DAV UNIVERSITY JALANDHAR

Course Scheme & Syllabus

For

Master of Science Zoology (Hons.)

(Program ID-42)

1st TO 4th SEMESTER

Syllabi Applicable For Admissions in 2013

DAV UNIVERSITY, JALANDHAR

Scheme of Courses Zoology

Master of Science (Honours)

Semester 1

S.No	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
							A	B	C	D	
1	ZOO501	Cell Biology	4	1	0	4	25	25	25	25	100
2	Z00502	Animal Physiology	4	1	0	4	25	25	25	25	100
3	Z00503	Animal Ecology and Bio resource Management	3	0	0	3	25	25	25	25	75
4	Z00504	Biosystematics and Biodiversity	3	0	0	3	25	25	25	25	75
5	Z00505	Immunology	3	0	0	3	25	25	25	25	75
6	ZOO506	Cell Biology LAB	0	0	3	2	20	-	-	80	50
7	ZOO507	Animal Physiology LAB	0	0	3	2	20	-	-	80	50
8	ZOO508	Animal Ecology and Bio resource Management LAB	0	0	2	1	20	-	-	80	25
9	ZOO509	Biosystematics and Biodiversity LAB	0	0	2	1	20	-	-	80	25
10	ZOO510	Immunology LAB	0	0	2	1	20	-	-	80	25
11	ZOO511	Seminar I	0	0	0	2	-	-	-	100	50
			17	**2**	**5**	**26**					**650**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type and Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type and Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks

L: Lectures T: Tutorial P: Practical Cr: Credits

DAV UNIVERSITY, JALANDHAR

Scheme of Courses Zoology

Master of Science (Honours)

Semester 2

S.No	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
							A	B	C	D	
1	ZOO512	Advanced Techniques in Zoology	3	0	0	3	25	25	25	25	75
2	ZOO513	Comparative Vertebrate Endocrinology	3	0	0	3	25	25	25	25	75
3	ZOO514	Biostatistics	4	1	0	4	25	25	25	25	100
4	ZOO515	Developmental Biology	3	0	0	3	25	25	25	25	75
5	BCH553	General Biochemistry	2	0	0	2	25	25	25	25	50
6	ZOO516	Advanced Techniques in Zoology LAB	0	0	2	1	20	-	-	80	25
7	ZOO517	Comparative Vertebrate Endocrinology LAB	0	0	2	1	20	-	-	80	25
8	ZOO518	Biostatistics LAB	0	0	3	2	20	-	-	80	50
9	ZOO519	Developmental Biology LAB	0	0	2	1	20	-	-	80	25
10	BCH552	General Bio chemistry LAB	0	0	2	1	20	-	-	80	25
11	ZOO520	Seminar II	0	0	0	2	-	-	-	100	50
			16	**1**	**6**	**23**					**575**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type and Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type and Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks
L: Lectures T: Tutorial P: Practical Cr: Credits

DAV UNIVERSITY, JALANDHAR

Scheme of Courses Zoology

Master of Science (Honours)

Semester 3

S.No	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
							A	B	C	D	
1.	BTY502	Molecular Biology	4	1	0	4	25	25	25	25	100
2.	BTY602	Computational Biology and Bioinformatics	4	0	0	3	25	25	25	25	75
3.	BOT605	Scientific Writing and Research Strategies	2	0	0	2	25	25	25	25	50
4.	ZOO601	Specialization Elective* Parasitology	4	0	0	3	25	25	25	25	75
5.	ZOO602	Specialization Elective* Vertebrate Reproductive Physiology	4	0	0	3	25	25	25	25	75
6.	ZOO603	Specialization Elective* Aquaculture and Fisheries	4	0	0	3	25	25	25	25	75
7.	ZOO604	Specialization Elective* Entomology	4	0	0	3	25	25	25	25	75
8.	BTY506	Molecular Biology LAB	0	0	3	2	20	-	-	80	50
9.	BTY606	Computational Biology and Bioinformatics LAB	0	0	2	1	20	-	-	80	25
10.	ZOO605	Specialization Elective* Parasitology LAB	0	0	2	1	20	-	-	80	25
11.	ZOO606	Specialization Elective* Vertebrate Reproductive Physiology LAB	0	0	2	1	20	-	-	80	25
12.	ZOO607	Specialization Elective* Aquaculture and Fisheries LAB	0	0	2	1	20	-	-	80	25
13.	ZOO608	Specialization Elective* Entomology LAB	0	0	2	1	20	-	-	80	25
14.	ZOO609	Seminar III	0	0	0	2	-	-	-	100	50
15.	ZOO610	Educational Tour	0	0	0	1	-	-	-	-	25
			22	**1**	**9**	**23**					**575**

***For Specialisation**: Students are required to choose any two theory cou1ses from ZOO 601 to Z00 604 and practical courses from ZOO 605-ZOO 608.*

A: Continuous Assessment: Based on Objective Type Tests

B: Mid-Term Test-1: Based on Objective Type and Subjective Type Test

C: Mid-Term Test-2: Based on Objective Type and Subjective Type Test

D: End-Term Exam (Final): Based on Objective Type Tests

E: Total Marks

L: Lectures T: Tutorial P: Practical Cr: Credits

DAV UNIVERSITY, JALANDHAR

Scheme of Courses Zoology

Master of Science (Honours)

Semester 4

S.No	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
							A	B	C	D	
1	ZOO611	Animal Biotechnology	4	0	0	3	25	25	25	25	75
2	ZOO612	Animal Behaviour and Wild Life Management	4	0	0	3	25	25	25	25	75
3	BTY652	Genomics, Proteomics and Metabolomics	4	1	0	4	25	25	25	25	100
4	ZOO613	Animal Biotechnology LAB	0	0	2	1	20	-	-	80	25
5	ZOO614	Animal Behaviour and Wild Life Management LAB	0	0	2	1	20	-	-	80	25
6	BTY656	Genomics, Proteomics and Metabolomics LAB	0	0	3	2	20	-	-	80	50
7	ZOO615	Seminar IV	0	0	0	2	-	-	-	100	50
8	ZOO616	Project	0	0	0	8	-	-	-	100	200
			12	**01**	**3**	**24**					**600**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type & Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type & Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks

L: Lectures T: Tutorial P: Practical Cr: Credits

Syllabus

Course Title: Cell Biology
Course Code: Z00 501

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: The students will learn molecular organization of cell and cellular organelles and molecular mechanisms of cellular functions.

UNIT-A 17 hours

- Cell as a unit of life, brief history and characteristics of cell theory.
- Structure of prokaryotic and eukaryotic cells, their similarities and differences
- Membrane structure-unit membrane model-lipid bilayer and proteins, membrane asymmetry and fluidity. Transport mechanisms-osmosis, diffusion, passive (uni-,sym- and antiport) and active transport, ion channels. Bulk transport by pinocytosis, phagocytosis and endocytic pathways.Transport across epithelia. Membrane potential.
- Cell surface modifications-invaginations, microvilli, basal lamina, tight junctions, desmosomes.
- General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions- connexins, neurotransmission and its regulation.
- Extracellular matrix- integrins, collagen and non-collagen components

UNIT-B 14 hours

- Endoplasmic reticulum- Smooth and rough.
- Golgi apparatus- protein sorting, glycosylation and packaging of proteins.
- Centrioles and basal bodies.
- Lysosomes- the proton pump, vacuoles.
- Ribosomes, peroxisomes and glyoxisomes
- Mitochondria and chloroplast as transducing systems and as semiautonomous organelles.
- Nucleus- nuclear envelope, nucleoplasm and nucleolus.

UNIT-C 19 hours

- Organisation of genes and chromosomes- chromatin, histones, heterochromatin and euchromotin, polytene and lampbrush chromosomes.Coding and noncoding genes,interrupted genes, gene families, unique and repetitive DNA,mobile DNA, transposons
- Cytoskeleton- microfilaments and microtubules- their structural dynamics and role in cell movements, division and internal transport. Role of kinesin and dynein.
- Cell division and cell cycle: different stages of mitosis and mieosis and their regulation- MPF, steps of cell cycle and their control- cyclins and cyclin dependant kinases-CDK-cyclin activation
- Signal transduction mechanisms-cell signaling from PM to nucleus, cell surface receptors, ligand binding, signal transduction pathways, second messengers, regulation of signaling pathways, signaling

through G-protein coupled receptors

UNIT-D 10 hours

- Cell differentiation- the molecular mechanisms
- Cellular ageing/senesence and programmed cell death (apoptosis)
- Cancer cells- oncogenes and their suppressors, metastasis, interaction of cancer cells with normal cells.
- Cell-cell fusion in both normal and abnormal cells.

Reference books:

1. DeRobertis, EDP, De Robertis,E.M.F. Cell Biology and Molecular Biology. Eighth Edition. W.B. Saunders Co., Philadelphia, 1995.
2. Cooper, G. M., The Cell A Molecular Approach, 4th ed., Sinauer Associates, Inc, Massachusetts (2007).
3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H. and Matsudaira, P., Molecular Cell Biology, 6th ed., WH Freeman Company, New York (2007)
4. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., Molecular Biology of the Cell, 4th ed., Garland Science, New York (2002).

Course Title: Animal Physiology
Course Code: ZOO 502

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: The students will learn physiological aspects of body processes at system, organ, tissue and cellular level as well as their regulation.

Unit A 17 hours

- **Nutrition**: Sources, functions and deficiency disorders of micro- and macro-nutrients.
  Digestion: Functional structure of digestive glands- salivary glands, pancreas, liver, gastric and intestinal wall glands- neural and hormonal regulation of secretion of digestive juices. Digestion of food nutrients in different parts of the alimentary canal in animals. Absorption of food- the molecular structure of the absorptive surface. Assimilation of food, egestion. The peristaltic movements, their regulation and significance. Energy balance, BMR
- **Respiration:** Types of respiration, comparison of respiration in different species-anatomical considerations, breathing mechanisms, alveolar ventilation and gaseous exchange in lungs- the respiratory membrane, transport of gases by the blood, oxygen-haemoglobin dissociation curve. Transport, dissociation and liberation of CO_2, chloride shift, cellular respiration and oxidation. Respiratory pigments and their oxygen carrying capacity. Neural and chemical regulation of respiration and respiratory quotient. Respiration during exercise and at high altitude

Unit B 15 hours

- **Blood and Circulation**: Blood corpuscles, haemopoiesis and formed elements, plasma functions, blood volume and its regulation, blood groups, haemoglobin, immunity, blood coagulation, haemostasis. Physiological and comparative anatomy of heart, blood vessels and lymphatic system. Cardiac musculature- specialized tissue and conduction system of the heart- myogenic and neurogenic heart- as a pump, ECG and its significance. Cardiac cycle, heart beat, heart sounds, cardiac output, blood pressure and their neural and chemical regulation. .
- **Excretion:** Functional anatomy of kidney-the nephron and its functions, the mechanism of urine formation and its concentration- the countercurrent theory,electrolyte balance Acid-base balance. The feedback and hormonal control of renal functions.Micturition. Comparative physiology of excretion of nitrogenous waste products.
- **Osmoregulation:** Mechanisms of water and salt balance in aquatic (freshwater, brackish and marine), migratory and terrestrial animals and its hormonal regulation.

Unit C 18 hours

- **Musculature**: Types of muscles, Fine structure of skeletal muscle fibre and its chemical composition, molecular mechanism of muscle contraction (sliding-filament theory). Electric organs in fishes.
- **Neurophysiology:** Neural structure- its types, neuroglia and blood-brain barrier. Resting potential, generation of action potential and its propagation-role of Na+-K+ and Ca++pumps, conduction of nerve impulse, myelination and saltatory conduction, neurotransmitters and mechanism of synaptic transmission, summation of excitatory and inhibitory nerve impulses and their

computation. Properties of a reflex and its types. Gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Electrophysiological methods: Single neuron recording, patch-clamp recording, EEG- Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.

- **Special Senses:** Physiology of vision- molecular and cellular structure of retina, colour blindness and other vision defects, Hearing and equilibrium and senses of smell, taste and touch.

Unit-D 10 hours

- **Endocrine Regulation**: Structure and functions of pituitary gland, thyroid, parathyroid, adrenals, Islets of Langerhans and their neuroendocrine regulation- the feedback mechanism. Chemical nature of hormones. Autocrine, paracrine and juxtacrine regulation. Mechanism of hormone action. Stress physiology.
- **Reproduction**: Reproductive patterns in animals, Hypothalamo-hypophyseal gonadal regulation. Structure and hormonal functions of gonads, Gametogenesis, hormonal regulation of ovulation, fertilization and implantation, pregnancy, parturition and lactation.

Reference books:

1. Wood DW. Principles of Animal Physiology. Hodder Arnold. 3rd edition.
2. Wison JA. Principles of Animal Physiology. Prentice Hall College Div. 2nd edition. 1979.
3. Prosser CL, Bishop DW. Comparative Animal Physiology. Philadelphia Saunders.1950.
4. Singh HR and Kumar N. Animal Physiology and Biochemistry. Vishal Publishing Co.
5. Schmidt-Nielsen K. Animal Physiology: Adaptations and Environment. Cambridge University Press; 5 edition. 1997.
6. Randall D, Eckert R, Burggren W, French K. Eckert Animal physiology: Mechanisms and Adaptations. WH Freeman & Co. 1997.
7. Guyton, A.X., Text Book of Medical Physiology, 7th edition, Saunders Company, 1986.
8. Best, J.P., Best and Taylor's physiological basis of medical practice,11th ed., William and Wilkins, 1985.
9. Hoar, W.S., General and comparative physiology, Adaptation and Environment ,3rd ed., Cambridge University Press, 1983.
10. Rhoades, R.A., Tanner, G.A., Medical Physiology, 2nd ed., Lippincott Williams and Wilkins, 2003.

Course Title: Animal Ecology and Bio resource Management
Course Code: ZOO 503

L	T	P	Credits	Marks
3	0	0	3	75

Course Objective: To acquaint students with the different ecological principles and make them understand the impact of environment pollution and management of bioresources.

Unit A 12 hours

- Environmental Education: objectives, guiding principles, major areas and scope of environmental education.
- Environmental challenges in India: population explosion and poverty, land degradation, human settlement, increase in agricultural growth, energy crisis, biodiversity, environmental pollution, water management etc.
- Interactions between animals and environment, concept of habitat and niches

Unit B 15 hours

- Biomonitoring of environment: microbial system, lower plants, higher plants, animals systems, human system, cell biology and genetics, aeroallergens, etc.
- Control of environmental pollution through law: Environmental Protection Act 1986 and amendments in air and water acts.
- Atmosphere pollution: sources, hazards of air pollutants on plants, animals, human beings and climate.
- Water pollution: impact of pollution due to sewage, industries, thermal power plants, silt, pesticides, fertilizers, detergents, etc.

Unit C 11 hours

- Management of solid municipal wastes – composting, incineration, sanitary landfills, etc.
- Management of hazardous wastes – deep well injection, land application, secure land fill, source reduction, treatment, incineration etc.
- Recycling and reclamation of wastes – anaerobic bacterial digestion, pyrolysis, as fuel composting, recycling, etc.

Unit D 7 hours

- Global Warming – Green house effect, changes in green house gases, impact of green house.
- Ozone depletion – Ozone depletion and CFC, Global efforts and management issues.
- Biodiversity – Concept, human activity as a major threat to biodiversity. Environment Impact Assessment

Reference books:

1. Singh, H.R. and Kumar, N., Ecology and Environmental Science, 7th ed., Vishal Publishing Co., Jalandhar, 2010.
2. Sharma, P.D., Ecology and Environment, 7th ed., Rastogi Publishers, Meerut, 2003
3. Kreb, J.C., Ecology, Harper & Row, Publ., New York, 2009.
4. Odum, E.P. and Barrett G.W.,Fundamentals of Ecology, Thomson Brooks/Cole, 2005.
5. Clarke,G. L., Elements of Ecology, John Wiley & Sons, New York, 1954.
6. Kendeigh, S.C., Ecology with special reference to animals and man, Prentice Hall of India, N. Delhi, 1961.
7. Smith, Ecology, Harper & Row Publishers, New York, 1990.
8. Kormondy, E.J., Concepts of Ecology, 2nd ed., Prentice Hall of India, New Delhi, 2005.

Course Title: Biosystematics and Biodiversity
Paper Code: ZOO 504

L	T	P	Credits	Marks
3	0	0	3	75

Course Objective: To enable the students to identify, classify and name the organisms according to international code of zoological nomenclature. To acquaint the student with different procedures of taxonomy and different methods of analysis of variations and theories of classification. To educate students about the importance and conservation of biodiversity.

UNIT-A 10 hours

- Definition and basic concepts of biosystematics and taxonomy-History, Importance and applications in biology, attributes of biosystematics
- Trends in Biosystematics-concepts of different conventional and newer aspects-chemotaxonomy, cytotaxonomy, molecular taxonomy

UNIT-B 18 hours

- Dimensions of speciation and taxonomic characters: Type of lineage changes, production of additional lineage, mechanism of speciation in panmictic and apomictic species.
- Species concepts-species category, different species concepts, sub species and other intra-specific categories
- Theories of biological classification, hierarchy of categories
- Taxonomic characters- different kinds, origin of reproductive isolation-biological mechanism of genetic incompatability

UNIT-C 12 hours

- Taxonomic procedures-taxonomic collections, preservation, curetting, process of identification
- Taxonomic keys-different kinds, their merits and demerits
- International code of zoological Nomenclature (ICZN)- its operative principles, interpretation and application of important rules, zoological nomenclature; formation of scientific names of various taxa

UNIT-D 5 hours

- Molecular perspective on the conservation of biodiversity
- Evaluation of biodiversity indices-Shannon-Weinner index, dominance index, similarity and dissimilarity index, association index

Reference books

1. M. Kato. The biology of Biodiversity, Springer
2. G.G. Simpson. Principles of animal taxonomy; Oxford IBH Publishing Company.
3. E. Mayer: Elements of taxonomy
4. EO Wilson. The Diversity of life (The College Edition), W.W. Northern Co.
5. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta

DAV UNIVERSITY, JALANDHAR

Course Title: Immunology
Paper Code: ZOO 505

L	T	P	Credits	Marks
3	0	0	3	75

Course Objective: To acquaint the students with the basic concepts of immunology and the immune effector mechanisms. To make the student understand the role of immunity in controlling the pathogenic infection.

UNIT-A 15 hours

- Innate and Adaptive Immunity.
- Organization and structure of lymphoid organs
- Cells of the immune system and their differentiation
- Lymphocyte traffic
- Nature of antigens and super antigens. Antigenicity and immunogenicity. Factors influencing immunogenicity. Epitopes and haptens
- Structure and functions of antibodies: classes and subclasses, gross and fine structure. Antibody mediated effector functions.
- Antigen-antibody interactions *in vivo* and *in vitro*
- Complement System

UNIT-B 12 hours

- MHC complex in mouse and HLA system in humans: MHC haplotypes, Class I and class II molecules, cellular distribution, peptide binding, expression and diversity, disease susceptibility and MHC/HLA
- antigen processing and presentation,
- Isolation, molecular components and structure of T cell receptors, T-cell Maturation, activation and differentiation, cell death and T cell population

UNIT-C 10 hours

- B-cell receptors, selection of immature self-reactive B cells, B-cell activation and proliferation, humoral immune response-kinetics.
- Cytokines: Structure and functions, cytokine receptors, cytokines and immune response
- Cell-mediated effector functions: Cell adhesion molecules, effector cells and molecules, CTL and NK cells-mechanisms of action, Delayed type hypersensitivity.

UNIT-D 8 hours

- Immunological tolerance and antiimmunity
- Toll-like receptors,
- Hypersensitivity
- Autoimmunity
- Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections,
- Congenital and acquired immunodeficiencies,

- Vaccines.

Reference books

1. Benjamini, Immunology, 5th ed., Coico & Sunshine, Wiley-Liss Publication, New York (2003).
2. Roitt, I.M., Brostoff, J. and Male, D., Immunology, 8th ed., Mosby Publications, Edinburgh, Mosby (2012).
3. Paul, W.E., Fundamental Immunology, 7th ed., Lippincott Raven Publication, Philadelphia, New York (2012).
4. Kuby J., Immunology, 6th ed., W.H. Freeman & Company, New York. (2007).
5. Janeway, C.A., Travers, P., Walport, M. and Shlomchik, M.J., Immunobiology: The
6. System in Health and Disease, Garland Science Publishers, (2005).

Course Title: Cell Biology Lab
Course Code: ZOO 506

L	T	P	Credits	Marks
0	0	3	2	50

- To study and compare the structure of a prokaryotic and eukaryotic cell
- To study cell organelles by cell fractionation
- To study cellular junctions in intestinal and testicular cells
- To study the process of osmosis (exo-and endo-) in RBCs
- To study specialized cells in semen and blood smear
- To count cells in sample of semen and blood
- To separate and identify cellular proteins by electrophoresis
- To study cell division in buccal mucosa/prepared slides

Note: Practicals related to Cell Biology Lab are in accordance with UGC guidelines and have been approved by Dissection Monitoring Committee

Course Title: Animal Physiology Lab
Course Code: ZOO 507

L	T	P	Credits	Marks
0	0	3	2	50

- Demonstration of activity of digestive enzymes (Amylase, Protease, Lipase).
- Haematological Tests-PVC, DLC, TLC, RBC and WBC count, Haemoglobin estimation.
- Measurement of blood pressure and pulse, bleeding and clotting time in human. Preparation of human blood film. Study of different types of blood cells, TLC, DLC
- Demonstration of pneumostastic recording of respiratory movements.
- Demonstration of oxygen uptake by pipette manometer.
- To study the effect of exercise on cardiovascular and respiratory system.
- To study the effect of insulin on blood glucose level of rat.
- To prepare the vaginal smears of mice and identify the stage of estrous cycle.
- To study the histology of different organs and endocrine glands.

Note: Practicals related to Animal Physiology Lab are in accordance with UGC guidelines and have been approved by Dissection Monitoring Committee.

DAV UNIVERSITY, JALANDHAR

Course Title: Animal Ecology and Bio resource Management Lab

L	T	P	Credits	Marks
0	0	2	1	25

Course Code: ZOO 508

- Study of different climatic factors, temperature, relative humidity, wind velocity and light intensity
- Estimation of physico-chemical characteristics of soil and water
- Ecological adaptations of animals in different habitats.
- Population estimates of planktons
- Visit to National Parks/Sanctuaries and Waste Management parks

Course Title: Biosystematics and Biodiversity Lab
Course Code: ZOO 509

L	T	P	Credits	Marks
0	0	2	1	25

- Identification of important animals using conventional taxonomic keys and modern molecular methods
- Sampling, extraction methods and identification of soil fauna

Course Title: ImmunologyLab
Course Code: Zoo 510

L	T	P	Credits	Marks
0	0	2	1	25

- To study the histology of lymphoid organs.
- Preparation of blood film and identification of white blood cells from normal and infected animals.
- To perform agglutination reaction by using blood group typing kit.
- To perform antigen – antibody interaction by Ouchterlony method.
- To isolate W.B.C. from blood using density gradient centrifugation.
- Detection of live/dead white blood cells using Acridine Orange/Ethidium bromide staining under U.V. light.
- To perform indirect fluorescent antibody test.
- To demonstrate antigen-antibody reaction by ELISA to students.
- To perform DOT- ELISA by using kit.

Note: Practicals related to Immunology Lab are in accordance with UGC guidelines and have been approved by Dissection Monitoring Committee.

DAV UNIVERSITY, JALANDHAR

SEMESTER 2

Course Title: Advanced Techniques in Zoology
Paper Code: ZOO 512

L	T	P	Credits	Marks
3	0	0	3	75

Course Objective: To acquaint the students with various instruments used in scientific laboratories and to make them understand the basic principles involved in the important techniques used in scientific research.

UNIT-A 18 hours

- Microscopic techniques: visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, principles of light, phase contrast, fluorescence, confocal, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, Microphotography and image processing methods in microscopy.
- Cell fractionation method: Different mechanical and chemical procedures. Principle of centrifugation and ultracentrifugation, different methods of ultracentrifugations (in brief) and their applications, structural parts of an analytical ultracentrifuge.
- Cell culture techniques: design and functioning of tissue culture laboratory, aseptic and sterilization techniques, factors affecting cell growth *in vitro,* cell proliferation measurements, cell viability testing, culture media preparation and cell harvesting methods

UNIT-B 7 hours

- Molecular biology methods: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels; isolation, separation and analysis of carbohydrate and lipid molecules; RFLP, RAPD and AFLP techniques.

UNIT-C 8 hours

- Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, immunocytochemistry, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH.

UNIT-D 12 hours

- Chromatography: Principles of chromatography, paper chromatography, thin layer chromatography, gas chromatography, gel permeation chromatography, ion exchange chromatography, high pressure liquid chromatography, affinity chromatography.
- Electrophoresis : Principle of electrophoresis, paper electrophoresis, polyacrylamide gel electrophoresis, Disc gel electrophoresis, and SDS-PAGE, agarose gel electrophoresis, isoelectric focusing, applications of electrophoresis - distinguishing of Phage DNA, detection of plasmids, separation of DNA molecules, Southern transfer, Northern transfer and Western transfer.

- Radioisotopes: Radioactive isotopes, half-life of isotopes, detection and measurement of radioactivity (Gas ionization, scintillation and autoradiography), applications of radioisotopes in biological sciences, autoradiography, metabolic labelling, Magnetic Resonance Imaging.

Reference books

1. Gurumani, N., Research methodology for Biological Sciences, MJP Publishers, Chennai (2007).
2. Kuby, J., Immunology, 6th ed., W.H. Freeman and Company (2007).
3. Freshney, R.I., Culture of Animal Cells: A manual of basic technique, 5th Ed., Wiley Liss Inc., New York. (2006).
4. Boyer, R., Modern Experimental Biochemistry, 3rd ed., Pearson Education (2004).
5. Wilson, Keith and Walker, John, Practical Biochemistry : Principles and techniques, 5th
6. Edition Edited, Cambridge University Press (2000).
7. Michael G, Flow Cytometry: A Practical Approach, 3rd Edition Edited Michael G.
8. Ormerod Oxford University Press (2000).Beckatt, A.H. and Stenlake, J.B., Practical Biochemistry, the Athlone Press, London (1988).
9. Bacq, Z.M. and Alexender, P, Fundamentals of Radiography, Pergamon Press, London (1989).
10. Benett, A.H. and Usterbere, H, Phase Microscopy: Principle and applications, John Wiley and Sons, London (1951).
11. Dawes, C.J.,Techniques for Transmission and Scanning Electron Microscopy, Ladd Rew. Ind.,Inc.,Publishers (1981).
12. Freefelder, D, Practical Biochemistry: Application to Biochemistry and Molecular Biology, W.H.Freeman, (1982).
13. Watt, J.M., The Principles and Practice of Electron Microscopy, Watt (1985).

Course Title: Comparative Vertebrate Endocrinology
Paper Code: ZOO 513

L	T	P	Credits	Marks
3	0	0	3	75

Course Objective: To acquaint the students with the functions of various endocrine glands and their secretions i.e. hormones.

UNIT-A 15 hours

- Aims and scope of endocrinology
- Basic concept of integrative/regulatory physiology-neural and endocrine
- Basic concepts of hormonal regulation of physiological processes
- Hormones-their discovery, classification and experimental methods of hormone research
- Mechanism of action of hormones, hormone receptors, their role in signal transduction and cascade events in the cell.

UNIT-B 12 hours

- Neuroendocrine system and Neurosecretion
- Hypothalamus-hypophyseal axis-anatomy and physiology
- Pituitary gland-its origin, anatomy, histology and hormonal secretions, their composition and effects.
- The feedback mechanism of hormonal regulation

UNIT-C 9 hours

- Thyroid and parathyroid glands-their anatomy, histology, biosynthesis and chemical nature of hormonal secretions and their effects
- The adrenal gland-its anatomy, hormones, chemical nature and its effects
- GIT hormones, their structure and effects
- Insulin, its source and role in regulating blood glucose level

UNIT-D 9 hours

- Role of hormones in stress physiology
- Hormones and behavior
- Hormones and homeostasis
- Hormones and human health. Production of hormones as pharmaceuticals and their therapeutic uses
- Brief description of endocrine disorders

Reference books

1. Turner, C.D. and Bagnars, W.B. (1976) General Endocrinology, Saunders Company.
2. Highnam, K.C. and Hill, L.(1981) Comparative Endocrinology of invertebrates, Enwaral Arnold Ltd., London.
3. Golds Worthy, G.J. Robinson, J. and Mordue, W. 1981. Endocrinology, John Wiley and Sons, New York.
4. Tombes, A.S.(1970) An Introduction to invertebrates endocrinology, Academic Press, New York

DAV UNIVERSITY, JALANDHAR

L	T	P	Credits	Marks
4	1	0	4	100

Course Title: Biostatistics
Paper Code: ZOO 514

Course Objective: The main objective of the course is to give applications of Statistical Methodology in life sciences to summarize and analyse the data, and modeling of real life data through standard distributions.

UNIT-A 17 hours

- Biostatistics- Definition and relevance in biological research.
- Descriptive Staistics: Meaning, Objectives,
- Organization of data, Population, sample, variable, parameter, primary and secondary data, screening and representation of data, frequency distribution, tabulation, bar diagram, histograms, pie diagram
- Measures of Central Tendency: Arithmetic Mean, median, mode, quartiles and percentiles
- Measures of Dispersion: Range, variance, standard deviation, coefficient of variation;
- Skewness and Kurtosis

UNIT-B 18 hours

- Inferential Statistics: Hypothesis testing, Errors in Hypothesis Testing- Null Hypotheis, Alternative Hypothesis, Type I and Type II errors, Confidence Limits. Setting up of level of significance. One tailed and Two- tailed tests, Probability and distributions- definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, examples- bernoulli, binomial, poisson and normal distributions; bivariate data- scatter plot,
- Correlation and Regression: Correlation coefficient (r), properties, interpretation of r, partial and multiple correlations, linear regression: Fitting of lines of regression, regression coefficient, Bivariate and Multiple Regression.

UNIT-C 15 hours

- Parametric and Non-Parametric Statistics: Definition, Advantages, Disadvantages, Assumptions
- Parametric Tests: Student's t-test, One Way Analysis of Variance, Two Way Analysis of Variance
- Non-Parametric Tests: Mann Whitney U test, Wilcoxon Signed Rank Sum Test, Kruskal Wallis Analysis of Variance, Chi square and Kendall Rank Correlation

UNIT-D 10 hours

- Use of Statistical softwares in analysis and interpretation of biological data with special emphasis on SPSS.

Reference books

1. Dunn, O.J: Basic Statistics: A primer for the Biomedical Sciences. (1964, 1977) by John Wiley
2. Bancroft, Holdon: Introduction to Bio-Statistics (1962) P.B. Hoebar Inc., New York.
3. Daniel, Wayne W.: Bio-statistics: A Foundation for Analysis in the Health Sciences. John Wiley (2005).

Course Title: Developmental Biology
Paper Code: ZOO 515

L	T	P	Credits	Marks
3	0	0	3	75

Course Objective: To enable the students understand the process of development in various animals and the phenomena associated with it. It also includes the genetic involvement and the role of maternal environment on fetal development. It will enable the students understand the environmental influences on development and factors responsible for ageing.

UNIT-A 6 hours

- Introduction to the basic concepts of embryology and developmental biology.
- Gametogenesis: Spermatogenesis, its cellular and hormonal regulation. Oogenesis-Folliculogenesis and oocyte maturatiom
- Fertilization-The cellular and molecular events-cell surface miolecules in sperm-egg recognition in animals and union of gametes.

UNIT-B 10 hours

- Cleavage patterns in animals.
- Early embryonic development and role of maternal contributions
- Blastula formation and embryonic fields
- Gastrulation and formation of germ layers
- Morphogenesis, morphogenetic cells and molecules.

UNIT-C 13 hours

- Genetic regulation in early development of *Drosophila*-Homeotic genes
- Neurulation and Organogenesis
- Eye lens induction in *Caenorhabditis elegans*
- Limb development and regeneration in vertebrates
- Post embryonic development-larva formation
- Metamorphosis-environmental regulation in normal development
- Sex determination

UNIT-D 16 hours

- Potency, commitment, specification of embryonic cells
- Induction, Competence
- Differentaition and Determination
- Morphogenetic gradients in egg cytoplasm
- Cell fate, cell lineages
- Stem cells, genomic equivalence
- Cytoplasmic determinants
- Imprinting and mutants
- Transgenics and their role in analysis of development
- Programmed Cell Death, ageing and senescence

Reference books

1. Balinsky, B.I. and Fabian, B. C., An Introduction to Embryology, 5th ed., Saunders, Philadelphia (2012).

2. Gilbert, S. F., Developmental Biology, 9th ed., Sinauer Associaters Inc Publishers (2010).
3. Browder, L.W., Developmental Biology, 3rd ed., Saunders College Publishing (1991).
4. Muller, W. A., Developmental Biology, Springer (1997).
5. Rastogi, V. B. and Jayaraj M. S., Developmental Biology, Kedar Nath Ram Nath, Meerut (2009)
6. Wolpert, L. et al., Principles of Development, 2nd ed., Oxford (2001)
7. Wright, S. J., A Photographic Atlas of Developmental Biology, Morton Publishing Company (2005).

Course Title: Advanced Techniques in Zoology Lab
Course Code: ZOO 516

L	T	P	Credits	Marks
0	0	2	1	25

- To study the parts of the compound microscope fluorescent microscope and phase contrast microscope and their maintenance.
- To study the living material under the phase contrast microscope.
- To find out the diameter, area and circumference with the help of stage micrometer and oculometer.
- To sketch the diagram of any tissue with the help of camera lucida and to draw its magnification line.
- Demonstration of section cutting and mounting of sections on the grid for SEM and TEM. Demonstration of SEM & TEM in the CIL lab.
- Demonstration of working of ultracentrifuge.
- To separate a sample of amino acids with the help of paper chromatography and TLC
- To find out pH with a pH meter and weight with electrical balance.
- To do a short term *in vitro* culture of a parasite.
- Demonstration of SDS-PAGE and western blotting to students.
- To demonstrate ELISA to students.

Course Title: Comparative vertebrate endocrinology Lab
Course Code: Zoo 517

L	T	P	Credits	Marks
0	0	2	1	25

- Dissection of endocrine glands in rat and their histological preparations
- Study of the estrous cycle in mice/rat.
- Study of the microscopic structure of endocrine glands-thyroid, pancreas, ovary, testes, adrenal and pituitary.
- Demonstration of a bioassay and radioimmunoassays of hormones.

Note: Practicals related to Comparative vertebrate endocrinology Lab are in accordance with UGC guidelines and have been approved by Dissection Monitoring Committee.

Course Title: Biostatistics Lab
Course Code: Zoo 518

L	T	P	Credits	Marks
0	0	3	2	50

- Recording of data by using any material such as fish or molluscs or insect.
- Calculation of standard deviation on the basis of recorded data.
- Calculation of correlation coefficient (between X & Y variables) on the basis of material provided.
- Setting up of regression equation and the calculation of the value of Y of unknown X on the basis of equation Y = a+bX.
- Analysis of data and construction of graphs using statistical packages.

Course Title: Developmental Biology Lab
Course Code: Zoo 519

L	T	P	Credits	Marks
0	0	2	1	25

The following practicals will be conducted using animal material/e-resources.

- To study gametogenesis, spermatogenesis and oogenesis- their cellular interactions and quantitative aspects.
- To study the different larvae in the invertebrates.
- To study the different stages of development in frog and chick.
- To prepare permanent stained slides of developing stage from fertilized egg of hen.
- To study the RNA activity in the polytene chromosomes in dipterans.
- To prepare permanent slides of larvae of invertebrates.
- To study the RNA activity in the polytene chromosomes in dipterans.

Note: Practicals related to Developmental Biology Lab are in accordance with and have been approved by Dissection Monitoring Committee.

DAV UNIVERSITY, JALANDHAR

SEMESTER 3

Course Title: Parasitology
Paper Code: ZOO 601

L	T	P	Credits	Marks
4	0	0	3	75

Course Objective: To enable the students to classify and study the variation in morphology, life cycle and pathogenesis of important parasites causing diseases in animals and human beings.

UNIT-A 15 hours

- Introduction to parasitic protozoa.
- General account of medically important parasites in Kinetoplastida, Coccidia, Piroplasmia and Microspora (for example *Leishmania, Trypanosoma, Encephalitozoon, Babesia, Theileria,, Sarcocystis, Isospora, Cryptosporidium* etc.).
- *In vitro* culture of protozoan parasites e.g. *Plasmodium, Entamoeba, Giardia, Leishmania, Trypanosoma* etc.

UNIT-B 10 hours

- Outline classification of trematodes with general account of important parasites in fasciolidae, paramphistomidae, dicrocoelidae, troglotrematidae, opisthorchidae and schistosomatidae.
- Ultrastructure of the body wall of digenetic trematodes.
- Variation in the life cycle in Digenea.

UNIT-C 10 hours

- Outline classification of cestodes with general account of important parasites of diphyllobothridae, taeniidae and anoplocephalidae.
- Ultrastructure of the body wall of cestodes.
- Variation in the life cycles of cestodes.
- Host Parasite Transmission
- Host parasite Interaction

UNIT-D 10 hours

- General organization and outline classification of nematodes with general account of important
- parasites in strongylidea, ascaridoidea, oxyuroidea, dracunculoidea, filarioidea and trichinelloidea.
- Ultrastructure of nematode sense organs like amphids, phasmids and Papillae.
- Variation in life cycle of nematodes.

Reference books

1. Ichchpujani R.L. & Rajesh Bhatia, Medical Parasitology, 3rd Ed. Jaypee Brothers Medical Publishers, New Delhi (2002).
2. Lynne Shore Garcia, Diagnostic Medical Parasitology 4th Ed. ASM Press, Washington DC, (2001).
3. Parija, S. C. Textbook of Medical Parasitology, All India Publishers and Distributors (2001)
4. Smyth, J.D., Introduction to Animal Parasitology, Hodder & Stoughton, London (2005).
5. Chatterjee, K. D., Parasitology: Protozoology and Helminthlogy, 13th ed., CBSpublishers and distributors Pvt Ltd (2009)
6. Cheng, T.C., General Parasitology, 2nd ed., Academic Press, London (1986).
7. Noble, E.R. & Noble, G.A., Parasitology: The biology of animal parasites 5th edition, Lea & Febiger, Philadelphia (1982).
8. Larry S. Roberts & John Janovy Jr., Foundations of Parasitology Mc. Graw Hill Book Co., (2000).
9. Ramnik Sood, Parasitology (Protozoology & Helminthology) CBS Publishers & Distributors, (1993).
10. Urquhart, Armour, Duncan, Dunn & Jennings,Veterinary Parasitology Blackwell Publishing, (2003).
11. Bernard E. Mathews, An introduction to Parasitology Cambridge University Press, (1998).

Course Title: Vertebrate Reproductive Physiology
Paper Code: ZOO 602

L	T	P	Credits	Marks
4	0	0	3	75

Course Objective: To acquaint students with the process of reproduction, its patterns in animals and the role of hormones in fertilization, implantation, parturition and lactation.

UNIT-A 8 hours

- Reproductive patterns, seasonal and continuous breeders and their ovulation in vertebrates-oviparity to viviparity. Cleidoic eggs and their significance.
- Environmental regulation of reproductive cyclicity
- Sex determination

UNIT-B 10 hours

- Spermatogenesis and its hormonal regulation
- Sperm maturation
- Oogenesis and its hormonal regulation during follicular growth.
- Oocyte maturation

UNIT-C 13 hours

- Ovulation-The release of ovum and its regulation, clutch size in vertebrates.
- Post ovulatory ovarian changes-corpus luteum and its secretory functions
- Transport of gametes
- Fertilization and transport of zygote

UNIT-D 14 hours

- Implantation and biology of decidualization
- Placentation and its regulation-types of placentae in mammmals. Foetoplacental unit as an endocrine entity
- Extraembryonic membranes
- Pregnancy and its hormonal regulation
- Parturition and its hormonal regulation in mammals, the litter size in mammals
- Lactation-the structure of mammary glands, milk, its secretion, ejection and hormonal regulation.
- Fertility and its regulation.
- ARTs

Reference books

1. Richards, W. Hill, Comparative Physiology of animals: An Environmental approach (Harper and Row) Pub. New York (1986).
2. F. Read Hausworth, Animal Physiology: Adaption and Function (Addision Wesley Pub. Co.California) (1981).
3. Knut Schmidt Nielsen, Animal Physiology: Adaption and Environmental (Cambridge Univ.Press, London) (1985).
4. A.C. Guyton, Textbook of Medical Physiology 7th ed. Saunders Publication (1984).
5. Turner, C.D. & Bagnara, W.D: General Endocrinology W.B. Saunders Co. Philadelphia, U.S.A. (1976).
6. Text Book of Biochemistry and Human Biology by Talwar, O.P. Prentice Hall of India Pvt. Ltd., New Delhi.
7. B.I. Balinsky, An Introduction to Embryology Saunders Company (1981).
8. Balian and Glasser, Reproductive Biology by Excerpta Media Amsterdam (1984).
9. Knobil and Jimmy D. Neill (eds). The Physiology of Reproduction Vol.I & II, Ernst Raven Press.
10. Robert, H. Williams, Text Book of Endocrinology Saunder Company (1981).

DAV UNIVERSITY, JALANDHAR

Course Title: Aquaculture and Fisheries
Paper Code: ZOO 603

L	T	P	Credits	Marks
4	0	0	3	75

Course Objective: To enable the students understand the different fresh water habitats, the classification of water bodies based on various physicochemical and biological parameters and the importance of fisheries as a science.

UNIT-A 15 hours

- Water as a substance: molecular structure and properties, specific heat, density, surface tension
- Types of Freshwater habitats – Lotic and Lentic Waters, Zonation in Lentic habitat
- Hydrobiological characteristics – Temperature, penetration of light, turbidity, dissolved gases, pH, biogenic salts etc.
- Water problems in aquatic and amphibious situations.
- Ecological classifications of freshwater organisms other than fishes :
  On the basis of trophic status
  On the basis of mode of life – Benthos, Periphyton, Plankton, Nekton and Neuston
  On the basis of zonation in lentic and lotic habitats.
- Classification of lakes:
  Trophic classification of lakes – Oligotrophic, eutrophic and dystrophic lakes.
  Thermal classification of lakes – Forel's and Yoshimura's classifications of lakes.
  Hutchinson's classification of lakes – Amictic, cold monomictic, dimictic, warm monomictic, oligomictic and polymictic lakes.
- Productivity: Concepts of productivity – Biomass, biotic potential, standing crop, carrying capacity, yield, productivity, primary and secondary productivity.

UNIT-B 12 hours

- Eutrophication: Definitions and types, Causes and impact of eutrophication. Control of eutrophication
- Thermal stratification
- Bioassay – Terminology, methodology, calculation of LC 50 and EC 50 values and threshhold concentrations.
- Methods in Field Biology: Methods of estimating population density of animals.

UNIT-C 10 hours

- Fishery Science: Its importance and application.
- Form and locomotion

- Morphological variations in the body form- in deep – sea and hillstream fishes.
- Feeding relationships among fishes
- Predation of fishes

UNIT-D 8 hours

- Exotic fishes: Different fishes introduced in India, history, causes, impacts, usefulness to fish culture.
- Pearl culture in India: species involved, implantation procedure, water quality, economics.
- Fish: biodiversity, loss of fish biodiversity, enhancement, role of genetics in aquaculture and fisheries.
- Fish as bioindicators of aquatic ecosystem health.

Reference books

1. Jhingran, V.G., Fish and Fisheries of India, Hindustan Publishing House (India), New Delhi (1991).
2. Aquaculture Production. FAO. Fisheries Circular No.815, No.4, Rev.FAO Rome (1998).
3. Mohan Joseph, M, Aquaculture in Asia, Asian Fisheries Society, Manglore (1990).
4. Talwar, P.K., & Jhingran, A.G., Inland Fishes of India, Vols.I & II, P.K. Talwar &
5. Jhingran, A.G., Oxford & IBH, New Delhi (1991).
6. Lagler Karl F., Freshwater Fishery Biology, Wm.C.Brown Company Publ., Dubuque, Iowa (1969).
7. Bangenal,T., Methods for Assessment of Fish Production in Freshwaters 3rd Ed , IBH
8. Handbook No.3 Blackwell Scientific Publication, Oxford (1970).
9. Johal, M.S., and Tandon, K.K., Monograph on the Fishes of reorganized Punjab, Parts I & II. Punjab Fisheries Bulletin (1979, 1980).
10. Odum, E.P., Fundamentals of ecology, W.B. Saunders Co. Philadelphia (1971).
11. Welch, P.S., Limnology, Mcgraw Hill Book Co. New York (1952)
12. Wetzel, R.G., Limnology, W.B.Saunders Co. Philadelphia (1983).
13. Hynes, H.B.N., The Biology of Polluted Waters, Liverpool Univ. Press, Liverpool (1978).
14. Ruttner, F., Fundamentals of Limnology, Univ. Press, Toronto (1975).
15. Tandon,K.K. & Johal, M.S., Age and growth in Indian Freshwater Fishes, Narendra Publishing House, Delhi (1995).
16. Johal, M.S., Aggarwal, S.C., Fishery Development, Narendra Publishing House, Delhi (1997).

Course Title: Entomology
Paper Code: ZOO 604

L	T	P	Credits	Marks
4	0	0	3	75

Course Objective: To enable the students to understand the dominance of Arthropods and their association with human welfare in a number of ways.

UNIT-A 15 hours

- Preliminary knowledge of thoracic and abdominal segments of insects.
- General structure and functional modifications in the antennae, wings and legs in different insect groups.
- External male genitalia and external female genitalia in different insect group.

UNIT-B 13 hours

- Comparative account of the structure and functions of digestive system in insects with special reference to the functional modifications like filter chamber and peritrophic membrane and digestive glands.
- Comparative account of the nervous in insects.

UNIT-C 10 hours

- General structure and functions of excretory, respiratory (terrestrial and aquatic) and circulatory systems in insects.
- Comparative account of the male and female reproductive systems in insects

UNIT-D 7 hours

- Types of metamorphosis in insects.
- Structural modifications in larvae and pupae and relationship of nymphs and naiads.
- Onset, termination and significance of diapause

Reference books

1. Snodgrass, R.E. Principles of Insect Morphology, CBS Publishers and distributors, Delhi, 1994.
2. Richard, O. W. and Davies, R.G., Imm's Text book of Entomology, 10th ed., Vol I & II, B1 publications Pvt. Ltd. New Delhi, 1997.
3. Chapman, R.F., The Insects; structure and Function, The English Language Book Society, and Hodder and Stoughton, Kent, 1980.
4. Mani, M.S., General Entomolgy, Oxford and IBH, New Delhi, Kalcutta, 1990.
5. Marshall, A. J. And William, W.D., Text Book of Zoology, Invertebrate, Vol. I, CBS Publication and Dist., Delhi, 1992.
6. Barrington, Invertebrate structure and function, E.J.W. Nelson, London, 1969.

Course Title: Parasitology Lab
Course Code: ZOO 605

L	T	P	Credits	Marks
0	0	2	1	25

The following practicals will be conducted using slides/specimens/models/charts/e-resources.

- Study of the cestodes
- Study of the trematodes
- Study of the digenetic trematode larvae from the snails.
- Study of the nematodes infecting sheep, goat, fowl and cockroaches.
- Detailed morphological and histological studies of *Ascaris.*
- Study of the protozoan parasites infecting cockroaches and mice.
- Study of *in vitro* culture of *Leishmania*

Note: Practicals related to Parasitology Lab are in accordance with UGC guidelines and have been approved by Dissection Monitoring Committee.

Course Title: Vertebrate Reproductive Physiology Lab
Course Code: ZOO 606

L	T	P	Credits	Marks
0	0	2	1	25

The following practicals will be performed using animal material/e-resources:

- Histological preparations and study of testes, epididymus, vas deferns, prostrate gland, seminal vesicles, urethera of fishes, amphibians, repltiles, birds and mammals.
- Histological preparations and study of ovaries, oviducts, uterus, mammary glands of fishes, amphibians, reptiles, birds and mammals.
- Qualitative and quantitative studies on spermataogenesis and folliculogenesis.
- Study of induction of ovulation and its detection in oviducts of rat/mouse.
- Induction of pseudopregnancy in rat
- Study of estrous cycle in rat
- Determination of sperm concentration and motility in semen
- Induction of sperm capacitation *in vitro*
- *In vitro* fertilization

Note: Practicals related to Vertebrate Reproductive Physiology Lab are in accordance with and have been approved by Dissection Monitoring Committee.

Course Title: Aquaculture and Fisheries Lab
Course Code: ZOO 607

L	T	P	Credits	Marks
0	0	2	1	25

- Qualitative study of biotic components of aquatic ecosystem.
- Quantitative study of biotic components of aquatic ecosystem.
- Study of different types of Phytoplankton (Bacillariophyceae, Chlorophyceae, Euglenophycea & Cyanophyceae).
- Study of different types of Zooplankton (Protozoa, Rotifera, Cladocera, Copepoda).
- Study of Benthic fauna.
- Study of Neuston.
- Study of Nekton.
- Study of Macrophytes.
- Estimation of Nitrates in water.
- Estimation of Phosphates in water.
- Estimation of dissolved oxygen by modified winklen method in water.
- Determination of Primary productivity in an aquatic habitat.
- Study of impact of Heavy metals on productivity.
- Identification of the following fishes up to species level of Punjab, Haryana and Himachal Pradesh using already prepared field keys. Noting down their important Characters, making sketches, and economic importance of each fish species along With ecological notes: *Notopterus notopterus, N.chitala, Schiozothorax richardsonii. plagiostomus,Hypophthalmichthys molitrix, Cyprinus carpio, Ctenopharyngodon idella, Puntius Labeo rohita, Catla catla, Cirrhinus mrigala,Tor putitora, Garra gotyla gotyla, Noemecheilus botia, Botia berdi., Mystus seenghala, Aorichthys spp., Wallago attu, Heteropneustes fossilis, Channa, Mastacembelus armatus.*
- Study of important deep-sea and hills stream fishes with special reference to Various adaptations.
- Study of hard parts e.g., scales, vertebrae, otoliths and opercular bones for age determination, Calculations of back-calculated lengths using Fraser-Lee. equation.
- On the basis of available growth data calculation of various growth parameters e.g., annual increment, specific rate of linear growth, growth characteristic, growth constant, calculation of harvestable size and maximum size to be attained by the fish.
- Study of various exotic fishes introduced in India and their characteristic features.
- Study of different bivalves involved in Pearl Culture.

L	T	P	Credits	Marks
0	0	2	1	25

Course Title: Entomology Lab

Course Code: ZOO 608

The following practicals will be conducted using animal material/e-resources.

- Study of representatives from different insect orders in order to understand the salient features and diversity in insect groups.
- Dissection of various insects to study the alimentary canal and glands associated with the digestion of different types of food.
- Dissection of an insect to study tracheation and spiracles.
- Dissection of various insects to demonstrate number, arrangement and associations of malpighian tubules.
- Dissection of an insect (cockroach/grasshopper) to expose neuroendocrine organs.
- To study the effect of temperature and photoperiod on the development of insects.
- Project work

Note: Practicals related to Entomology Lab are in accordance with UGC guidelines and have been approved by Dissection Monitoring Committee.

DAV UNIVERSITY, JALANDHAR

SEMESTER 4

Course Title: Animal Biotechnology
Paper Code: ZOO 611

L	T	P	Credits	Marks
4	0	0	3	75

Course Objective: To impart expertise in cell, tissue and organ culture techniques.

UNIT-A 12 hours

- History and scope of biotechnology.
- Cell, Tissue and Organ culture techniques: Aseptic and sterilisation techniques, culture media, factors effecting cell growth *in vitro*. Specialized Cell Culture Techniques,.
- Somatic cell hybridization
- Hybridoma Technology, Monoclonal antibody antibody production and their applications

UNIT-B 18 hours

- DNA Isolation, PCR, Variations in PCR, Applications, Advantages and Limitations of PCR.
- Genetic Engineering. Steps in gene cloning, restriction enzymes, genomic library, vectors, recombination, Selection of recombinant clones, screening.
- Genome Maps, Genetic Markers, Human Genome Project
- Methods of vaccine production: Preparation of first, second and third generation vaccines.
- Antigen-antibody based diagnostic assays: Immunoblotting, ELISA, etc.

UNIT-C 10 hours

- Techniques involved in breeding of animals including artificial insemination, super ovulation, *In vitro* fertilization and embryo transfer.
- Gene mapping, gene cloning and gene transfer
- Transgenesis and animal cloning, Molecular farming

UNIT-D 5 hours

- Application of biotechnology in agriculture, veterinary science, pharmaceutical industry, food industry, chemical industry and environment.

Reference books

1. RW Old and SB Primrose. Principles of gene manipulation: An introduction to genetic engineering.
2. RA Meyers (Ed.): Molecular Biology and Biotechnology (VCH Publishers)
3. Glick:Molecular Biotechnology
4. Animal Cell Culture- A practical approach. Ed. John RW Masters, IRL Press
5. BD Singh. Biotechnology Expanding Horizons. Kalyani Publishers. 2008.

Course Title: Animal Behaviour and Wild Life Management
Paper Code: ZOO 612

L	T	P	Credits	Marks
4	0	0	3	75

Course Objective: To acquaint students with different behaviour patterns of animals and conservation startegies for protection of wild life.

.UNIT-A 10 hours

- Introduction-Ethology as branch of biology
- Animal psychology-Classification of behavioural; patterns; analysis of behavior (ethogram)
- Innate behavior, perception of environment-mechanical, electrical, chemical, olfactory, auditory and visual.
- Neural and hormonal regulation of behavior.

UNIT-B 17 hours

- Genetic and environmental components in development of behavior
- Communication-Chemical (pheromones), visual, light, audio, vocal (sp. Specific songs) and evolution of language in primates.
- Ecological concepts of behavior: Habitat, food selection, optimal foraging theory, antipredator defences, aggression, homing, territoriality, dispersal, host-parasite relations
- Social behavior- Aggregations, schooling in fishes, flocking in birds, herding in mammals, group and kin selection, altruism (reciprocal). Social organization in insects and primates

UNIT-C 9 hours

- Reproductive behavior: Evolution of sex and reproductive startegies, mating system, courtship, sperm competition, sexual role and parental care.
- Biological rhythms: Circadian and circannual; Orientation and navigation, Migration in fish, turtles and birds.
- Learning and Memory-Conditioning, habituation, , insight and associative learning, reasoning and cognitive skills

UNIT-D 9 hours

- Background and current status of wild life management and conservation in India
- Biographical notes on important wild animals
- Habitat Management
- Wild life damage control
- Mitigating human wild life conflict, wild life census
- Wild life protection Act and and wild life projects.
- Conservation-principles and strategies

Reference books

1. Alcock J. Animal Behaviour. An evolutionary approach. Sinauer Assoc., Sunderland, Mass. USA.
2. Bradbury JW and SL Vehrencamp. Principles of animal communication. Sinauer Assoc., Sunderland, Mass. USA.

3. Clutton-Brock TH. The evolution of parental care. Princeton Univ. Press, Princeton, NJ, USA.
4. Eibi-Eibesfeldt I. Ethology. The biology of behaviour. Holt, Rinehart & Winston, New York.
5. Gould JL. The mechanisms and evolution of behaviour
6. Hauser M. The evolution of communication. MIT Press, Cambridge, Mass. USA
7. Hinde RA. Animal Behaviour. A synthesis of ethology and comparative psychology. McGraw Hill, New York

Course Title: Animal Biotechnology Lab
Paper Code: ZOO 613

L	T	P	Credits	Marks
0	0	2	1	25

- Isolation of DNA, RNA and Proteins from animal samples
- Electrophoresis- agarose, SDS-PAGE, native PAGE and other modifications of PAGE.
- PCR and its modifications
- Cloning techniques
- ELISA and its modifications
- Immunoblotting
- Preparation of first, second and third generation vaccines and immunization of animals
- Basic techniques in hybridoma and monoclonal antibody production
- Sterilization techniques and maintenance of *in vitro* cell culture

Note: Practicals related to Animal Biotechnology Lab are in accordance with and have been approved by Dissection Monitoring Committee.

Course Title: Animal Behaviour and Wild Life Management Lab
Paper Code: ZOO 614

L	T	P	Credits	Marks
0	0	2	1	25

- Demonstrations of fixed action patterns.
- Maze experiments on animal learning. Food preference.
- Behaviour of estrous females
- Nest building behavior and mate choice in birds
- Identification of wild life species and preparation of the inventory
- Economic evaluation of wild life areas
- Visit to zoo, sanctuaries, national parks
- Project on wild life species or habitat.

Note: Practicals related to Comparative functional anatomy of vertebrates Lab are in accordance with UGC guidelines and have been approved by Dissection Monitoring Committee.

DAV UNIVERSITY, JALANDHAR

Interdisplinary Courses offered by other Departments to Zoology Students

SEMESTER 2

Course Title: General Biochemistry
Paper Code: BCH 553

L	T	P	Credits	Marks
3	0	0	3	75

Course Objective: The course is intended for master's course students in disciplines other than master's degree students of Biochemistry. This course is a broad survey of all the major concepts of biochemistry with emphasis on biomolecules and their metabolism.

Unit A (10 hours)

Introduction - Atoms, molecules and chemical bonds. Water: biological importance, pH and acid - base balance. Buffers - biological importance.

Carbohydrates - Monosaccharides: Classification and nomenclature, Biological importance, Structural representations of sugars- Acetal and hemiacetal, ketal and hemiketal linkages, Glucose, fructose, galactose, mannose and ribose. Isomerism – structural isomerism and stereoisomerism, optical isomerism, epimerism and anomerism. Mutarotation and inversion of sugars. Glycosidic bond. Disaccharides: Sucrose, Lactose, Maltose, Isomaltose, Cellobiose and Trehalose. Polysaccharides: Homopolysaccharides- Starch, Glycogen, Cellulose, Chitin, Dextrans, Inulin, Pectin. Heteropolysaccharides- Hyaluronic acid, Heparin, Chondroitin sulphate, Keratan sulphate, Dermatan sulphate and Agar-agar. Glycoproteins and Mucoproteins.

Proteins Structure, classification and properties of amino acids. Amphoteric properties of amino acids, pK value and iso-electric point of amino acids. Peptide bond formation and peptides. Reactions (due to carboxyl group, amino group and side chains). Colour reactions of amino acids and proteins. Classification and properties of proteins. Conformation of proteins- chemical bonds involved, Secondary structure- Alpha helix, Collagen helix, Beta pleated sheet, Ramachandran angles and Ramachandran map. Fibrous proteins- examples (Keratin, Collagen, Elastin, Fibrous muscle proteins). Chaperons. Tertiary structure- e.g. Myoglobin. Quaternary structure – e.g. Haemoglobin.

Unit B (15 hours)

Lipids - Classification of lipids: simple, compound and derived lipids. Biological importance of lipids. Fatty acids: classification, nomenclature. Simple fats: Triacylglycerol (Triglycerides) - Physical properties. Reactions-Hydrolysis, Saponification, Rancidity. Acid number, Saponification number, Iodine number, Polenske number and Reichert-Meissl number of lipids. Waxes. Compound lipids: Phospholipids- Lecithin, Phosphatidyl inositol, Cephalins, Plasmologens. Glycolipids, Sphingolipids. Derived Lipids, Steroids: Biologically important steroids-cholesterol, Vitamin D, Bile acids, Ergosterol, Terpenes, Lipoproteins. Prostaglandins- structure, types, synthesis and functions.

Nucleic Acids - Structure of nucleic acids and nucleotides: Structural organization of DNA (Watson –Crick model) Characteristic features of A, B, C and Z DNA. Structural organization of tRNA; Protein-nucleic acid interaction. DNA regulatory proteins, folding motifs, conformation flexibilities, denaturation, renaturation, DNA polymerases, Restriction endonucleases. Biological roles of nucleotides and nucleic acids.

Enzymes - Classification- (I.U.B.system), co-enzymes, iso-enzymes, ribozyme. Enzyme specificity. Mode of action of enzymes. Formation of enzyme substrate complex. Lowering of activation energy, Various theories, Active site. Enzyme kinetics: Michaelis-Menten equation. Km value and its significance. Enzyme velocity and factors influencing enzyme velocity. Kinetics of enzyme inhibition, suicide inhibition and feedback inhibition. Enzyme regulation: Allosteric regulations- Key enzymes, Covalent modification. Enzyme engineering.

Unit C (10 hours)

Carbohydrate Metabolism - Major metabolic pathways- Glycolysis – Fate of pyruvate. Citric acid cycle and its significance; Central role of citric acid cycle. Oxidative and substrate level phosphorylation. Gluconeogenesis, Cori cycle. Glycogen metabolism- Glycogenesis, Glycogenolysis, Adenylate cascade system, Ca+2 Calmodulin-sensitive phosphorylase kinase. Regulation of glycogen synthesis. Minor metabolic pathways of carbohydrates: Pentose Phosphate pathway, Glucuronic acid metabolism, Galactose metabolism. Inborn errors associated with carbohydrate metabolism. Glycogen storage diseases, Lactose intolerance, Galactosuria.

Metabolism of Proteins – Amino acid metabolism - Deamination, Transamination and Trans-deamination. Formation and disposal of ammonia. Urea cycle. Fate of carbon skeletons of amino acids: glucogenic, ketogenic, partly glucogenic and ketogenic with examples. Synthesis of biologically significant compounds from different amino acids with special reference to glycine, glutamic acid, phenylalanine, tyrosine and tryptophan.

Unit D (10 hours)

Metabolism of Lipids - Beta oxidation, alpha oxidation and omega oxidation of fatty acids. De novo synthesis of fatty acids. Metabolism of cholesterol, synthesis and its regulation. Biosynthesis of triglycerides. Metabolism of ketone bodies - Ketogenesis, Ketolysis, Ketosis.

Nucleic Acid and Mineral Metabolism - Catabolism of purines and pyrimidines. Major and minor nutrients. Role of Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chloride, Sulphur and Iron. Free radicals and antioxidants, Generation of free radicals. Reactive oxygen species. Free radical scavenger systems. Lipid peroxidation. Preventive antioxidants.

Recommended Books:

1. Nelson DL & Cox M.M., Lehninger Principles of Biochemistry, 5th Edition, WH Freeman & Company, New York, 2008.

2. Conn EE, Stumpf PK, Bruening G and Doi RH. Outlines of Biochemistry. 5th edition, John Wiley & Sons Inc, 1987.

3. Voet D & Voet JG, Biochemistry, 3rd Edition, John Wiley & Sons Inc., Singapore, 2004.

4. Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's Illustrated Biochemistry, 27th Edition, McGraw Hill Company Inc. Singapore, 2006.

Course Title: General Biochemistry Laboratory

L	T	P	Credits	Marks
0	0	2	1	25

Paper Code: BCH 552

Experiments:

1. Quantitative estimation of blood glucose by Folin-Wu/Anthrone/DNS/O-Toluidine/Enzymatic method

2. Estimation of proteins by Biuret/ Lowry et al. method

3. Quantitative estimation of blood urea/ creatine/ uric acid

4. Quantitative estimation of cholesterol in the blood

5. Estimation of alkaline and acid phosphatases

DAV UNIVERSITY, JALANDHAR

SEMESTER 3

Course Title: Molecular Biology

Course Code:BTY502

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: A comprehensive knowledge of molecular aspects of biological function at the molecular level, particular emphasis on the structure and regulation of genes, as well as, the structure and synthesis of proteins and applications of these concepts in human medicine and health, agriculture, study evolution and other areas.

1. Introduction to molecular biology, basic techniques in molecular biology. DNA and its various forms, super coiling of DNA, DNA melting, repetitive sequences, cot and rot curves, C value paradox, DNA protein interaction, DNA super coiling. Prokaryotic & eukaryotic DNA replication, enzymes and accessory proteins involved in DNA replication, replication origin & replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, gene amplification, mobile genetic elements, homologous and site specific recombination. **12 hours**
2. Prokaryotic and eukaryotic transcription, RNA polymerase, transcription factors, regulatory elements, transcriptional activator, repressor & mechanism of transcription regulation, post-transcriptional processing of mRNA, rRNA & tRNA. **12 hours**
3. Protein synthesis and processing: Ribosome structure, genetic code, prokaryotic & eukaryotic translation, the translation machinery, mechanism and regulation of translation & translation proof-reading, translational inhibitors, Post- translational modification of proteins and intracellular protein targeting, import into nucleus, mitochondria and peroxisome. **10 hours**
4. Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing). Cell signaling: signal transduction pathways and their regulation. **10 hours**
5. Genome sequencing: Genome sizes, organelle genomes, genomic libraries, YAC, BAC libraries, and strategies for sequencing genome, packaging, transfection and recovery of clones, application of sequence information for identification of defective genes. **8 hours**
6. Photoregulation and phytochrome regulation of nuclear and chloroplastic gene expression. Molecular mechanism of nitrogen fixation. Molecular biology of various stresses, viz. abiotic stresses like drought, salt, heavy metals and tempreture; and biotic stresses like bacterial, fungal and viral disease. Signal transduction and its molecular basis, molecular mechanism of

plant hormone action mitochondrial control of fertility, structure, organization and regulation of nuclear gene concerning storage proteins and starch synthesis. **8 hours**

Books:

1. Molecular cell biology (2008) by Harvey F. Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher (W.H.Freeman).
2. Genes IX (2008) by Benjamin Lewin (Jones and Bartlett Publishers).
3. Molecular cloning: A laboratory manual (2000) by J. Sambrook, E.F.Fritish and T. Maniatis (Cold Spring Harbor Laboratory Press,New York).

Course Title: Molecular Biology-LAB

Course Code:BTY506

L	T	P	Credits	Marks
0	0	2	1	25

- Isolation of genomic DNA from bacteria.
- Isolation of genomic DNA from plant.
- Isolation of total RNA from tissue.
- Demonstration of DNA protein interaction.
- Quantitation of nucleic acids and proteins.
- Gel electrophoresis:
    - Nucleic acid
    - Protein

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Course Title: Computational Biology & Bioinformatics

Course Code:602

L	T	P	Credits	Marks
4	0	0	3	75

1. Introduction to Computational Biology: Nature and scope of Computational Biology and Bioinformatics, Basic Algorithms in Computational Biology, Introduction to sequence alignment. Analysis of the whole genome sequencing data: Processing and assembly of whole genome sequence data, Base-calling (PHRED), Vector and E-coli masking. Assembly using PHRAP, CAP3, Assessment of final data quality (Coverage, PHRAP score International guidelines for data quality) Types of Misassembles and their solution. **10 hours**
2. Analysis and submission of EST and GSS data: Processing and quality trimming of nascent sequences; Preparation of submission files; Clustering of ESTs (overview of clustering procedure, pros and cons of clustering). **6 hours**
3. Whole Genome annotation strategies: Basic overview of whole genome annotation strategies, strategies for Human and Arabidopsis genomes. Introduction to DNA and Protein sequencing, Human Genome Project. **6 hours**
4. Bioinformatics databases, Type of databases, Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, GeneBank, DDBJ; Secondary nucleotide sequence databases. **5 hours**
5. Protein structure prediction: Protein Secondary Structure Prediction: Secondary Structure Prediction for Globular Proteins, Transmembrane Proteins, Coiled Coil Prediction. **3 hours**
6. Protein Tertiary Structure Prediction: Methods, Homology Modeling, Threading and Fold Recognition, Ab Initio Protein Structural Prediction, CASP. **3 hours**
7. Sequence motif databases -Pfam, PROSITE, Protein structure databases, Protein Data Bank-SCOP, CATH, KEGG, Chembank, Sequence, structure and function relationship. **5 hours**
8. Applications of bioinformatics: Bioinformatics in pharmaceutical industries, Bioinformatics in immunology, Bioinformatics in agriculture, Bioinformatics in forestry, Geoinformatics, Legal, ethical and commercial ramifications of bioinformatics, Biosensing. **7 hours**

Course Title: Computational Biology & Bioinformatics-LAB

Course Code: BTY606

L	T	P	Credits	Marks
0	0	2	1	25

- Detailed study of NCBI Homepage.
- To perform BLAST for Nucleotide Sequence
- BLAST for a protein sequence
- To perform multiple sequence alignment via CLUSTAL
- Phylogenetic analysis
- To display PDB structure using Rasmol
- Comparative study of the two formats: Gene Bank/ Genepept and FASTA
- Analysis of Prosite pattern
- Motif search database study
- Prediction of protein structure

DAV UNIVERSITY, JALANDHAR

Paper: Scientific Writing and Research Methodology

Code: BOT601

L	T	P	Credits	Marks	Minimum marks
3	1	0	2	50	20

Objective:

To make the students learn how to design an experiment and what are the various research strategies?

Teaching Methodology:

Class room Lectures, practicals, models, charts, power point presentations.

Learning outcomes

This course will impart the comprehensive knowledge of designing a research experiment, how to write a research paper, the relevant ethics, copy right, impact factor etc.

Instruction for candidates:

- The question paper for end-semester examination will have a weightage of 25%. It will consist of 100 objective questions of equal marks. All questions will be compulsory.
- Two preannounced test will be conducted having a weightage of 25% each. Each preannounced test will consist of 20 objective type, 5 short questions/problems on the UGC-NET (objective type) pattern as well as one long answer type question. The student is expected to provide reasoning/solution/working for the answer. The candidates will attempt all question. Choice will be given only in long answer type. The question paper is expected to contain problems to the extent of 40% of total marks.
- Four objective/MCQ type surprise test will be taken. Two best out of four objective/MCQ type surprise test will be considered towards final each of 12.5% weightage to the final. Each surprise test will include 20-25 questions.
- The books indicated as text-book(s) are suggestive However, any other book may be followed.

UNIT-I

Basic principles and significance of research design

Experimental set-up

Randomized Block Designs (RBD), completely randomized designs (CRD); Latin square design and Factorial design **(5 Lectures)**

UNIT-II

Data collection, organization and interpretation.

Research articles, research papers, popular research articles and reviews;

Difference between periodicals; journals; monographs, magazines; proceedings.

How to write a research paper, reference styles. **(8 Lectures)**

UNIT-III

Process of proof reading of a research manuscript.

Process of reviewing.

Process of submission of a paper.

Important journals in plant sciences. **(6 Lectures)**

UNIT-IV

An introduction to Science citation index; H-index, Impact factor of a journal; Eigen factor

Copyright act; Academic frauds; Plagiarism; Softwares to check plagiarism. **(5 Lectures)**

Suggested Readings

1. Kothari C.R. Research Methodology – Methods and Techniques. 2nd revised ed. New Age International (P) Ltd. Publishers, New Delhi, 2007.

2. McKillup S. *Statistics Explained. An Introductory Guide for Life Scientists*. Cambridge University Press, Cambridge, UK, 2006.

3. Selvin S. *Biostatistics – How it Works.* First Impression. Pearson Education Inc., New Delhi, 2007.

DAV UNIVERSITY, JALANDHAR

SEMESTER IV

Course Title: Genomics, Proteomics and Metabolomics

Course Code:BTY652

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: The aim of the course is to provide students practical and bioinformatical skills in genomics, transcriptomics, proteomics and metabolomics, knowledge and the notion about how the methods are applied in real-life scientific research.

1. Introduction to –omes and –omics. Gene, Genome and Genomics. **2 hour**
2. Whole genome analysis: Preparation of genomic library in vectors, ordered cosmid libraries, BAC libraries, shotgun libraries. Genome analysis for global patterns of gene expression using fluorescent-labelled cDNA or end-labelled RNA probes. **6 hours**
3. FISH, Sequencing: Conventional sequencing (Sanger, Maxam and Gilbert methods), automated sequencing, analysis of sequence information FISH. Analysis of single nucleotide polymorphism using DNA chips. **4 hours**
4. Transcriptomics. Microarray, EST, SAGE. Bioinformatical methods in ranscriptomics. Application of transcriptomics. Genome sequencing projects (technology of sequencing and assembly, bioinformatics of genome annotation, current status of genome sequencing projects) Genomic browsers and databases Orthology prediction (comparative genomics), Search for transcription factor binding sites (TFBS), Computational prediction of miRNA target genes *De novo* prediction of regulatory motifs in genome, Single nucleotide polymorphisms (SNP) in medical genetics and basic research. **10 hours**
5. Next generation sequencing using new technologies. Alignment of pairs of sequences of DNA and proteins. Multiple sequence alignment. Searching databases for similar sequences. Phylogeny: Different approaches to tree construction. Analyze sequences and its role in understanding the evolution of organisms and genes. **6 hours**
6. **Proteomics.** Aims, strategies and methods. Bioinformatics tools in proteomics. Application of proteomics. Protein microarrays. Proteomics technologies: 2D-electrophoresis, MALDI-TOF mass spectrometry, yeast 2-hybrid system. Protein-protein interactions: experimental and computational methods, databases. **8 hours**
7. Types of data and databases, quality of annotation. Protein structure prediction. The proteome. High throughput proteomics and its use to the biologists. **4 hours**
8. Novel approaches to protein expression analysis: Scope of functional proteomics. Proteome analysis: 2DE based strategy. Alternatives to 2DE for protein expression analysis. **5 hours**

9. Application of proteome analysis to drug development and toxicology: Basic principle and making use of the data. **4 hours**
10. Protien-DNA interactions. Cancer profiling using DNA microarrays. Proteomics as tool for plant genetics and breeding. **5 hours**
11. Introduction to metabolomics. Technologies in metabolomics. Nutrigenomics. Nuclear Magnetic Resonance Spectroscopy and Mass Spectrometry in metabolomics. Metabolic pathways resources: KEGG, Biocarta. Nutrigenomics and metabolic health. Solved problems and future challenges. **6 hours**

Books:

1. A primer of genome science (2009) by Gibson G. and Muse S. V., (Sinauer Associates, Inc. Sunderland, MA).
2. Knowledge discovery in proteomics (2006) by Igor Jurisica, Dennis Wigle (Chapman & Hall / CRC).
3. Proteomics: From protein sequence to function (2002) edited by Pennington SR, Dunn M. J. (Viva Books Pvt. Ltd).
4. Informatics in proteomics (2005) edited by Srivastava Sudhir (Taylor & Francis Group / CRC).
5. Genomics and proteomics engineering in medicine and biology (2007) edited by Akay M. (Wiley-Interscience John Wiley & Sons, Inc. Publication, USA).
6. Essentials of genomics and bioinformatics (2002) by Christoph W. Sensen (Wiley-VCH, Weinheim).
7. Current protocols in bioinformatics (2004) by Baxevanis A.D., Davison, D.B., Page, R.D.M. & Petsko, G.A (John Wiley & Sons, Inc. Publications, New York).

Course Title: Genomics, Proteomics and Metabolomics-LAB

Course Code: BTY656

L	T	P	Credits	Marks
0	0	3	2	50

- Site directed mutagenesis. Deleting a DNA sequence from a plasmid and introduction into *E. coli.*
- Functional validation of gene expression.
- Analysis of mutants using Southern blot and PCR analysis.
- Introduction to DNA sequencing.