation of biodiversity: National parks, Wildlife sanctuaries, biosphere reserves, single species / single habitat based conservation programme (e.g. Project tiger).

3.3 Human-wildlife interactions: Conflict between man and wildlife, Ecotourism-its cost and benefits.

3.4 Wildlife damage, assessment and control, Role of NGOs like IUCN, CITES, WWF in wildlife conservation.

Note for the paper setter:

The question paper will have 2 sections. Section 'A' will be compulsory having 06 questions of one mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having 4 options each or fill in the blanks type. Section 'B' will carry 6 questions, two from each unit. The candidates will attempt 1 question from each unit. Each question will carry 8 marks.

Books recommended:

1. G.S. Shukla and Upadhay (2001): Economic Zoology, Rastogi publications, Meerut, 4th Edition.
2. Gopal Rajesh (2012): Fundamentals of wild life management, S. Chand Publishers, 7th Edition.
3. Negi S. S. (2012): Wild life conservation, Natraj Publishers 5th Edition.
4. P. Malhotra (2008): Economic Zoology, Adhyayan Publishers, New Delhi, 5th Edition.
5. Pradip. V. Jabde (2005): Text book of applied zoology, Discovery publishing house, New Delhi. 1st Edition.
6. Richard. E. Blackwelder (1996): Taxonomy A text and reference book, Jhon Wiley and Sons INC, NewYork, London, Sydney, 3rd Edition.

Course code: Zol-372
Course title: Biology of Immune System
Credits: 04

Maximum marks: 100
Sessional Assessment: 40
University Examination: 60
Duration of Exam: 3 hours

Objectives:

This course introduces students to molecular and cellular components of the immune system and how they protect from the pathogens by discriminating self from non-self antigens, thereby keeping the individuals healthy.

Unit 1: Introduction to immunology

1.1 Types of immunity, innate and adaptive, features of immune response, memory; recognition of self and non-self.
1.2 Hematopoiesis. Cells and organs of immune system: B and T cells, macrophages, dendritic cells, NK cells, eosinophills, neutrophills and mast cells, Lymphoid organs; thymus, bursa of fabricus, spleen, lymph nodes and lymphatic system.
1.3 Immunoglobulins: structure, classes and subclasses.
1.4 Nature and biology of antigens, immunogenicity versus antigenicity, epitopes, antigen and antibody interactions and Haptens.

Unit 2: Humoral and cell mediated immunity

2.1 Generation of humoral and cell mediated immune responses, Antigen processing and presentation.
2.2 Complement fixing antibodies and complement pathways.
2.3 Major histo-compatibility complex and HLA system, recognition of antigens by T-cells and role of MHC.
2.4 Cytokines, types and functions, cell adhesion molecules, Cytokines related diseases; therapeutic use of Cytokines.

Unit 3: Immunological disorders

3.1 Type I, type II, type III and type IV hypersensitivity reactions.
3.2 Autoimmune disorders: Systemic lupus erythematosus (SLE), Multiple sclerosis (MS) and Arithritis.
3.3 Cancer: oncogenes and proto-oncogenes, tumor antigens, tumor evasion of immune system.
3.4 AIDS, HIV infection of Target Cells and Activation of Provirus.

Unit 4: Immunodiagnostic procedures

4.1 Techniques: Flow cytometry, ELISA and Western blotting.
4.2 RIA (principles, properties and applications), advantages and disadvantages.
4.3 Immunolocalization of antigens: Fluorescence and Confocal microscopy.
4.4 Separation of immunoglobulin from serum.

Unit 5: Immunobiotechnology

5.1 Raising Polyclonal antibodies (antigen preparation, immunization and antibodies collection & screening).
5.2 Monoclonal antibodies: Production, detection and applications.
5.3 Organ transplantation: immunological basis of graft rejection and immunosuppressive therapy.

5.4 Vaccines: conventional vaccines, peptide vaccines, genetically engineered, DNA, vaccines.

Note for the paper setter:

The question paper will have two sections. Section A carrying 10 compulsory, objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will have 10 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 10 marks.

Books recommended:

1. Eli Benjamin, Rechard Coico, Geoffrey: Immunlogy, A Short Course, Sunshine (Wiley-Liss). 4th Ed.
2. Goldsby, R. A. Kindt, T. J., and Osborne, B. A. (2000): Kuby Immunology, W/H/Freeman and Company, New York, 5th Ed.
3. Roitt I., Brostoff. J., and Male, D., (1999): Immunology, Hartcourt Brace and Company ASI Pte. Ltd. 7th Ed.
4. Warren, Levinson. (2010): Review of Medical Microbiology and Immunology, LANGE Basic Science. 11th Ed.

Academic Council
Meeting- 29-02-2020
Approved for the Year,
2020 to 2023

Course Code: Zol-373
Course Title: Cytogenetics
Credits: 04

Maximum Marks: 100
Internal Assessment: 40
External Examination: 60
Duration of Exam: 03 hours

Objective:

The course is designed to make students aware about the structure and functions of chromosomes and chromosomal aberrations both numerical and structural. It will help the students understand and appreciate the anomalies in the chromosomal behavior and their impact on the survival of species.

Unit 1: Chromosome Organization

1.1 Introduction to cytogenetics. Structure of eukaryotic chromosome; nucleosome model; banding patterns for identification of chromosomes (Q, C, N, G and R bands).
1.2 Morphology of chromosomes: centromeres, secondary constriction; knob; telomeres; satellite and nucleolar organizer region (NOR).
1.3 Different forms of chromosomes; polytene chromosomes; Lampbrush chromosome and B chromosomes.
1.4 Karyotype symmetry; chromosome numbers; symbols & terminologies; euchromatin and heterochromatin.

Unit 2: Chromosome variation

2.1 Numerical variation in chromosomes: euploidy and aneuploidy.
2.2 Numerical disorders: Patau's syndrome, Edward's syndrome, Down's syndrome, Turner's syndrome and Klinefelter's syndrome.
2.3 Structural variation in chromosomes: deletion, duplication, inversion and translocations.
2.4 Structural chromosome abnormalities: Cri du Chat, Williams syndrome, Fragile X syndrome, Prader–Willi syndrome and Burkitt's lymphoma.

Unit 3: Chromosomal basis of inheritance

3.1 Sex chromosomes and sex determination: sex determination in human, sex determination in *Drosophila.*
3.2 Genic balance theory of sex determination.
3.3 Chromosomal dosage compensation in human, monotremes (*Platypus*), *Drosophila* and *C elegans.*
3.4 Sex-linked inheritance: X-linked and Y-linked traits in humans. Evolutionary significance of Y-chromosome.

Unit 4: Linkage, Crossing Over and Cytogenetic Mapping

4.1 Linkage, Recombination and Crossing Over. Evidence for linkage and recombination.
4.2 Chromosome Mapping: recombination frequency, coupling and repulsion, recombination mapping with two-point and three-point test cross.
4.3 Cytogenetic Mapping: localizing genes using deletions and duplications.
4.4 Evolutionary significance of recombination.

Unit 5: Molecular Cytogenetic

5.1 Chromosomal DNA content and C-value paradox. Genome evolution.
5.2 Repetitive DNA sequences, techniques for detecting repetitive DNA.
5.3 FISH and GISH techniques: principles and applications, concept of chromosome painting.
5.4 Molecular cytogenetics in cancers.

Note for the paper setter:

The question paper will have two sections. Section A carrying 10 compulsory, objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will have 10 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 10 marks.

Books recommended:

1. Snustad DP & Simmons MJ. **Principles of Genetics.** (7th Edition) John Wiley & Sons.
2. Gardner EJ, Simmons MJ & Snustad DP. **Principles of Genetics.** (Latest Edition) John Wiley & Sons.
3. Benjamin A. Pierce. **Genetics: A Conceptual Approach.** (5th Edition) W. H. Freeman.
4. Klug, Cummings, Spencer & Pallandino. **Concepts of Genetics.** (Latest Edition). Pearson Publishers.
5. Athony J.F. Griffiths Susan R. Wessler, Richard C. Lewontin, William M. Gelbart, David T. Suzuki, Jeffrey H. Miller. **An Introduction to Genetic Analysis.** (Latest Edition).
6. Paul Popescu, Helene Hayes, Bernard Dutrillaux, R. Popescu. **Techniques in Animal Cytogenetics** (Latest Edition).
7. Edward S. Tobias, Michael Connor, Malcolm & Ferguson-Smith. **Essential Medical Genetics.** (6th Edition) Wiley-Blackwell.
8. Tom Strachan, & Andrew Read. **Human Molecular Genetics.** (4th Edition) Garland Science.
9. Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll, John Doebley. **An Introduction to Genetic Analysis** (11th Edition).
10. Hartl, D.L. and Ruvolo M. **Genetics: Principles and Analysis.** Jones and Bartlett Publishers. (Latest Edition).

Course Code: Zol-374
Course Title: Embryology and Histology
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

The course is designed to familiarize the students a brief understanding of the tissue and embryo. Study of tissues and embryo can be useful as they can understand the intricacies of the tissue and organs formed during the development.

Unit-1 Elements of Embryology

1.1 Introduction to embryology. Gametes: ultra structure of sperm and ovum, types of eggs.
1.2 Cleavage: types of cleavages (Determinate, inderminate, holoblastic and meroblastic).
1.3 Fate map, Morphogenetic movements in gastrula of frog and chick.
1.4 Formation and functions of Foetal membranes in chick embryo, placenta in mammals.

Unit-2 Fundamentals of Histology

2.1 Introduction to histology. Epithelial tissue: Characteristics and basics of epithelial tissue, organization of epithelial cell surface modifications.
2.2 Muscle tissue: Characteristics, ultrastructure and functions of muscle cells, muscle contraction/movement.
2.3 Bone tissue: ultrastructure and functions of bone cells, effect of hormones and vitamins on bone regulation.
2.4 Connective tissue: Tropocollagen synthesis, collagen types, functions and diseases; glycosylation.

Unit-3 Tools and techniques in Histology

3.1 Tools in histology: Principles, design and functioning of microtomes, automated microtomes, ultramicrotome, cryostat, problems and trouble shooting.
3.2 Techniques in histology: Sample preparation, obtaining tissue samples, fixatives, processing of fixed samples, dehydration, embedding, block making, sectioning of tissues for light and Electron microscopy. Handling of reagents. Precautions.
. 3.3 Principles and methods of staining, histological stains (Haematoxylin & Eosin, sudan black, methyl green pyronin)
3.4 Basic principles of cryotomy and histochemistry.

Note for the paper setter:

The question paper will have 2 sections. Section 'A' will be compulsory having 06 questions of one mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having 4 options each or fill in the blanks type. Section 'B' will carry 6 questions, two from each unit. The candidates will attempt 1 question from each unit. Each question will carry 8 marks.

Books Recommended

1. Bancroft, J.D. & Stevens, A. (2002). Theory and Practice of Histological techniques, Churchill Livingstone.
2. Casselman, W.G.B. (1959). Histochemical techniques, John Wiley,
3. Pearse, A.G.E.: Histochemistry; Theoretical and Applied (Vol. I, II & III), (4th ed.), Churchill Livingstones, 1980-1993.

4. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
5. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
6. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc. M.P.A

Elective courses

Course code: Zol-375
Course title: Principles of Parasitology
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

The course has been designed to understand the parasite biology, life cycles, host–parasite relationship, environmental and host factors regulating parasitic diseases and to recognize the general outlines of parasite treatment and control.

Unit 1: Introduction to Parasitology

1.1 Basic concept of parasitism, animal associations – symbiosis, commensalisms, phoresis, mutualism, parasitism and hyper parasitism.

1.2 Parasite and host relationship; parasitic adaptations and parasitic Zoonoses.

1.3 Factors influencing parasitic fauna: Influence of age of the host on parasite fauna, Food of the host and its mode of life. Migration of the hosts, Effects of geographical factors on parasitic fauna. Influence of human activity on parasite.

1.4 Introduction of parasitic protozoa. Classification of parasitic Sarcomastigophora and Ciliophora. *Entamoeba histolytica*, *E. coli, E. gingivalis* and *Giardia lamblia*: Morphology, life-cycle, mode of infection, disease, chemotherapy and prevention.

Unit 2: Protozoology and helminthology

2.1 Morphology, lifecycle, mode of infection of *Plasmodium*, *Trypanosomes* and *Leishmania*. Molecular biology of Plasmodium – drug targets, mechanism of drug resistance, vaccine strategies.

2.2 General organization and classification of Medical and Veterinary Platyhelminthes. Trematoda and Cestoda: General life cycle, morphology and ultra structure of tegument.

2.3 *Schistosoma mansoni*, *S. haematobium*, *S. japonicum*, *Taenia solium. T. saginata, Fasciola gigantica,* and *F. hepatica* - Morphology, lifecycle, mode of infection, chemotherapy and prevention.

2.4 Classification of parasitic nematodes, Diagnostic features of various orders and families. Gastro-intestinal nematodes: *Ascaris* and *Ancylostoma*- morphology, life-cycle, chemotherapy and prevention.

Unit 3: Parasite Biochemistry and Immunology

3.1 Introduction to parasite biochemistry and Immunology. Biochemical adaptations. Excretory /secretory role of tegument. Biochemistry of egg-shell formation.

3.2 Type of Immune responses against parasitic infections: Innate and acquired immunity. Immune evasive strategies of parasites.

3.3 Natural resistance and acquired immunity to malaria. Antigenic variation in Trypanosomes and mechanism of protective immunity.

3.4 Immune response, self-defense mechanisms of parasites; parasites of veterinary importance.

Note for the paper setter:

The question paper will have 2 sections. Section 'A' will be compulsory having 06 questions of one mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having 4 options each or fill in the blanks type. Section 'B' will carry 6 questions, two from each unit. The candidates will attempt 1 question from each unit. Each question will carry 8 marks.

Recommended Books:

1. Chandler, A. C. & Read. C. P. (1961). Introduction to Parasitology, John Wiley 10th Edition.
2. Smyth, J. D. (1994). Animal Parasitology. Cambridge University Press. Soulsby, 3rd Edition.
3. Marr, J., Nilsen, T.W. & Komuniecki, R.W. (2002). Molecular Medical Parasitology. Academic Press. 1st Edition.
4. Hyde, John E. (1990). Molecular Parasitology. Chapman & Hall.
5. Kennedy, M.W. & Harnett, W. (2001). Parasitic Nematodes. CABI Publishing. 1st Edition.
6. Bush, A.O., Esch, G.W. & Seed, J.R. (2001). Parasitism: The Diversity and Ecology of Animal Parasites. Cambridge University Press. 1st Edition.
7. Wakelin, D. (1996). Immunity to Parasites: How Parasitic Infections are Controlled. Cambridge University Press. 2st Edition (Revised)
8. Cohen, S. & Sadun, E.H. (1976). Immunology of Parasite infection. Blackwell Scientific Publications. 1st Edition.

Course code: Zol-376
Course title: Insect Morphology & physiology
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

The course has been designed to provide students with sufficient information about the morphology, diversity and physiology of insects which form the basis for undertaking entomological studies by the students subsequently.

Unit: 1 General structure of insect body

1.1 General organizations of the insect body, structure of integument/cuticle.
1.2 Head: sutures and area of cranium, tentorium; gnathal appendages.
1.3 Thorax: Pro- legs and its modification.
1.4 Wings venation, modifications and wing coupling apparatus.

Unit: 2 Digestive, Excretory, Circulatory and Respiratory system

2.1 Digestive system: structure of alimentary canal and its modification; physiology of digestion in phytophagous, omnivorous and carnivorous insects
2.2 Excretory system, excretory function of hind gut and significance of cryptonephridial system.
2.3 Circulatory system, Diaphragm and heart, haemolymph and its functions.
2.4 Respiratory system, Organs of respiration and their modifications.

Unit: 3 Nervous and Reproductive system and Sense organs.

3.1 Nervous system and its modification; sense organ: mechanoreceptor, chemoreceptor; auditory organ; light producing organ; sound producing organ.
3.2 Visual organ, physiology of vision and hearing, brief account of sound and light production.
3.3 Male and female external genitalia and their modification.
3.4 Reproductive system: morphology, anatomy and physiology of male and female reproductive system, the associated ducts and glands.

Note for the paper setter:

The question paper will have 2 sections. Section 'A' will be compulsory having 06 questions of one mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having 4 options each or fill in the blanks type. Section 'B' will carry 6 questions, two from each unit. The candidates will attempt 1 question from each unit. Each question will carry 8 marks.

Books Recommended:

1. Timothy, (2007). Insect Ecology. Marc J. Klowden Elsevier Inc.
2. Marc J. Klowden (2007). Physiological Systems in Insects. Elsevier Inc.
3. Waldbauer, (2007). The Handy Insect G.K. Book. Jaico Publ. House.
4. Pedigo and Rice, (2009). Entomology and Pest Management. Publ. PHI Learning, Pvt. Ltd.
5. R.F. Chapman, (1998). The Insect; Structure and Function. 4th Ed.

Course code: Zol-377
Course title: Elements of Ichthyology
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

The course has been designed to provide students sufficient information regarding fish classification, structure and adaptation to various ecological conditions along with feeding, nutrition and reproduction so that they can appreciate the significance of this fascinating and useful group of aquatic animals.

Unit: 1 Introduction to fishes

1.1 Tools of fish classification; major divisions of living fishes; schemes of fish classification with special emphasis on Berg's scheme
1.2 Outline classification of local ichthyofauna.
1.3 External Anatomy: Body shape, skin and chromatophores; structure, types and modification of scales.
1.4 Fins: Structure, modification and theory of origin of fins; swimming methods and energetics of swimming.

Unit: 2 Morphology and Anatomy of digestive, respiratory and circulatory systems

2.1 Digestive system: Structure of Alimentary canal and feeding adaptations
2.2 Respiratory system: Structure of gills; air breathing organs; structure, modifications and function of swim bladder.
2.3 Circulatory system: Structure of heart and blood vessels.
2.4 Lateral line system, bioluminescence in fishes.

Unit: 3 Morphology and Anatomy of excretory system, reproductive system and thermoregulation

3.1 Excretory system: Structure of excretory organ and osmoregulation.
3.2 Reproductive system: Structure of reproductive organs, breeding and parental care.
3.3 Migratory behavior of fishes.
3.4Thermal regulation in fishes.

Note for the paper setter:

The question paper will have 2 sections. Section 'A' will be compulsory having 06 questions of one mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having 4 options each or fill in the blanks type. Section 'B' will carry 6 questions, two from each unit. The candidates will attempt 1 question from each unit. Each question will carry 8 marks.

Books Recommended:

1. Vasanth Kumar (2013). Advancers in Aquatic Ecology. Daya Publ. House, New Delhi.
2. Lynwood, S. Smith (2003). Introduction to the fish physiology. Narendra Publ. House, Delhi.
3. Arvind Kumar and Pushaplata Dubey (2006). Fish Management and Aquatic Environment Daya Publ. House, Delhi.
4. Lagler, Bardock, Miller & Possino, (2012). Icthyology, 2nd Ed. John Wiley & Sons, N.Y., London.

Course Code: Zol-380
Course Title: Lab course based on Animal Biotechnology, Biology of Immune System and Embryology & Histology

Maximum Marks: 100
University Examination: 50
Sessional Assessment: 50

1. Identification of different types of cells from human blood films.
2. Identification of the antibodies present in serum using appropriate techniques.
3. Quantitative and qualitative analysis of antigens by Double Immunodiffusion and Immuno-electrophoresis.
4. Analysis of antigens by Radial immunodiffusion.
5. Purification of IgG from serum.
6. Determination of contents of haemoglobin through Shali's haemocytometer.
7. Determination of the bleeding and clotting time of your blood.
8. Determination of the TLC and DLC of your blood using haemocytometer.
9. Determination of the erythrocyte count of your blood using haemocytometer.
10. Determine the blood groups.
11. Preparation of single cell suspension from spleen and thymus.
12. To count the cells of an animal tissue and check their viability by dye exclusion method.
13. Preparation of media for animal cell culture.
14. Isolation of DNA from human blood by salting out method.
15. Attempt animal cell fusion using PEG.
16. Demonstration of flow cytometry.
17. To familiarize the use of CO_2 incubator and laminar air flow hood.
18. Study of T.S. of testis and ovary of a mammal.
19. Study of chick embryos of 18 hours, 21 hours, 30 hours and 48 hours of incubation.
20. Principle and working of a microtome.
21. Fixation, dehydration, embedding, sectioning, staining, permanent mounting of tissues (chick and goat liver)
22. Microscopic measurements of histological samples using micrometers.

Course Code: Zol - 381 **Maximum Marks: 100**
Course Title: Lab exercises based on Elective course, Animal Resources, Threats & Conservation & Cytogenetics **University Examination: 50**
Sessional Assessment: 50

1. Chromosome preparation from the root tip cells of *Allium cepa.*
2. Idiogram preparation and determination of karyotype asymmetry in *Homo sapiens.*
3. Drosophila culture: media preparation and handling of flies
4. Study of Drosophila life cycle and its external morphology.
5. Mounting of sex comb of *Drosophila melanogaster*
6. To study salivary gland chromosomes of *Drosophila.*
7. Feulgen staining of DNA in protozoa (*Paramecium*)
8. Demonstration of FISH and GISH techniques.
9. General survey of larvivorous, game and unwanted fishes.
10. Determination of LC50 value of pollutants in fishes.
11. To study various types of rodent traps
12. To study and locate national parks of India on political map.
13. To study and locate biosphere reserves of India on political map.
14. To study and locate wildlife sanctuaries of India on political map.
15. To study various endangered birds of India.

Lab course on elective courses

Principles of Parasitology

1. Study of different types of parasitic protozoans from permanent slide/chart
2. Study of different types of parasitic helminthes from permanent slide/chart
3. Study of different types of insect vectors.
4. Collection and identification of various ecto and endo parasites and preparation of permanent stained slides and their submission for evaluation.
5. Study of mouth parts of insect vectors.
6. Study of life cycles of various parasites.
7. Dissection of Honey bee, Poison apparatus.
8. Collection, fixation, staining and preservation of protozoa by wet and dry method.
9. Disease transmitting arthropod parasites
10. Collection, fixation and preservation of nematodes.

Insect morphology and physiology

1. Dissection/demonstration of insect organ systems (digestive, excretory and reproductive) in insects like grasshopper, cockroach, wasp, honey bee.
2. Preparation of permanent stained mounts of insects, their body parts and dissected organs.
3. Study of permanent slides of insects, their body parts, organs and histological preparations.
4. Study of insect specimens showing coloration, mimicry and sound production.

Elements of Ichthyology

1. Study of Cranial nerves of *Scoliodon* and *Labeo* using charts.
2. Accessory respiratory organs of air breathing fish.
3. Study of histological (permanent) slides of stomach and intestine of teleosts.
4. Study of museum specimens of the cartilaginous and bony fishes.
5. Prepare the temporary slides of fish scales (Ganoid, placoid, ctenoid and cycloid).

Semester – IV

List of courses
For the years 2020-2023

Core course Course code	Course Title	Credits	Scheme of Examination			
			Duration	Marks		
			Hours	SA	UE	Total
Zol 470	Genetic Engineering	02	02	20	30	50
Zol 471	Animal Physiology	04	03	40	60	100
Zol 472	Fundamentals of Endocrinology	04	03	40	60	100
Zol 473	Dissertation	04	-	-	-	100
Elective courses						
Zol 474	Fundamentals of Nematode Genomics	02	02	20	30	50
Zol 475	Human Genetics	02	02	20	30	50
Zol 476	Wildlife Biology, Conservation & management.	02	02	20	30	50
Total A				160	240	400

Laboratory Courses

Zol 480	Lab course on Genetic Engineering & Elective paper.	04	03	50	50	100
Zol 481	Lab course on Animal physiology and Endocrinology.	04	03	50	50	100
Total B				100	100	200

Grand Total = A + B = 400+200 = 600

SA – Sessional Assessment
UE – University Examination

Course Code: Zol- 470
Course Title: Genetic Engineering
Credits: 02

Maximum Marks: 50
Sessional Assessment: 20
University Examination: 30
Duration of Exam: 2 hours

Objectives:
Genetic Engineering involves manipulation of genetic material for improvement and value addition of bioresources. This course will help students to learn the basic techniques of gene manipulation.

Unit 1: Genetic engineering techniques - I

1.1 Definition, brief history and scope of genetic engineering; Milestones in the development of genetic engineering as technology.
1.2 Molecular tools employed in genetic engineering: restriction enzymes-types, nomenclature and cleavage patterns; concept of linkers and adapters, ligases-types and nature of action.
1.3 Cloning Vectors for prokaryotes: properties of an ideal vector, plasmid vectors- pBR322 vectors, pUC8 vectors, M13 bacteriophage vectors, cosmids and shuttle vectors.
1.4 Cloning vectors for eukaryotes: Yeast integrative plasmids (YIps), Yeast artificial chromosome vectors (YAC) and bacterial artificial chromosome (BAC) vectors.

Unit 2: Genetic engineering techniques - II

2.1 Gel electrophoresis: Agarose, pulsed field and PAGE, Blotting techniques: Northern blotting, Southern blotting and Western blotting (Overview).
2.2 Polymerase Chain Reaction: principle, applications and importance; variation in PCR.
2.3 Genomic/cDNA libraries – construction, screening and choice of vectors.
2.4 DNA sequencing – chemical degradation and enzymatic methods, Automatic DNA Sequencers; DNA Fingerprinting – technique and applications.

Unit 3: Applications of genetic engineering

3.1 Gene transfer in animal cells, various methods used including transfer and particle bombardment mediated gene transfer.
3.2 Transgenic animal models and their significance for human welfare.
3.3 Gene therapy: introduction and its applications in human diseases (ADA and CFTR).
3.4 Production of recombinant proteins: Recombinant insulin, Human growth hormone and Recombinant factorVII.

Note for the paper setter:

The question paper will have two sections. Section A carrying 6 compulsory Objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will carry 6 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 8 marks.

Books recommended:

1. Brown, T. A. (2006). Gene Cloning – An Introduction. Blackwell Publishing. (5th edition).
2. Clark, D. P. (2005). Molecular Biology: Understanding the Genetic Revolution. Academic Press.
3. Clark, D. P. and Pazdernik, N. J. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Inc.
4. Davies, J. A. and Reznikoff, W.S. (1992). Milestones in Biotechnology, Classic Papers on Genetic Engineering. Butterworth – Hienemann, Boston.
5. Kingsman, S. M. and Kingsman, A. J. (1998). Genetic Engineering: An Introduction to

Gene Analysis and Exploitation in Eukaryotes. Blackwell Scientific Publications, Oxford.
6. Walker, M. R. and Rapley, R. (1997). Route Maps in Gene Technology, Blackwell Science Ltd, Oxford.
7. Williams, J., Ceccarelli, A. and Wallace, A. (2001). Genetic Engineering *Second Edition.* Springer – Verlag, New York Inc.

Course code: Zol-471
Course title: Animal Physiology
Credits: 04

Maximum Marks: 100
Internal Assessment: 40
External Examination: 60
Duration of Exam: 3 Hours

Objectives:

The course has been designed to make students understand the functioning of organs/ systems of animals so that students can further appreciate the knowledge of biochemistry and endocrinology acquired during the previous/current semesters.

Unit 1: Homeostasis: The central concept in physiology

1.1 Introduction to animal physiology, scope and significance. Body organization.
1.2 Homeostasis; Homeostatic control system- feedback and feed forward.
1.3 Thermoregulation - Heat balance in animals, Adaptations to temperature extremes, torpor, aestivation and hibernation.
1.4 Adaptations to Stress- basic concept of environmental stress, acclimatization, avoidance and tolerance (management), stress and hormone.

Unit 2: Digestion, Excretion and Ionic regulation

2.1 Digestion: Types of digestion, ingestion, motility of alimentary canal (Peristalsis and control of motility).
2.2 Absorption of food in the small intestine and feces formation in large intestine.
2.3 Excretion in Vertebrates- types of excretory products, renal physiology, composition of urine and countercurrent mechanism.
2.4 Renal control mechanism; renal water and sodium regulation.

Unit 3: Respiratory and Circulatory systems

3.1 Gas exchange; in lungs and gills, transport of oxygen and carbon dioxide, role of respiratory pigments, lung volumes and capacities.
3.2 Respiratory center and regulation of respiratory center.
3.2 Heart of Vertebrates; cardiac cycle, heart sounds, cardiac output. **Blood pressure.**
3.3 Cardiovascular control by central nervous system, baroreceptors, arterial chemoreceptors, regulation of capillary blood flow.

Unit 4: Sensory mechanisms and nerve physiology

4.1 Classification of general and special senses and their receptors; Physiology of olfactory and gustatory sensation.
4.2 Mechanism of hearing and vision, photoreceptor cells and phototransduction, sound transmission in the ear.
4.3 Origin and propagation of nerve impulse, velocity of impulse in different types of nerve fibers, properties of nerve fibers.
4.4 Concept of synapses, synaptic integration, synaptic plasticity, membrane potential and synaptic transmission.

Unit 5: Physiology of reproduction

5.1 Production of gametes: Process of spermatogenesis and oogenesis.
5.2 Reproductive cycle: Oestrous and Menstrual cycles.
5.3 Zygote formation: capacitation, acrosome reaction and cortical reaction of egg.
5.4 Abnormalities of male sexual function and secretion of the ovaries.

Note for the paper setter:

The question paper will have two Sections. Section "A" carrying 10 compulsory objective-cum- short answer type questions two from each unit. Section "B" will carry 10 questions, 2 from each unit. The students will have to attempt 1 question from each unit. Each question will carry 10 marks.

Books recommended:

1. C. Guyton and J. E. Hall. (2001). Text book of Medical Physiology, Publisher - W. B. Saunders Company, Philadelphia, 10th edition.
2. Comparative Vertebrate Endocrinology 3rd edition (1998), P. J. Bentley. PublisherCambridge University Press.
3. Endocrinology, 5th edition (2008), Mac. E. Hadley. Publisher-Pearson Education Inc. and Dorling Kindersley Publishing Inc.
4. Ian Kay (1998). Introduction to Animal Physiology, Bios Scientific Publishers. 1st edition.
5. Principles of Anatomy and Physiology, (2006). G. J. Tortora and B. Derrickson. Publisher-John Wiley and Sons Inc. 11th edition.
6. Principles of Animal Physiology (2006). C. D. Moyes and P. M. Schulte. Publisher – Pearson Education Inc. and Dorling Kindersley Publishing Inc. Recent edition.
7. S. C. Rastogi (2007). Essential of Animal Physiology, New age International (P), Limited, Publishers, New Delhi, 4th Edition.
8. The World of the Cell, 7th edition, (2005), Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin., Publisher - Benjamin Cummings.
9. Vertebrate Endocrinology 3rd edition (1997), D. O. Norris. Publisher- Academic Press: An imprint of Elsevier.

.

Course Code: Zol-472
Course Title: Fundamentals of Endocrinology
Credits: 04

Maximum Marks: 100
Internal Assessment: 40
External Examination: 60
Duration of Exam: 3 hours

Objectives:

The course is designed to afford the student a broad understanding of the important branch of animal physiology. A comparative approach is useful to understand as to how different hormones regulate a particular physiological activity, irrespective of their diversity in order to maintain homeostasis. Besides this, adequate knowledge of endocrinology is quite imperative because it constitutes a very vital field of contemporary human medicine.

Unit 1: Introduction to endocrinology

1.1 Historical background, scope and application of endocrinology.
1.2 Homeostasis; Concept of homeostasis, hormones and homeostasis, neuroendocrine integration in homeostasis.
1.3 Hormones; Synthesis, release and their transport.
1.4 Mechanism of hormone action-Cell surface and intracellular signaling.

Unit 2: Neuroendocrinology

2.1 Hypothalamus; the hypophysiotropic hormones, control of hypophysial hormone secretion.
2.2 Pituitary gland: Anatomy, secretion and physiological role of the adenohypophysis hormones.
2.3 Neurohypophysis; Formation, release and control of neurohypophysial hormones.
2.4 Neuroendocrine role in insect metamorphosis.

Unit 3: Endocrine glands-structure and function-I: Thyroid, Parathyroid and Pancreas 3.1 Thyroid gland-its anatomy, hormones- synthesis, secretion, transport and their role.
3.2 Pararthyroid; structure, biosynthesis and function of parathormone, deficiency diseases.
3.3 Parafollicular C- cells. Calcitonin-biosynthesis, role in calcium regulation.
3.4 Pancreas-anatomy of endocrine part, hormones secreted-Insulin, glucagon: structure, biosynthesis, secretion, function and deficiency diseases. Diabetes mellitus- types and management

Unit 4: Endocrine glands-structure and function-II Adrenals and Gonads

4.1 Adrenal glands-anatomy, Hormones secreted. Renin-Angiotensin-Aldosterone System.
4.2 Steroid hormones; structure and function of gonadal (male & female) sex hormone and adrenal steroid hormones. Feedback control of gonadotropin secretion
4.3 Hormonal control of menstrual cycle. Placental hormones and their role in maintaining pregnancy.
4.4 Neural and endocrine mechanism for control of parturition. Hormonal contraception and menopause.

Unit 5: Endocrine glands-structure and function-III and Assay methods. Pineal gland, Gastrointestinal peptides, Invertebrate hormones.

5.1 Pineal gland; synthesis and function of pineal hormones.
5.2 Gastrointestinal hormones and their physiological role.
5.3 Principal Invertebrate hormones and their role in biology and control.
5.4 Hormone assay methods for clinical diagnosis.

Note for the paper setter:

The question paper will have 2 Sections. Section 'A' will be compulsory having ten questions of 01 mark each. The questions will be either short answer type having answers not exceeding 20 words or multiple choice type having four options each or fill in the blanks type. Section 'B' will contain ten long answer questions of 10 marks each, two from each Unit. The candidates will be required to answer one question from each Unit.

Books Recommended:

1. Bantley, P.J. (1976). Comparative Vertebrate Endocrinology, 3rd Edition, Cambridge University Press, U.K.
2. Barringtron, E.E.W. (1968). An Introduction to Comparative Endocrinology, Willey Eastern Pvt. Ltd.USA.
3. Garbman. D, Vigna, Clark & Ralph (1995). Comparative Endocrinology, 3rd Edition, John Wiley & Sons Publishers.
4. Jhon E. Hall. (2011). Guyton & Hall Text Book of Medical Physiology, 12th Edition, Sauanders Elsiever Publishers.
5. Lewin R. (1972). Hormones, Illustrated Edition, Geoffrey Chapman Publishers.
6. Lewis J.G. (1970). The Endocrine System, Illustrated Edition, Library of Congress Publishing Division.
7. Matty A. J. (1985). Fish Endocrinology, 2nd Edition, Croom Helm publishers.
8. Norris D. O. (2007). Vertebrate Endocrinology, 2nd Edition (Illustrated), Elsevier Academic Press.
9. Turner, S.L. (1966). General Endocrinology, 3rd Edition, E.S. Saunders, Toppan Co. Ltd. Tokyo Japan.

Course code: Zol-473
Course title: Dissertation

Maximum Marks: 100
Dissertation: 80
Viva Voce: 20

Dissertation

Elective courses

Course Code: Zol-474
Course Title: Fundamentals of Nematode Genomics
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

The principal objective of this course is to impart knowledge about basics of nematode genomics. The nematode model organism, Caenorhabditis elegans owed much of its initial appeal as an experimental organism to understand the generalized overview of fundamental processes in nematode genomics. In addition it will enable students to comprehend, analyze, evaluate and intelligently critique different aspects in this field.

Unit I: Structural genomics of Nematode:

1.1 General structure and morphology of nematodes, general taxonomic characters involved identification in nematodes.
1.2 Basic biology of nematodes by studying *Caenorhabditis elegans* as model organism.
1.3 General overview of nematode genomics, genome evolution in nematodes: evolution of genome size, chromosome evolution, evolution of gene content and rate of evolution in nematodes.
1.4 Genome organization and Gene structure in nematodes (*Caenorhabditis elegans*): concept of gene, gene number and size, pseudogenes.

Unit II Fundamental techniques in nematode genomics

2.1 Sampling and isolation of nematodes from soil and farmyard manure, Agar based culturing of nematodes for molecular analysis.
2.2 Microscopy: principle and application of bright field and inverted microscopy in the field of nematode taxonomy.
2.3 Principle for isolation of genomic DNA from nematodes, qualitative and quantitative analysis of isolated DNA using agarose gel electrophoresis and Spectrophotometer.
2.4 Polymerase chain reaction: basic principle, types (RT-PCR, qRT-PCR and nested PCR) and applications of PCR.

Unit III. Functional genomics: DNA barcoding and phylogenetic analysis

3.1 Molecular taxonomy and concept of DNA barcoding-application in nematode taxonomy.
3.2 Molecular markers: general characteristics of DNA based molecular markers; comparative account of different DNA based markers.
3.3 Markers used in DNA barcoding: Internal transcribed Spacer sequences (ITS) and mitochondrial cytochrome oxidase C subunit 1.
3.4 Molecular phylogenetics: concept of phylogenetic tree, analysis of phylogenetic trees and tree building methods and software's used for constructing phylogenetic trees.

Note for the paper setter:

The question paper will have two sections. Section 'A' carrying 6 compulsory Objective –cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section 'B' will carry 6 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 8 marks.

Books Recommended:

1. Brown, T. A (2007). Genomes. 3rd edition, BIOS Scientific Publishers Ltd.
2. Jairajpuri S. (2002) Nematode Structure, 1st edition, Impression quality printers.
3. Jones J., Godelieve G., Carmen F. (2011). Genomics and Molecular Genetics of Plant-Nematode Interactions. Springer, 2nd edition, ISBN-13: 978-9400704336.
4. Wharton D. A. (2012). A Functional Biology of Nematodes (Functional Biology Series), Springer; 1st edition, ISBN-13: 978-1461585183.
5. Wilson K., and J. Walker, (2010): Principles and Techniques of Biochemistry and Molecular Biology Techniques, Cambridge Univ. Press. 7th Ed. *WormBook.* The *C. elegans* Research Community, WormBook,doi/10.1895/wormbook.1.7.1, http://www.wormbook.org.

Course Code: Zol-475
Course Title: Human genetics
Credits: 02

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

The course is designed to afford the student a broad understanding of the important branch of genetics. Study of human genetics can be useful as it can answer questions about human nature, understand the diseases and development of effective disease treatment and to better understand and improve the quality of human life.

Unit 1: Human Genome

1.1 Human genome project: applications and ethical issues; human mitochondrial genome.
1.2 Genetic and physical mapping of human genome, homozygosity mapping, linkage disequilibrium mapping, radiation hybrid mapping.
1.3 Discovering human disease genes: functional and positional candidate gene cloning strategies.
1.4 Detection of mutations in human genes: single-strand conformation polymorphism analysis, denaturing gradient gel electrophoresis, heteroduplex analysis, chemical mismatch cleavage, direct DNA sequencing, protein truncation test.

Unit 2: Behavioral and Clinical Genetics

2.1 Polygenic inheritance, heritability and its measurements and quantitative trait loci (QTL).
2.2 Genetics of neurological disorders: Schizophrenia, Parkinson, Alzheimer and Huntington disease.
2.3 Family history and congenital malformations: chromosomal disorders, neural tube defects, teratogenic effects, multiple malformation syndromes.
2.4 Disease and carriers screening: prenatal screening, neonatal screening, carrier detection and presymptomatic screening of adults.

Unit 3: Population Genetics

3.1 Hardy–Weinberg Law: rate of change in gene frequency through mutation, migration, non-random mating, genetic drift and natural selection; Neutral theory of molecular evolution.
3.2 Concept of phenotype, allele, genotype, heterozygosity and homozygosity; Heterozygosity advantage.
3.3 Population structure: gene pool, genetic distance, genetic identity and phylogeny.
3.4 Genetic markers: classical and molecular markers used in human population genetics.

Note for the paper setter:

The question paper will have two sections. Section A carrying 6 compulsory Objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will carry 6 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 8 marks.

Books recommended:

1. Human Genetics: McConky
2. An Introduction to Medical Genetics: Roberts and Pembrey
3. Essentials of Medical Genetics: Ferguson Smith
4. Human Genetics: Vogel and Motulsky

Course code: Zol-476
Course title: Wildlife Biology, Conservation & Management

Maximum Marks: 50
Internal Assessment: 20
External Examination: 30
Duration of Exam: 2 hours

Objectives:

There is a growing need for knowing what wildlife means and what is its importance in the balance of nature. The course has been designed to convey the information regarding wildlife in India to desirous students so that they can understand its management along biological lines and the techniques associated with it.

Unit 1: Basics of Wildlife Biology

1.1 Introduction and scope of Wildlife Biology.
1.2 Wildlife values: Commercial, game, aesthetic, ethical, scientific and ecological values.
1.3 Introduction of wildlife population: Density and biomass, population structure, natality and mortality.
1.4 Physiological Basis of Hibernation, Aestivation, Awakening, Migration; Circadian rhythms; Hypothalamo- Hypophysial Axis and its role; Pineal gland and its role; Day- length influences on Phenology.

Unit 2: Wildlife management

2.1 Population viability and habitat analysis (PVHA); Captive breeding and propagation
2.2 Rescue, rehabilitation and reintroduction.
2.3 Gene banks, ex-situ and in-situ conservation.
2.4 Forest landscape restoration and importance of microorganisms.

Unit 3: Wildlife conservation

3.1 Introduction and history of wildlife conservation: Global and Indian perspectives.
3.2 The history of wildlife conservation and how it has shaped conservation today, modern concepts such as the Protected Area Network (PAN), IUCN, and CITES.
3.3 Values and ethics in wildlife conservation: Definitions and traditions (instrumental, intrinsic, ecocentrism, religious traditions and conservation.
3.4 Aldo Leopold's land ethic and ethics in conservation.

Note for the paper setter:

The question paper will have two sections. Section A carrying 6 compulsory Objective – cum – short answer type questions, two from each unit. Each question will carry 01 mark. Section B will carry 6 questions, two from each unit. The students will attempt 1 question from each unit. Each question will carry 8 marks.

Books recomended:

1. Dasmann, R.F. 1981.Wildlife Biology. 2nd Ed. Johm Wiley and Sons.
2. Caughley, G., and Sinclair, A.R.E. 1994. Wildlife Ecology and Management. Blackwell Science.
3. Sutherland, W.J. 2000. The Conservation Handbook: Research, Management and Policy. Blackwell Sciences.
4. Bookhout, T.A. 1996. Research and Management Techniques for Wildlife and Habitats, 5th Ed. The Wildlife Society, Allen Press.
5. Woodroffe R., S. Thirgood and A. Rabinowitz. 2005. People and Wildlife, Conflict or Co-existence? Cambridge University.
6. Caughley, G. 1977.Analysis of vertebrate populations.John Wiley and Sons.

Course Code: Zol-480
Course Title: Lab course on Genetic Engineering and elective paper

Maximum Marks: 100
Sessional Assessment: 50
University Examination: 50

1. Ethics of laboratory practices.
2. Preparation of bacterial cells for transformation.
3. Selection of lac Z^+ *E. coli* colonies by using blue white selection method to detect transformants.
4. Restriction digestion of genomic DNA.
5. Agarose gel electrophoresis of digested genomic DNA.
6. Demonstration of construction of restriction maps of DNA.
7. Perform Polymerase Chain Reaction

Course code: Zol-481
Course title: Lab course on Animal Physiology and Fundamentals of Endocrinology.

Maximum Marks: 100
University Examination: 50
Sessional Assessment: 50

1. Study of types of heart (Myogenic & Neurogenic).
2. Recording of blood pressure using sphygmomanometer.
3. Assessing physical and chemical modifiers of heart rate in frog/albino rat.
4. Determination of glucose of your own blood.
5. Detection of urea and creatinine of your own blood.
6. Preparation of haemin crystals from human blood.
7. To study the enzyme activity of amylase, trypsin.
8. Counting of RBCs corpuscles and WBCs corpuscles of your own blood.
9. Study of different types of sperm by smear preparation (grasshopper, frog and rat) under microscope.
10. Demonstration of endocrine glands in cockroach/ albino rat.
11. Whole mount of chick embryo stages.
12. Making permanent stained preparations of kidneys, pancreas and gonads.

Lab course on Elective courses

Fundamentals of Nematode Genomics

1. Sampling and collection of nematodes from different habitats.
2. Extraction of nematodes using Cobbs sieving and modified Baermann's funnel technique.
3. Preparation of permanent slides of nematodes.
4. Culturing of Rhabditid nematodes in agar medium.
5. Isolation of genomic DNA from nematodes.
6. Agarose gel electrophoresis of genomic DNA.
7. Construction of phylogenetic tree by appropriate software.
8. Demonstration of Polymerase chain reaction (PCR).

Human Genetics

1. Mutation analysis from a given sequence electropherograms.
2. Testing human intelligence quotient (IQ) using Wechsler Intelligence Scale.
3. Observation of red-green color blindness among human populations.
4. Testing sickle cell anemia in human blood samples.
5. Pedigree analysis in human families.
6. Calculation of coefficient of inbreeding from given human pedigrees.
7. Observation of phenotypic and genotypic frequencies using phenylthiocarbamide (PTC) taste sensitivity marker.
8. Calculation of allele frequency, genotype frequency and heterozygosity from given data.
9. Chi-square test calculation with p-vale significance of given human population traits/ or disease data.

Wildlife Biology, conservation and managemnet

1. Identification of mammalian fauna of Rajouri region.
2. Identification of avian fauna of Rajouri region.
3. Identification of herpeto-fauna of Rajouri region.
4. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses, Camera trap, Sherman trap, Camping gear).
5. Identification/preparation of museum specimens. Precautions taken in the field.