

DAV UNIVERSITY, JALANDHAR

DAV UNIVERSITY JALANDHAR



Course Scheme & Syllabi

For

**B.Sc. (Hons.) Zoology
(Program ID-8)**

(As per Choice Based Credit System)

1st to 6th SEMESTER

Syllabi Applicable for Admissions in 2019

DAV UNIVERSITY, JALANDHAR

SCHEME OF COURSES

B.Sc. (Hons.) Zoology

Semester 1

S. No.	Paper Code	Course Title	Course Type	L	T	P	Cr.
1	ZOO121	Non-chordates I: Protista to Pseudocoelomates	Core	4	0	0	4
2	ZOO122	Non-chordates I: Protista to Pseudocoelomates Laboratory	Core	0	0	3	2
3	ZOO123	Perspectives in Ecology	Core	4	0	0	4
4	ZOO124	Perspectives in Ecology Laboratory	Core	0	0	3	2
5	ZOO127	Fundamentals of Cell Biology	Core	4	0	0	4
6	ENG151B	Basic Communication Skills	AECC	3	0	0	3
7	ENG152A	Basic Communication Skills Lab		0	0	2	1
8	Generic Elective-I		GE				6
Total							26

GE (Generic Elective-I) (Choose one)

S.No.	Paper Code	Course Title	L	T	P	Cr.
1	BOT131	Plant Diversity	4	0	0	4
	BOT132	Plant Diversity I Laboratory	0	0	3	2
2	MIC111	Introduction to Microbiology	4	0	0	4
	MIC112	Introduction to Microbiology Laboratory	0	0	3	2

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Semester 2

S.No.	Paper Code	Course Title	Course Type	L	T	P	Cr.
1	Z00125	Non Chordates-II: Coelomates	Core	4	0	0	4
2	ZOO126	Non Chordates-II: Coelomates Laboratory	Core	0	0	3	2
3	ZOO325	Basics of Parasitology	Core	4	0	0	4
4	ZOO326	Basics of Parasitology Laboratory	Core	0	0	3	2
5	EVS100	Environmental Science	AECC	4	0	0	4
6	SGS 107	Human Values and General Studies	AECC	4	0	0	4
7	Skill Enhancement Course-I		SEC				2
8	Generic Elective-II		GE				6
Total							28

GE (Generic Electives)-II (choose one)

S.No.	Paper Code	Course Title	L	T	P	Cr.
1	CHE157	General Chemistry I	4	0	0	4
	CHE158	General Chemistry I Laboratory	0	0	3	2
2	BCH403	Biochemical Correlations in Diseases	4	0	0	4
	BCH404	Biochemical Correlations in Diseases Laboratory	0	0	3	2

SEC (Skill Enhancement Course)-I (choose one)

S.No.	Paper Code	Course Title	L	T	P	Cr.
1	ZOO225	Apiculture	2	0	0	2
2	ZOO226	Aquarium fish keeping	2	0	0	2
3	ZOO227	Sericulture	2	0	0	2

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Semester 3

S.No.	Paper Code	Course Title	Course Type	L	T	P	Cr.
1	ZOO221	Diversity of Chordates	Core	4	0	0	4
2	ZOO222	Diversity of Chordates Laboratory	Core	0	0	3	2
3	ZOO223A	Life Sustaining Systems	Core	4	0	0	4
4	ZOO329	Biology of Insecta	Core	4	0	0	4
5	ZOO330	Biology of Insecta Laboratory	Core	0	0	3	2
6	BCH101	Biomolecules	Core	4	0	0	4
7	BCH102	Biomolecules Laboratory	Core	0	0	3	2
8	Generic Elective-III		GE				6
Total							28

GE (Generic Electives-III) (choose one)

S.No.	Paper Code	Course Title	L	T	P	Cr.
1	BOT241	Plant Physiology and Metabolism	4	0	0	4
	BOT242	Plant Physiology and Metabolism Laboratory	0	0	3	2
2	BCH401	Gene, Organization, Expression and Regulation	4	0	0	4
	BCH402	Gene, Organization, Expression and Regulation Laboratory	0	0	3	2

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Semester 4

S.No.	Paper Code	Course Title	Course Type	L	T	P	Cr.
1	ZOO345	Comparative Anatomy of Vertebrates	Core	4	0	0	4
2	ZOO230A	Controlling and Coordinating Systems	Core	4	0	0	4
3	ZOO349	Physiology and Anatomy Laboratory	Core	0	0	3	2
4	BCH103	Metabolism	Core	4	0	0	4
5	BCH104	Metabolism Laboratory	Core	0	0	3	2
6	Skill Enhancement Course-II		SEC	2	0	0	2
7	Generic Elective-IV		GE				6
Total							24

SEC (Skill Enhancement Course)-II (choose one)

S.No.	Paper Code	Course Title	L	T	P	Cr.
1	ZOO232	Medical Diagnostics	2	0	0	2
2	ZOO233	Research Methodology	2	0	0	2
3	ZOO234	Swachh Bharat Internship Programme	2	0	0	2

GE (Generic Electives)-IV (choose one)

S.No.	Paper Code	Course Title	L	T	P	Cr.
1	CHE257	General Chemistry II	4	0	0	4
	CHE258	General Chemistry II Laboratory	0	0	3	2
2	BTY243	Biotechnology and Human Welfare	4	0	0	4
3	BTY244	Biotechnology and Human Welfare Laboratory	0	0	3	2

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Semester 5

S.No	Paper Code	Course Title	Course Type	L	T	P	Cr.
1	ZOO343	Principles of Genetics	Core``	4	0	0	4
2	ZOO321	Fundamentals of Developmental Biology	Core	4	0	0	4
3	ZOO322	Fundamentals of Developmental Biology Laboratory	Core	0	0	3	2
4	ZOO327	Basics of Fish and Fisheries	Core	4	0	0	4
5	ZOO328	Basics of Fish and Fisheries Laboratory	Core	0	0	3	2
6	Discipline Specific Elective-I		DSE				6
7	Discipline Specific Elective-II		DSE				6
Total							28

DSE (Discipline Specific Electives)-II (choose any two)

S. No.	Paper Code	Course Title	L	T	P	Cr.
I	ZOO323	Principles of Wild Life Conservation and Management	4	0	0	4
	ZOO324	Principles of Wild Life Conservation and Management Laboratory	0	0	3	2
II	ZOO335	Reproductive Biology	4	0	0	4
	ZOO336	Reproductive Biology Laboratory	0	0	3	2

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Semester 6

S.No	Paper Code	Course Title	Course Type	L	T	P	Cr.
1	ZOO331	Taxonomy and Evolution	Core	4	0	0	4
2	ZOO332	Taxonomy and Evolution Laboratory	Core	0	0	3	2
3	ZOO341	Principles of Molecular Biology	Core	4	0	0	4
4	ZOO350	Biotechniques Laboratory	Core	0	0	3	2
5	Discipline Specific Elective-III		DSE				6
6	Discipline Specific Elective-IV		DSE				6
Total							24

DSE (Discipline Specific Electives)-III (choose one)

S.No	Paper Code	Course Title	L	T	P	Cr.
1	ZOO339	Fundamentals of Animal Biotechnology	4	0	0	4
2	ZOO340	Fundamentals of Animal Biotechnology Laboratory	0	0	3	2
3	ZOO333	Basic Computational Biology	4	0	0	4
4	ZOO334	Basic Computational Biology Laboratory	0	0	3	2

DSE (Discipline Specific Electives)-IV (choose one)

S.No	Paper Code	Course Title	L	T	P	Cr.
1	MIC233	Basic Immunology	4	0	0	4
2	MIC234	Basic Immunology Laboratory	0	0	3	2
3	ZOO337	Endocrinology	4	0	0	4
4	ZOO338	Endocrinology Laboratory	0	0	3	2

Syllabi

SEMESTER 1

Course Title: Non-chordates I: Protista to Pseudocoelomates
Paper Code: ZOO121

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the general characters and classification of Acoelomates to Pseudocoelomates and the affinities between different groups.

UNIT-A 19 hours

- **Protozoa:** General characteristics of protozoans and their classification up to orders; Detailed study of *Euglena*, *Plasmodium*- Life cycle and pathogenicity; locomotion and reproduction in protozoans; Evolution of symmetry and segmentation of Metazoa

UNIT-B 23 hours

- **Porifera:** General characteristics and classification up to orders; Canal system and spicules in sponges. Detailed study of *Sycon*
- **Cnidaria:** General characteristics and classification up to orders; Metagenesis in *Obelia*; corals and coral reefs; polymorphism in Cnidaria
- **Ctenophora:** General characteristics and Evolutionary significance

UNIT-C 10 hours

- **Platyhelminthes:** General characteristics and classification up to orders. Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*

UNIT-D 8 hours

- **Nemathelminthes:** General characteristics and classification up to orders; Life cycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti*;
- Parasitic adaptations in helminthes

Reference books:

1. Dhami, P.S. and Dhami, J.K. *Invertebrate Zoology*. 5th ed. New Delhi: R. Chand & Co.,
2. Hyman L.H. *The Invertebrates*. Vol. I, II, III, IV and V. McGraw Hill Book Company. Inc., 1959.
3. Kotpal, R.L. *Minor phyla*. 5th ed. Meerut: Rastogi Publishers, 2006.
4. Kotpal, R.L. *Modern Text Book of Zoology Invertebrates*. 10th ed., Rastogi Publishers, Meerut, 2012.

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Course Title: Non-Chordates I: Protista to Pseudocoleomates

Laboratory

Paper Code: ZOO122

L	T	P	Credits	Marks
0	0	3	2	50

1. General survey of invertebrate phyla:
 - Protozoa: *Amoeba*, *Euglena*, *Paramecium*, *Vorticella*, *Balantidium*, *Nyctotherus*, *Opalina*.
 - Porifera: *Sycon*, *Grantia*, *Spongilla*, *Euplectella*, *Euspongia*, Temporary mounts of gemmules and spicules of *Sycon*.
 - Coelenterata: *Hydra*, *Obelia*, *Porpita*, *Velella*, *Physalia*, *Aurelia*, *Metridium*, *Tubipora*, *Zooanthus*, *Madrepora*, *Favia*, *Fungia*, *Bougainvillea*.
 - Ctenophora: One specimen/slide
 - Platyhelminthes: *Planaria*, *Fasciola* (W.M.), larval stages of *Fasciola*, *Taenia* (scolex, proglottids-mature and gravid),
 - Nematelminthes: *Ascaris lumbricoides* (male and female) and its life stages.
2. Submission of report on an educational visit.
3. Culture of Protozoa and preparation of their temporary mounts.

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

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Course Title: Perspectives in Ecology

Paper Code: ZOO123

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To educate the students about the basic environmental phenomena like ecosystem, energy flow through the ecosystem and biogeochemical cycles.

UNIT-A

30 hours

- **Introduction to Ecology:** History of ecology; Autecology and Synecology; levels of organization; laws of limiting factors; study of physical factors
- **Population:** Unitary and Modular populations; Unique and group attributes of population; density; natality; mortality; life tables; fecundity tables; survivorship curves; age ratio; sex ratio; dispersal and dispersion; Exponential and logistic growth; equation and patterns; r and K strategies; Population regulation- density dependent and independent factors; Population interactions; Gause's principle with examples; Lotka-Volterra equation for competition and Predation, functional and numerical responses.

UNIT-B

12 hours

- **Community:** Community characteristics: species richness, dominance, diversity, abundance, vertical stratification; Ecotone and edge effect; Ecological succession with one example; Theories pertaining to climax community.

UNIT-C

10 hours

- **Ecosystem:** Types of ecosystems with one example in detail; Detritus and Grazing food chains; Linear and Y-shaped food chains; Food web; Energy flow through the ecosystem; Ecological pyramids and Ecological efficiencies; Nutrient and biogeochemical cycle with one example of Nitrogen cycle; Human modified ecosystem

UNIT-D

8 hours

- **Zoogeography:** Zoogeographical realms; Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms
- **Applied Ecology:** Ecology in Wildlife Conservation and Management
- **Restoration Ecology:** Ecosystem restoration, rehabilitation, reclamation

Reference books:

1. Krebs, J.C. *Ecology*. New York: Harper & Row, Publ., 2009.
2. Odum, E.P. *Fundamentals of Ecology*. Indian Edition. Thomson Brooks/Cole, 2008.

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3. Clarke, G. L. *Elements of Ecology*. New York: John Wiley & Sons, 1954.
4. Kendeigh, S.C. *Ecology with special reference to animals and man*. New Delhi: Prentice Hall of India, 1961.
5. Smith. *Ecology*. New York: Harper & Row Publishers, 1990.
6. Kormondy, E.J. *Concepts of Ecology*. 2nd ed. New Delhi: Prentice Hall of India, 2005.

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Course Title: Perspectives in Ecology Laboratory

Paper Code: ZOO124

L	T	P	Credits	Marks
0	0	3	2	50

- Life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
- Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
- Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO₂
- Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

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Course Code: ZOO127

Course Title: Fundamentals of Cell Biology

L	T	P	Credit
4	0	0	4

Unit I: Cells and organelles	18 hours
Introduction: Cell as a basic unit of living system, Biochemical composition of cell, the cell theory, ultrastructure of cell.	
Cytoskeleton: The Nature of the Cytoskeleton and endomembrane system, intermediate filaments, microtubules, cilia and centrioles, actin filaments, actin-binding proteins.	
Cell membranes: Architecture and dynamics (models); Membrane composition, the lipid bilayer/membrane; A summary of membrane functions - simple diffusion, Facilitated transports, Active transport, Endocytosis, Pinocytosis, Phagocytosis, Exocytosis. Introduction to important receptors in cell membrane.	
Unit II: Molecule and Protein Trafficking	16 hours
The compartmentalization of higher cells, transport of molecules into and out of organelle membranes, the endoplasmic reticulum, transport from the ER through the Golgi Apparatus, transport from the trans Golgi network to lysosomes, transport from the plasma membrane via endosome: Endocytosis, molecular mechanisms of vesicular transport; introduction to transit peptide, signal peptide and translocons.	
Unit III: Nucleus and Cell Cycle	10 hours
Genome organization, structure and function of nucleus, nuclear envelope, structure of chromatin, nucleosome and chromosome, cell cycle, mitosis and meiosis.	
Unit IV: Eukaryotic cell organelles and functions	16 hours
Structure and functions of the following cell organelles: endoplasmic reticulum, Golgi complex, lysosome, ribosome and mitochondria. Principles & applications of differential centrifugation in the fractionation of cellular organelles and Svedberg unit; endosymbiotic theories	

Reference Books:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. *Molecular Biology of the Cell*. 5th Edition. Garland Science. 2007. Print.
2. Lodish, H.F. *Molecular Cell Biology*. 6th Edition. W.H. Freeman & Company. 2007. Print.
3. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G.P. *The World of the Cell*. 7th Edition. Benjamin Cummings. 2008. Print.
4. Powar, C.B. *Cell Biology*. Himalaya Publishing House. 2007. Print.

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SEMESTER 2

Course Title: Non-Chordates II- Coelomates

Paper Code: ZOO125

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the general characters and classification of coelomates and the affinities between different groups.

UNIT-A 12 hours

- **Introduction to Coelomates:** Evolution of Coelom and Metamerism.
- **Annelida:** General characteristics and classification up to orders. Detailed study of Earthworm.

UNIT-B 21 hours

- **Arthropoda:** General characteristics and classification up to orders; vision and respiration in Arthropoda; Metamorphosis in Insects; social life in bees and termites.
- **Onychophora:** General characteristics and Evolutionary significance.

UNIT-C 12 hours

- **Mollusca:** General characteristics and classification up to orders; Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves; Evolutionary significance of trocophore larva.

UNIT-D 12 hours

- **Echinodermata:** General characteristics and classification up to classes; water vascular system in Asteroidea; Larval forms in Echinodermata; Affinities with Chordates.

Reference books:

1. Dhama, P.S. and Dhama, J.K. *Invertebrate Zoology*. 5th ed. New Delhi: R. Chand & Co., 2004.
2. Hyman, L.H. *The Invertebrates*. Vol. I, II, III, IV and V. McGraw Hill Book Company. Inc., 1959.
3. Kotpal, R.L. *Minor phyla*. 5th ed. Meerut: Rastogi Publishers, 2006.
4. Kotpal, R.L. *Modern Text Book of Zoology Invertebrates*. 10th ed., Meerut: Rastogi Publishers, 2012.
5. Parker, T.J. and Haswell, W.A. *Text book of Zoology, Invertebrates*. 7th ed., Vol. I. Delhi: CBS Publishers & Distributors, 1992.

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Course Title: Non chordates II- Coelomates Laboratory

Paper Code: ZOO126

L	T	P	Credits	Marks
0	0	3	2	50

1. General survey of the following phyla through charts, models and e-resources:

- **Annelida:** *Pheretima, Lumbricus, Nereis, Heteronereis, Polynoe, Aphrodite, Amphitrite, Chaetopterus, Arenicola, Hirudinaria, Pontobdella.*
- **Arthropoda:** *Peripatus, Lepisma, Periplanata*, mouth parts of *Periplanata*, Grasshopper, Praying mantis, Termite (queen and other castes), Butterfly, Moth, Beetle, Honeybee, Crab, Prawn, *Balanus, Apus, Limulus*, Scorpion, Spider, Millipede, Centipede, *Cypris, Cyclops, Daphnia*, Prawn.
- **Mollusca:** *Anodonta, Mytilus, Pecten, Haliotis, Aplysia, Doris, Pila, Octopus, Nautilus, Chiton*; Glochidium larva and radula of *Pila*.
- **Echinodermata:** *Asterias, Antedon, Ophiothrix, Holothuria*

2. Demonstration of anatomy of the following animals through charts/models/e-resources

- Earthworm: digestive and nervous systems
- Cockroach: digestive and nervous systems; mouth parts of Cockroach
- Prawn: digestive and nervous systems; Appendages and gills of Prawn
- *Pila*: digestive and nervous systems; Radula of *Pila*
- *Asterias*: Aristotle's lantern, tube feet.

3. Study of on larval forms of all phyla.

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Course Title: Basics of Parasitology

Paper Code: ZOO325

Course Objective: The acquaint students with life cycles of different parasites, the diseases caused by them and the therapeutic options available.

UNIT-A

- **Introduction to Parasitology:** Brief introduction of Parasitism, 3 hours
Parasite, Parasitoid and Vectors (mechanical and biological vector),
Host parasite relationship
- **Parasitic Protists:** Study of Morphology, Life Cycle, Prevalence, 15 hours
Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of
Entamoeba histolytica, *Giardia intestinalis*, *Trypanosoma gambiense*,
Leishmania donovani, *Plasmodium vivax*

UNIT-B

- **Parasitic Platyhelminthes:** Study of Morphology, Life Cycle, 15 hours
Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and
Treatment of *Fasciolopsis buski*, *Schistosoma haematobium*, *Taenia*
solium and *Hymenolepis nana*

UNIT-C

- **Parasitic Nematodes:** Study of Morphology, Life Cycle, Prevalence, 15 hours
Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of
Ascaris lumbricoides, *Ancylostoma duodenale*, *Wuchereria bancrofti*
and *Trichinella spiralis*. Study of structure, life cycle and importance
of *Meloidogyne* (root knot nematode), *Pratylenca* (lesion nematode)

UNIT-D

- **Parasitic Arthropoda:** Biology, importance and control of ticks, 10 hours
mites, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis*
and *Cimex lectularius*
- **Parasitic Vertebrates:** A brief account of parasitic vertebrates; 2 hours
Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat

Reference books

1. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. *Biology of Disease*. Taylor and Francis Group, 2007.
2. Arora, D. R and Arora, B. *Medical Parasitology*. II Edition. CBS Publications and Distributors, 2001.
3. E.R. Noble and G.A. Noble. *Parasitology: The biology of animal parasites*. V Edition, Lea & Febiger, 1982.
4. K. D. Chatterjee. *Parasitology: Protozoology and Helminthology*. XIII Edition, CBS Publishers & Distributors (P) Ltd., 2009.

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5. *Meyer, Olsen & Schmidt's Essentials of Parasitology*, Murray, D. Dailey, W.C. Brown Publishers
6. Parija, S. C. *Textbook of medical parasitology, protozoology & helminthology* (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
7. Rattan Lal Ichhpujani and Rajesh Bhatia. *Medical Parasitology*, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi

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Course Title: Basics of Parasitology Laboratory

Paper Code: ZOO326

L	T	P	Credits	Marks
0	0	3	2	50

- Study of life stages of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* and *Plasmodium vivax* through permanent slides/micro photographs
- Study of adult and life stages of *Fasciolopsis buski*, *Schistosoma haematobium*, *Taenia solium* and *Hymenolepis nana* through permanent slides/micro photographs
- Study of adult and life stages of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/micro photographs
- Study of plant parasitic root knot nematode, *Meloidogyne* from the soil sample
- Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopi* and *Cimex lectularius* through permanent slides/ photographs
- Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
- Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a byproduct]
- Submission of a brief report on parasitic vertebrates

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Skill enhancement courses

Course Title: Apiculture

Paper Code: ZOO225

L	T	P	Credits	Marks
2	0	0	2	50

Course Objective: To acquaint students with bee keeping methods and use of bee products.

UNIT-A 14 hours

- **Biology of Bees:** History, Classification and Biology of Honey Bees
Social Organization of Bee Colony
- **Rearing of Bees:** Artificial Bee rearing (Apiary), Artificial beehives – Newton and Langstroth models; Bee Pasturage; Selection of Bee Species for Apiculture; Bee Keeping Equipment; Methods of Extraction of Honey (Indigenous and Modern)

UNIT-B 5 hours

- **Diseases and Enemies:** Bee Diseases-brood diseases; Enemies of honey bees.

UNIT-C 2 hours

- **Bee Economy:** Products of Apiculture Industry and their uses (Honey, Bees Wax, Propolis).

UNIT-D 4 hours

- **Entrepreneurship in Apiculture:** Bee Keeping Industry – Recent Efforts

Reference books:

1. Bisht D.S., Apiculture, ICAR Publication.
2. Prost, P. J. Apiculture. Oxford and IBH, New Delhi, 1962.
3. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.

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Course Title: Aquarium Fish Keeping

Paper Code: ZOO226

L	T	P	Credits	Marks
2	0	0	2	50

Course Objective: To acquaint students with the technique of rearing fishes in aquarium.

UNIT-A 5 hours

- **Introduction to Aquarium Fish Keeping:** The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes.

UNIT-B 10 hours

- **Biology of Aquarium Fishes:** Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish

UNIT-C 6 hours

- **Food and feeding of Aquarium fishes:** Use of live fish feed organisms. Preparation and composition of formulated fish feeds
- **Fish Transportation:** Live fish transport - Fish handling, packing and forwarding techniques.

UNIT-D 4 hours

- **Maintenance of Aquarium:** General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry

Reference books:

1. D.E. Boruchowitz, The Simple Guide to Freshwater Aquariums (Second Edition) TFH Publications
2. D.J. Smith, Aquarium Keeping as a Profit Generator Hobby CreateSpace Independent Publishing Platform 2016-12-13
3. J.R. Norman, *A history of Fishes*, Hill and Wang Publishers
4. Q Bone and R Moore, *Biology of Fishes*, Talyor and Francis Group, CRC Press, U.K.
5. S.S. Khanna and H.R. Singh, *A text book of Fish Biology and Fisheries*, Narendra Publishing House.

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Course Title: Sericulture

Paper Code: ZOO227

L	T	P	Credits	Marks
2	0	0	2	50

Course Objective: To acquaint the students with rearing of silk worms and entrepreneurship programmes in sericulture.

UNIT-A

6 hours

- **Introduction:** Sericulture- Definition, history and present status; Silk route; Types of silkworms, Distribution and Races; Exotic and indigenous races; Mulberry and non-mulberry sericulture
- **Biology of Silkworm:** Life cycle of *Bombyx mori*; Structure of silk gland and secretion of silk

UNIT-B

13 hours

- **Rearing of Silkworms:** Selection of mulberry variety and establishment of mulberry garden; Rearing house and rearing appliances; Disinfectants: Formalin, Bleaching powder; RKO; Silkworm rearing technology: Early age and Late age rearing; Types of mountages; Spinning, harvesting and storage of cocoons

UNIT-C

4 hours

- **Pests and Diseases:** Pests of silkworm and their management; Diseases of silkworm and their control.

UNIT-D

2 hours

- **Entrepreneurship in Sericulture:** Prospectus of Sericulture in India: Sericulture industry in different states; employment, potential in mulberry and non-mulberry sericulture.

Reference books:

1. *A Guide for Bivoltine Sericulture*; K. Sengupta, Director, CSR & TI, Mysore, 1989.
2. *Appropriate Sericultural Techniques*; Ed. M. S. Jolly, Director, CSR & TI, Mysore. Bangalore, 1986.
3. *Handbook of Silkworm Rearing: Agriculture and Technical Manual-1*, Fuzi Pub. Co.
4. *Improved Method of Rearing Young age silkworm*; S. Krishnaswamy, reprinted CSB, Ltd., Tokyo, Japan, 1972.
5. *Manual on Sericulture*. Food and Agriculture Organisation, Rome, 1976
6. Narasimhanna M. N. *Manual of Silkworm Egg Production*;, CSB, Bangalore, 1988. Pub. Govt. Press, Bangalore, 1956
7. *Silkworm Rearing and Disease of Silkworm*, Ptd. By Director of Ptg., Stn. &
8. *Silkworm Rearing*; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome, 1988.

9. Ullal, S.R. and Narasimhanna. *M.N. Handbook of Practical Sericulture*. CSB,

DAV UNIVERSITY, JALANDHAR

SEMESTER 3

Course Title: Diversity of Chordates

Paper Code: ZOO221

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the general characters and classification of chordates and the affinities between different groups.

UNIT-A

12
hours

- **Introduction to Chordates:** General Characteristics; Outline classification
- **Protochordata:** General characteristics of Hemichordata, Urochordata and Cephalochordata. Hemichordates as link between non-chordates and chordates; study of larval forms in protochordates; retrogressive metamorphosis in Urochordata. Detailed study of *Herdmania* and *Branchiostoma*
- **Origin of Chordata:** Dipleurula concept and the Echinoderm theory of origin of chordates; Advanced features of vertebrates over Protochordata

UNIT-B

10
hours

- **Agnatha:** General characteristics and classification up to orders of Cyclostomata. Affinities of cyclostomata.
- **Pisces:** General characteristics of Chonrichthyes and Osteichthyes; Classification up to orders; Migration; osmoregulation and Parental care in fishes

UNIT-C

12
hours

- **Amphibia:** Origin of Tetrapoda (Evolution of terrestrial ectotherms); General characteristics and classification up to orders; Parental care in Amphibians
- **Reptilia:** General characteristics and classification up to orders; Affinities of *Sphenodon*; Poison apparatus and biting mechanisms in snakes

UNIT-D

18
hours

- **Aves:** General characteristics and classification up to orders; *Archaeopteryx*- a connecting link; Principles and aerodynamics of flight; Flight adaptations; Migration in birds
- **Mammals:** General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

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Reference books:

1. Kotpal, R.L. *Text Book of Zoology- Vertebrates*. Meerut: Rastogi Publications, 2012.
2. Parker, T.J., and Haswell, W.A. *A Text Book of Zoology Vertebrates*. 7th ed. Vol. II. London: Mac Millan, 1972.
3. Dodson, E.O. *A Text Book of Zoology*. Delhi: CBS Publishers & Distributors, 1976.
4. Young, J. Z. *The Life of Vertebrates*. III Edition. Oxford university press., 2004
5. Hall B.K. and Hallgrimsson B. *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc., 2008.
6. Dhama, P.S., Dhama, J.K. *Chordate Zoology*. 5th ed. New Delhi: R. Chand & Co., 2006.

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Course Title: Diversity of Chordates laboratory

Paper Code: ZOO222

L	T	P	Credits	Marks
0	0	3	2	50

1. General survey of chordates through charts/models and e-resources:
 - Hemichordata: *Balanoglossus*
 - Protochordata - *Herdmania*, pharynx and spicules of *Herdmania*, *Molgula*, *Botryllus*, *Pyrosoma*, *Doliolum*, *Oikopleura* and *Branchiostoma*, T.S. *Branchiostoma* through different regions
 - Cyclostomata – *Myxine*, *Petromyzon* and *Ammocoetes* larva.
 - Chondrichthyes - *Zygaena*, *Pristis*, *Narcine*, *Trygon* and *Rhinobatus*.
 - Actinopterygii – *Polypterus*, *Acipenser*, *Mystus*, *Labeo rohita*, *Cirrhinus mrigala*, *Hippocampus*, *Syngnathus*, *Exocoetus*, *Diodon*, *Ostracion*, *Echeneis*, *Lophius*, *Solea* and *Anguilla*.
 - Dipneusti (Dipnoi) – Any of the lungfishes.
 - Amphibia – *Necturus*, *Proteus*, *Amphiuma*, *Salamandra*, *Ambystoma*, *Hyla*, *Rhacophorus*, *Ichthyophis* and *Axolotl* larva.
 - Reptilia- Tortoise, Turtle, *Hemidactylus*, *Draco*, *Varanus*, *Phrynosoma*, *Chamaeleon*, *Typhlops*, *Python*, *Ptyas*, *Bungarus*, *Naja*, *Hydrus*, *Vipera*, *Crocodylus*, *Gavialis* and Alligator. Key for identification of poisonous and non-poisonous snakes.
 - Aves : *Anas*, *Ardea*, *Milvus*, *Pavo*, *Tyto*, *Alcedo*, *Eudynamis*, *Casuaris* and *Struthio*; types of beaks and claws.
 - Mammalia – *Echidna*, *Ornithorhynchus*, *Macropus*, *Erinaceus*, *Sorex*, *Loris*, *Macaca*, *Manis*, *Hystrix*, *Funambulus*, *Felis*, *Capra*, *Canis*, *Herpestes*, *Pteropus* and *Leo*.
2. Project report on vertebrate fauna of different regions.

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

DAV UNIVERSITY, JALANDHAR

Course Title: Life Sustaining Systems

Paper Code: ZOO223A

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint the students with functioning of various systems of animal body.

UNIT-A

- **Physiology of Digestion:** Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract. 14 hours

UNIT-B

- **Physiology of Respiration:** Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration 12 hours

UNIT-C

- **Renal Physiology:** Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance 8 hours

UNIT-D

- **Blood:** Components of blood and their functions; Structure and functions of haemoglobin; Haemostasis: Blood clotting system, Kallikrein-Kininogen system, and Fibrinolytic system, Haemopoiesis; Blood groups: Rh factor, ABO and MN 14 hours
- **Physiology of Heart:** Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses; Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate, Electrocardiogram, Blood pressure and its regulation 12 hours

Reference books:

1. Best, J.P. *Best and Taylor's physiological basis of medical practice*. 11th ed., William and Wilkins, 1985.

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2. Guyton, A.C. and Hall, J.E. *Text Book of Medical Physiology*. XIth edition, Saunders Company, 2006.
3. Hoar, W.S. *General and comparative physiology, Adaptation and Environment*. 3rd ed.,
4. Tortora, G.J. and Grabowski, S. *Principles of Anatomy & Physiology*. XI Edition John Wiley & sons, 2006.
5. Victor P. Eroschenko. *diFiore's Atlas of Histology with Functional correlations*. XII Edition. Lippincott W. & Wilkins, 2008.

DAV UNIVERSITY, JALANDHAR

Course Title: Biology of Insecta

Paper Code: ZOO329

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The acquaint students with taxonomy, morphology and physiology of insects. To educate students about insect societies and insect-host relationships.

UNIT-A

- **Introduction:** General features of insects; Distribution and success of insects on the Earth 4 hours
- **Insect Taxonomy:** Basis of insect classification; Classification of insects up to orders 4 hours
- **General Morphology of Insects:** External Features; Head –eyes, types of antennae, mouth parts with respect to feeding habits; Thorax: wings and wing articulation, types of Legs adapted to diverse habitat; Abdominal appendages and genitalia 8 hours

UNIT-B

- **Physiology:** Structure and physiology of insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system; Sensory receptors; Growth and metamorphosis 28 hours

UNIT-C

- **Insect Society:** Group of social insects and their social life; Social organization and social behaviour (any one example) 6 hours
- **Insect Plant Interactions:** Theory of co-evolution, role of allelochemicals in host plant mediation; Host-plant selection by phytophagous insects, Insects as plant pests 4 hours

UNIT-D

- **Insects as Vectors:** Insects as mechanical and biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors 6 hours

Reference books

- Bernays, E. A., and Chapman, R. F., Chapman and Hall, *Host Selection by Phytophagous insects*, New York, USA
- Borror, D. J., Triplehorn, C. A., and Johnson, N. F., *M Introduction to the study of insects*, Saunders College Publication, USA
- Chapman, R. F., *The Insects: Structure and function*, Cambridge University Press, UK

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- Gullan, P. J. , and Cranston, P. S *The Insects*, An outline of Entomology,, Wiley Blackwell, UK
- Imms , A. D., *A general text book of entomology*, Chapman & Hall, UK , 1977.
- Klowden, M. J., *Physiological system in Insects*, Academic Press, USA
- Nation, J. L., *Insect Physiology and Biochemistry*, CRC Press, USA
- Snodgrass, R. E., *Principles of Insect Morphology*, Cornell Univ. Press, USA
- Wilson, E. O., *The Insect Societies*, Harward Univ. Press, UK

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Course Title: Biology of Insecta Laboratory

Paper Code: ZOO330

L	T	P	Credits	Marks
0	0	3	2	50

- Study of one specimen from each insect order
- Study of different kinds of antennae, legs and mouth parts of insects
- Study of head and sclerites of any one insect
- Study of insect wings and their venation.
- Study of insect spiracles
- Methodology of collection, preservation and identification of insects.
- Morphological studies of various castes of *Apis*, *Camponotus* and *Odontotermes*
- Study of any three insect pests and their damages
- Study of any three beneficial insects and their products
- Field study of insects and submission of a project report on the insect diversity

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

Course Code: BCH101

Course Title: Biomolecules

L	T	P	Credit
4	0	0	4

Unit A

(15 hours)

Introduction to Biochemistry

Water as a biological solvent. Weak acids and bases. pH and buffers. Henderson-Hasselbalch equation. Physiological buffers. Fitness of the aqueous environment for living organisms.

Carbohydrates

Structure of monosaccharides. Stereoisomerism and optical isomerism of sugars. Reactions of aldehyde and ketone groups. Ring structure and anomeric forms, mutarotation. Reactions of sugars due to hydroxyl groups. Important derivatives of monosaccharides, disaccharides and trisaccharides (structure, function and occurrence of important ones). Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides - cellulose, chitin, agar, alginic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, glycogen and starch. Bacterial cell wall polysaccharides. Glycoproteins.

Unit B

(15 hours)

Proteins

Introduction to proteins. Classification based on solubility, shape, composition and functions. Amino acids: common structural features, stereoisomerism and RS system of designating optical isomers. Classification and structures of standard amino acids as zwitterion in aqueous solutions. Physical and chemical properties of amino acids. Titration of amino acids. Separation of amino acids. Essential amino acids.

Structure of peptide bond. Solid-phase synthesis of peptides. Peptide sequencing. Chemical and enzymatic cleavage of polypeptide chains and separation of peptides. Levels of structure in protein architecture. denaturation and renaturation of proteins. Behaviour of proteins in solutions. Salting in and salting out of proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (haemoglobin, myoglobin), lipoproteins, metalloproteins, glycoproteins and nucleoproteins.

Unit C

(15 hours)

Nucleic Acids

Nature of genetic material. Evidence that DNA is the genetic material. Composition of DNA and RNA. Generalized structural plan and Nomenclature of nucleic acids. DNA double helix. Structure and roles of different types of RNA. Size of DNA in prokaryotes and eukaryotes. Central dogma of molecular biology. Concepts of gene, genome and chromosome.

Porphyrins

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Porphyrin nucleus and classification of porphyrins. Important metalloporphyrins occurring in nature. Detection of porphyrins. Bile pigments – chemical nature and physiological significance.

Unit D

(15 hours)

Lipids

Definition and classification of lipids. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, prostaglandins. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats – hydrolysis, saponification value, rancidity of fats, Reichert-Meissel Number and reaction of glycerol. Biological significance of fats. Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidylserine, phosphatidylinositol, plasmalogens), sphingomyelins, glycolipids – cerebrosides, gangliosides. Properties and functions of phospholipids, isoprenoids and sterols.

Recommended books

1. Nelson, David L., and Cox, Michael M., *Lehninger Principles of Biochemistry*, 5th Edition, W.H. Freeman & Company, New York, 2008. Print.
2. Voet, Donald and Voet, Judith G., *Biochemistry*, 3rd Edition, John Wiley & Sons Inc., Singapore, 2004. Print.
3. Murray, R.K., Granner, D.K. and Rodwell, V.W. *Harper's Illustrated Biochemistry*, 27th Edition, McGraw Hill Company Inc. Singapore, 2006. Print.

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Course Code: BCH102

Course Title: Biomolecules Laboratory

L	T	P	Credit
0	0	3	2

Experiments:

1. Preparation of normal, molar and percent solutions.
2. Titration curve of Glycine.
3. Buffer preparation.
4. Qualitative tests for Carbohydrates, Lipids, Amino acids, Proteins, Nucleic acids
5. Preparation of casein from milk and determination of its isoelectric point.
6. Titrimetric analysis of Vitamin C.

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SEMESTER 4

Course Title: Comparative Anatomy of Vertebrates

Paper Code: ZOO345

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the internal structure of vertebrates.

UNIT-A

- **Integumentary System:** Structure, functions and derivatives of integument 8 hours
- **Skeletal System:** Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches 8 hours

UNIT-B

- **Digestive System:** Alimentary canal and associated glands, dentition 8 hours
- **Respiratory System:** Skin, gills, lungs and air sacs; Accessory respiratory organs 8 hours

UNIT-C

- **Circulatory System:** General plan of circulation, evolution of heart and aortic arches 8 hours
- **Urinogenital System:** Evolution of kidney and urinogenital ducts, Types of mammalian uteri 6 hours

UNIT-D

- **Nervous System:** Comparative account of brain, Autonomous nervous system, Spinal cord, Cranial nerves in mammals 8 hours
- **Sense Organs:** Classification of receptors, Brief account of visual and auditory receptors in man 6 hours

Reference books

1. Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons
2. Kardong, K.V. *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education, 2005.
3. Kent, G.C. and Carr R.K. *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies, 2000.
4. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House

DAV UNIVERSITY, JALANDHAR

Course Title: Controlling and Coordinating Systems

Paper Code: ZOO230A

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint the students with functioning of various systems of animal body

UNIT-A 10 hours

- **Tissues:** Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue
- **Bone and Cartilage:** Structure and types of bones and cartilages, Ossification, bone growth and resorption

UNIT-B 10 hours

- **Nervous system:** Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types - reflex arc; Physiology of hearing and vision.

UNIT-C 12 hours

- **Muscle:** Histology of different types of muscles; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus

UNIT-D 28 hours

- **Reproductive System:** Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female
- **Endocrine System:** Classification of hormones; Regulation of their secretion; Mode of hormone action, Signal transduction pathways for steroidal and non-steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Placental hormones

Reference books

1. Guyton, A.C. & Hall, J.E. *Textbook of Medical Physiology*. XI Edition. Herculart Asia PTE Ltd. W.B. Saunders Company, 2006.
2. Tortora, G.J. & Grabowski, S. *Principles of Anatomy & Physiology*. XI Edition John Wiley & sons, 2006.
3. Vander A, Sherman J. and Luciano D. *Vander's Human Physiology: The Mechanism of Body Function*. XIII Edition, McGraw Hills, 2014.
4. Victor P. Eroschenko. *diFiore's Atlas of Histology with Functional correlations*. XII Edition. Lippincott W. & Wilkins, 2008.

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Course Title: Physiology and Anatomy Laboratory

Paper Code: ZOO349

L	T	P	Credits	Marks
0	0	3	2	50

1. Demonstration of osmosis and diffusion.
2. Demonstration of the presence of amylase enzyme in saliva. Effect of pH and temperature on enzyme action.
3. Recording of blood pressure of man.
4. Enumeration of red blood corpuscles and white blood corpuscles of man.
5. Estimation of haemoglobin content in blood.
6. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
7. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
8. Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit
9. Mammalian skulls: One herbivorous and one carnivorous animal
10. Study of structure of any two organs (heart, lung, kidney, eye and ear)
11. Demonstration of anatomy of the following animals through charts/models/e-resources:
Labeo: Digestive and reproductive systems
Rana: Digestive, arterial, venous and reproductive systems
Varanus: Digestive, arterial, venous and reproductive systems
Columba: Digestive, arterial, venous and reproductive systems
Oryctolagus: Digestive, arterial, venous, urinogenital systems, skeleton

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

DAV UNIVERSITY, JALANDHAR

Course Title: Metabolism

Paper Code: BCH 103

L	T	P	Credits	Marks
4	1	0	4	100

Course Objectives: The course is designed to survey the major metabolic pathways involved in energy generation and synthesis of biomolecules.

Unit A (15 hours)

Introduction to Metabolism

General features of metabolism, experimental approaches to study metabolism – intact organisms, bacterial mutants, tissue slices, radioisotopes.

Carbohydrate Metabolism

Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Reactions and energetics of TCA cycle. Gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of pentose phosphate pathway. Regulation of glycolysis and TCA cycle. Photosynthesis – a brief review.

Unit B (10 hours)

Electron Transport Chain and Oxidative Phosphorylation

Structure of mitochondria. Sequence of electron carriers. Sites of ATP production. Inhibitors of electron transport chain. Chemiosmotic hypothesis. Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing potentials into mitochondria.

Unit C (20 hours)

Lipid Metabolism

Introduction. Hydrolysis of triacylglycerols. Transport of fatty acids into mitochondria. β -oxidation of saturated fatty acids. ATP yield from fatty acid oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of ketone bodies. Oxidation of unsaturated and odd chain fatty acids. Biosynthesis of triglycerides and important phospholipids, glycolipids, sphingolipids and cholesterol. Regulation of cholesterol metabolism.

Amino Acid Metabolism

General reactions of amino acid metabolism – transamination, oxidative deamination and decarboxylation. Urea cycle. Degradation and biosynthesis of amino acids. Glycogenic and ketogenic amino acids.

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Unit D (15 hours)

Nucleotide Metabolism

Sources of atoms in the purine and pyrimidine nucleotides. Biosynthesis and degradation of purines and pyrimidines. Regulation of purine and pyrimidine biosynthesis.

Porphyrin Metabolism

Biosynthesis and degradation of porphyrins. Production of bile pigments.

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: Metabolism Laboratory

Paper Code: BCH 104

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Estimation of blood glucose.
2. Estimation of cholesterol
3. Sugar Fermentation in Microorganisms.
4. Estimation of Glucose 6-P.
5. Assay of serum transaminases.
6. Estimation of Urea.
7. Estimation of Uric acid.
8. Estimation of Creatinine.

Skill enhancement courses

Course Title: Medical Diagnostics

Paper Code: ZOO232

L	T	P	Credits	Marks
2	0	0	2	50

Course Objective: To give students a brief overview of various diagnostic methods for different diseases.

UNIT-A

- **Introduction to Medical Diagnostics and its Importance.** 2 hours
- **Diagnostics Methods Used for Analysis of Blood:** Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.) 10 hours

UNIT-B

- **Diagnostic Methods Used for Urine Analysis:** Urine Analysis: Physical characteristics; Abnormal constituents 6 hours

UNIT-C

- **Non-infectious Diseases:** Types, causes, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary); Testing of blood glucose using Glucometer/Kit 6 hours

UNIT-D

- **Infectious Diseases:** Types, causes, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis 3 hours
- **Tumours:** Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs). 3 hours

Reference books

- Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
- Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
- Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
- Park, K. *Preventive and Social Medicine*, B.B. Publishers, 2007.
- Prakash, G. *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd, 2012.
- Robbins and Cortan, *Pathologic Basis of Disease*, VIII Edition, Saunders

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Course Title: Research Methodology
Paper Code: ZOO233

L	T	P	Credits	Marks
2	0	0	2	50

Course Objective: To give students an overview of the research methods.

UNIT-A

- **Foundations of Research:** Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied 5 hours

UNIT-B

- **Research Design:** Need for research design: Features of good design, Important concepts related to good design: Observations and facts, Prediction and explanation, Development of models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs. 8 hours

UNIT-C

- **Data Collection, Analysis and Report Writing:** Observation and collection of data, Methods of data collection, Sampling methods, Data processing and analysis strategies, Technical reports and thesis writing, Preparation of tables and bibliography, Data presentation using digital method. 12 hours

UNIT-D

- **Ethical Issues:** Intellectual property rights, Commercialization, Copyright, Royalty, Patent law, Plagiarism, Citation, Acknowledgement. 5 hours

Reference books

1. Anthony, M, Graziano, A.M. and Raulin, M.L. *Research Methods: A Process of Inquiry*, Allyn and Bacon, 2009
2. C.R.Kothari: *Research Methodology*, New Age International, 2009
3. Coley, S.M. and Scheinberg, C.A. "*Proposal writing*". Stage Publications, 1990
4. Wadhera, B.L.: *Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications*, Universal Law publishing, 2002
5. Walliman, N. *Research Methods- The Basics*. Taylor and Francis, London, New York, 2011

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SEMESTER 5

Course Name: Principles of Molecular Biology

L	T	P	Credits	Marks
4	0	0	4	100

Course Code: ZOO341

Course Objective: The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

Course Contents:

UNIT I: DNA structure and replication

15 hours

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II: DNA damage, repair and homologous recombination

15 hours

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

UNIT III: Transcription and RNA processing

15 hours

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation. RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT IV: Regulation of gene expression and translation

15 hours

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation,

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elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation.
Posttranslational modifications of proteins.

Reference Books:

1. Freshney, R. I. *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*. 6th Edition. Wiley-Blackwell, 2010. Print.
2. Atala, A. and Lanza, R. *Methods of Tissue Engineering*. 1st Edition. Academic Press. 2001. Print.
3. Harrison, M.A. and Rae, I.F. *General Techniques of Cell Culture*. 1st Edition. Cambridge University Press. 1997. Print.
4. Masters, J.R.W. *Animal Cell Culture: A Practical Approach*. 3rd Edition. Oxford University Press. 2000. Print.
5. Friefelder, D. *Molecular Biology*. 2nd Edition. Narosa Book Distributors Pvt. Ltd. 2008. Print.
6. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. *Molecular Biology of the Cell*. 5th Edition. Garland Science. 2007. Print.

DAV UNIVERSITY, JALANDHAR

Course Title: Fundamentals of Developmental Biology

Paper Code: ZOO321

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To give students a brief overview of the developmental processes in animals.

UNIT-A

- **Introduction:** Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division 4 hours

UNIT-B

- **Early Embryonic Development:** Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers 28 hours

UNIT-C

- **Late Embryonic Development:** Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta) 8 hours
- **Post Embryonic Development:** Metamorphosis-Changes, hormonal regulations in amphibians and insects; Regeneration- Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing-Concepts and Theories 12 hours

UNIT-D

- **Implications of Developmental Biology:** Teratogenesis: Teratogenic agents and their effects on embryonic development; *In vitro* fertilization, Stem cell (ESC), Amniocentesis 8 hours

Reference books

1. Balinsky B. I. and Fabian B. C. *An Introduction to Embryology*, V Edition, International Thompson Computer Press, 1981.
2. Carlson, R. F. *Patten's Foundations of Embryology*
3. Gilbert, S. F. *Developmental Biology*, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA, 2010.
4. Kalthoff. *Analysis of Biological Development*, II Edition, McGraw-Hill Publishers, 2008.

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5. Lewis Wolpert. *Principles of Development*. II Edition, Oxford University Press, 2002.

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Course Title: Fundamentals of Developmental Biology

Laboratory

Paper Code: ZOO322

L	T	P	Credits	Marks
0	0	3	2	50

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

- Study of whole mounts and sections of developmental stages of frog: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
- Study of whole mounts of developmental stages of chick: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
- Study of the developmental stages and life cycle of *Drosophila/Tribolium*
- Study of different sections of placenta
- Project report on development of any insect.

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

DAV UNIVERSITY, JALANDHAR

Course Title: Basics of Fish and Fisheries

Paper Code: ZOO327

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The acquaint students with the different types of fishes and aquaculture methods.

UNIT-A

- **Introduction and Classification:** General description of fish; Account of systematic classification of fishes (upto orders); Classification based on feeding habit, habitat and manner of reproduction. 6 hours

UNIT-B

- **Morphology and Physiology:** Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Parental care; Migration 18 hours

UNIT-C

- **Fisheries:** Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations 12 hours

UNIT-D

- **Aquaculture:** Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products 20 hours
- **Fish in research:** Transgenic fish, Zebrafish as a model organism in research 4 hours

Reference books

1. C.B.L. Srivastava, *Fish Biology*, Narendra Publishing House
2. D. H. Evans and J. D. Claiborne, *The Physiology of Fishes*, Taylor and Francis Group, CRC Press, UK von der Emde, R.J. Mogdans and B.G. Kapoor. *The Senses of Fish: Adaptations for the Reception of Natural Stimuli*, Springer, Netherlands
3. J.R. Norman, *A history of Fishes*, Hill and Wang Publishers

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4. Q Bone and R Moore, *Biology of Fishes*, Talyor and Francis Group, CRC Press, U.K.
5. S.S. Khanna and H.R. Singh, *A text book of Fish Biology and Fisheries*, Narendra Publishing House.

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Course Title: Basics of Fish and Fisheries Laboratory

Paper Code: ZOO328

L	T	P	Credits	Marks
0	0	3	2	50

- Morphometric and meristic characters of fishes
 - Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
 - Study of different types of scales (through permanent slides/ photographs).
 - Study of crafts and gears used in Fisheries
 - Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
 - Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
 - Demonstration of induced breeding in Fishes (video)
 - Demonstration of parental care in fishes (video)
- Project Report on a visit to any fish farm/ pisciculture unit.

Note: The above mentioned practicals are in accordance with the guidelines of UGC.

Practicals involving animal material will be conducted using models/charts/e-resources.

Minor modifications in the curriculum are allowed subject to the availability of resources.

Discipline Specific Elective Courses

Course Title: Principles of Wild Life Conservation and Management

Paper Code: ZOO323

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The acquaint students with conservation strategies to protect the wild life.

UNIT-A

- **Introduction to Wild Life:** Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.
- **Evaluation and management of wild life:** Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

UNIT-B

- **Management of habitats:** Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats
- **Population estimation:** Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

UNIT-C

- **Management planning of wild life in protected areas:** Estimation of carrying capacity; Ecotourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbation.
- **Management of excess population:** Bio-telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

UNIT-D

- **Protected areas:** National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

Reference books

- Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5 th edition. The Wildlife Society, Allen Press.
- Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.

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- Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). *Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell Publishing.
- Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences
- Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Co-existence?* Cambridge University.

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Course Title: Principles of Wild Life Conservation and Management Laboratory

L	T	P	Credits	Marks
0	0	3	2	50

Paper Code: ZOO324

- Identification of mammalian fauna, avian fauna, herpeto-fauna
- 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)
- Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
- Demonstration of different field techniques for flora and fauna
- PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
- Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

DAV UNIVERSITY, JALANDHAR

Course Title: Reproductive Biology

Paper Code: ZOO335

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The educate students about the functioning of male and female reproductive systems.

UNIT-A

- **Reproductive Endocrinology:** Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation. 8 hours
- **Functional anatomy of male reproduction:** Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract 8 hours

UNIT-C

- **Functional anatomy of female reproduction:** Outline and histological of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto–maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation 12 hours

UNIT-D

- **Reproductive Health:** Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, *in vitro* fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning 10 hours

Reference books

1. Drickamer & Vessey: *Animal Behaviour, Concepts, Processes and Methods* (Wadsworth)
2. Grier: *Biology of animal behaviour* (Mosby College)
3. Immelmann: *Introduction to Ethology* (Plenum Press)
4. McFarland: *Animal Behaviour, Psychology, Ethology and Evolution* (Pitman)

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Course Title: Reproductive Biology Laboratory

Paper Code: ZOO336

L	T	P	Credits	Marks
0	0	3	2	50

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

- Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
- Examination of vaginal smear of rats from live animals.
- Surgical techniques: principles of surgery in endocrinology. Ovarectomy, hysterectomy, castration and vasectomy in rats.
- Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
- Human vaginal exfoliate cytology.
- Sperm count and sperm motility in rat
- Study of modern contraceptive devices

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

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SEMESTER 6

Course Title: Taxonomy and Evolution

Paper Code: ZOO331

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To give students an insight into the origin of life and evolutionary history of animals

UNIT-A

- **Life's beginnings:** Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes. 18 hours
- **Historical review of evolutionary concept:** Lamarckism, Darwinism, Neo-Darwinism.
- **Evidences of evolution:** Fossil record (types of fossils, transitional forms), Geological time scale, Evolution of horse, Neutral theory of molecular evolution, Molecular clock (examples of Globin gene family, rRNA/Cyt c).

UNIT-B

12 hours

- **Sources of variations:** Heritable variations and their role in evolution.
- **Population genetics:** Hardy-Weinberg Law (Statement and derivation of equation, Applications of law to human population)

UNIT-C

15 hours

- **Product of evolution:** Micro-evolutionary changes (Inter-population variations, Clines, Races), Species concept, Isolating mechanisms, Modes of speciation: Allopatric, Sympatric, Adaptive radiation/Macroeolution (Exemplified by Galapagos finches)
- **Extinctions:** Background and mass extinctions (Causes and effects), Detailed example of K-T extinction.
- **Phylogenetic trees:** Multiple sequence alignment, Construction of phylogenetic trees, Interpretation of trees.

UNIT-D

15 hours

- **Taxonomy:** Definitions and perspectives of systematics, classification and taxonomy; history, goals and importance of taxonomy; procedures of taxonomy-identification, classification, nomenclature, phena, taxa, category; key and its significance; higher taxa and linnean hierarchy; international code of Zoological nomenclature-principles and objectives and rules for nomenclature

Reference books:

- Campbell, N.A. and Reece J.B. *Biology*. IX Edition. Pearson, Benjamin, Cummings, 2011.
- Douglas, J. Futuyma. *Evolutionary Biology*. Sinauer Associates, 1997.
- Hall, B.K. and Hallgrimson, B. *Evolution* IV Edition. Jones and Barlett Publishers, 2008.
- Pevsner, J. *Bioinformatics and Functional Genomics*. II Edition Wiley-Blackwell, 2009.
- Ridley, M. *Evolution* III Edition Blackwell publishing, 2004.
- Snustad. S *Principles of Genetics*.

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Course Title: Taxonomy and Evolution Laboratory

Paper Code: ZOO332

L	T	P	Credits	Marks
0	0	3	2	50

- Study of taxonomic keys of Insects, Fishes and snakes
- Study of fossils from models/ pictures
- Study of homology and analogy from suitable specimens
- Study of evolution of horse, elephant, camel and man
- Study of Dinosaurs
- Study and verification of Hardy-Weinberg Law by chi square analysis
- Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
- Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
- Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

DAV UNIVERSITY, JALANDHAR

Course Code: Principles of Genetics

Course Code: ZOO343

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective:

This course is aimed at understanding the basic concepts of genetics at molecular level to develop analytical and quantitative skills from classical to molecular genetics.

Course Contents:

Unit I: Chromosome Theory of Inheritance

6 hours

The chromosome theory of heredity, Sex chromosomes, Sex linkage, the parallel behaviour of autosomal genes and chromosomes.

Unit II: Mendelian Genetics

15 hours

Mendelian laws of inheritance, Monohybrid cross and the law of segregation, Dihybrid cross and law of independent assortment, Chromosome theory of inheritance, Multiple allele, lethal allele, Blood group, Rh factor, Gene interactions, Modified dihybrid ratio. Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Three point testcross, Interference, Calculating recombinant frequencies from selfed dihybrids, examples of linkage maps, The X2 test mitotic segregation in humans.

Unit III: Fine Structure of Genes and Chromosomes

14 hours

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. Structural organisation of chromatids, Centromeres, Telomeres, Chromatin, Nucleosome organisation; Euchromatin and heterochromatin; Special chromosomes (e.g., polytene and lampbrush chromosomes), Banding patterns in human chromosomes. Structural and numerical aberrations involving chromosomes; **Hereditary defects** - Klinefelter, Turner, Cri-du-Chat and Down syndromes. Mutations - spontaneous and induced, Chemical and physical mutagens.

Unit IV: Extrachromosomal inheritance and Molecular Genetics

10 hours

Coiling of shell in snails, Mitochondrial and chloroplast genetic systems, population genetics: Hardy-Weinberg equilibrium, Gene and genotypic frequencies.

Reference Books:

1. Strickberger, M.W. *Genetics*. 3rd Edition. Prentice-Hall, India. 2008. Print.
2. Jones, S. *The Language of the Genes*. HarperCollins Publishers. 2012. Print.
3. Ridley, M. *Nature via Nurture: Genes, Experience, & What Makes Us Human*. HarperCollins Publishers. 2004. Print.
4. Aggarwal, V.K. and Verma, V.S. *Genetics*. 9th Edition. S. Chand, India. 2010. Print.

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5. Snustad, D.P. and Simmons, M.J. *Principles of Genetics*. 6th Edition. John Wiley & Sons. 2011. Print.
6. Pierce, B.A. *Genetics: A Conceptual Approach*. 4th Edition. W.H. Freeman & Company 2010. Print.

DAV UNIVERSITY, JALANDHAR

Course Code: Biotechniques Laboratory

L	T	P	Credits	Marks
0	0	3	2	50

Course Code: ZOO350

Experiments

- Understanding microscope adjustments, light sources, microscopic measurements, calibration and types of microscopes available.
- Preparation of different types of stains
- Cytological preparations, Fixation, dehydration and staining
- Squash preparation of meiotic and mitotic cells
- Embedding, sectioning and micrtotomy
- Examination of various stages of mitosis and meiosis
- Isolation of DNA from animal and plant tissue using classical methods
- Agarose gel electrophoresis
- Polyacrylamide gel electrophoresis
- Polymerase Chain Reaction
- Preparation of karyograms from the given photographs for karyotypic formula
- Study of Mendel's laws, and deviations from Mendelian ratios using seed samples in the ratios of 9:7, 9:4:3, 13:3, 15:1, 12:3:1. Use Chi-Square Test for Testing the ratios
- Making of phylogenetic trees using softwares
- Exercises with respect to Hardy-Weinberg equilibrium
- Segregation demonstration in preserved material (Maize)
- Inheritance of other human characteristics, ability to test PTC, Thiourea

Discipline Specific Elective Courses

Course name: Fundamentals of Animal Biotechnology

Course Code: ZOO339

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The aim of the course is to provide equal importance to areas like *in vitro* fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

Course Contents:

UNIT-I

Principles and objectives of animal biotechnology; physical and chemical procedures; aseptic techniques; types of chemical agents and their applications/limitations.

Cell culture-Types of cell cultures, cell lines, Equipments needed for culture, culture media

UNIT II

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT III

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

UNIT IV

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT V

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

Hybridoma technology-Production of monoclonal antibodies, concept of polyclonal antibodies

Reference Books:

1. Freshney, R. I. *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*. 6th Edition. Wiley-Blackwell, 2010. Print.

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2. Masters, J.R.W. *Animal Cell Culture: A Practical Approach*. 3rd Edition. Oxford University Press. 2000. Print.
3. Twine, R. *Animals as Biotechnology: Ethics, Sustainability and Critical Animal Studies*. 1st Edition. Routledge Publishers. 2010. Print.
4. Verma, A. and Singh, A. *Animal Biotechnology: Models in Discovery and Translation*. 1st Edition. Academic Press. 2013. Print.

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Course Name: Fundamentals of Animal Biotechnology

Laboratory

Course Code: ZOO340

L	T	P	Credits	Marks
0	0	3	2	50

Experiments

- Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
- Sources of contamination and decontamination measures.
- Preparation of Hanks Balanced salt solution
- Preparation of Minimal Essential Growth medium
- Isolation of lymphocytes for culturing
- Isolation of rat macrophages from peritoneum for culturing
- Primary Lymphoid culture
- DNA isolation from animal tissue
- Quantification of isolated DNA
- Resolving DNA on Agarose Gel.

DAV UNIVERSITY, JALANDHAR

Course Title: Basic Computational Biology

Paper Code: ZOO333

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The acquaint students with different bioinformatics tools and their applications.

UNIT-A

5 hours

- **Introduction to Bioinformatics:** Importance, Goal, Scope; Genomics, Transcriptomics, Proteomics, Systems biology, Functional genomics, Metabolomics, Molecular phylogeny; Applications and limitations of bioinformatics.
- **Biological Databases:** Introduction to biological databases; Primary, secondary and composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL and NDB); Protein databases (PIR, SWISS-PROT, TrEMBL, PDB); Metabolic pathway databases (KEGG, EcoCyc, and MetaCyc); Small molecule databases (PubChem, Drug Bank, ZINC, CSD).

10 hours

UNIT-B

- **Data Generation and Data Retrieval:** Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (Flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez).

14 hours

UNIT-C

- **Basic Concepts of Sequence Alignment:** Scoring matrices (PAM, BLOSUM), Methods of alignment (Dot matrix, Dynamic programming, BLAST and FASTA); Local and global alignment, pairwise and multiple sequence alignments; Similarity, identity and homology of sequences.

14 hours

UNIT-D

- **Applications of Bioinformatics:** Structural bioinformatics (3-D protein, PDB), Functional genomics (genome-wide and high throughput approaches to gene and protein function), Drug discovery method (Basic concepts).
- **Biostatistics:** Introduction, calculation of standard deviation, standard error, Co-efficient of variance, Chi-square test, Z test, t-test.

7 hours

10 hours

Reference books

- Antonisamy, B., Christopher S. and Samuel, P. P Biostatistics: Principles and Practice. Tata McGraw Hill Education Private Limited, India, 2010.
- Ghosh Z and Mallick B. *Bioinformatics: Principles and Applications*, Oxford University Press, 2008.
- Pagana, M. and Gavreau, K. Principles of Biostatistics, Duxberry Press, USA, 2000.
- Pevsner J. *Bioinformatics and Functional Genomics*, II Edition, Wiley Blackwell, 2009.
- Zar, Jerrold H. Biostatistical Analysis, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc. USA, 1999.
- Zvelebil, Marketa and Baum O. Jeremy. Understanding Bioinformatics, Garland Science, Taylor and Francis Group, USA, 2008.

DAV UNIVERSITY, JALANDHAR

Course Title: Basic Computational Biology Laboratory

Paper Code: ZOO334

L	T	P	Credits	Marks
0	0	3	2	50

- Accessing biological databases
- Retrieval of nucleotide and protein sequences from the databases.
- To perform pair-wise alignment of sequences (BLAST) and interpret the output
- Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences
- Predict the structure of protein from its amino acid sequence.
- To perform a “two-sample t- test” for a given set of data
To learn graphical representations of statistical data with the help of computers (e.g. MS Excel).

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

DAV UNIVERSITY, JALANDHAR

Course Code: MIC333

L	T	P	Credit
4	0	0	4

Course Title: IMMUNOLOGY

Course Objective: The course will expose the students to the basic concepts of immune system including important cells and organs on immune system, antigens and antibodies, generation of immune response, immunological techniques etc.

Course Content:

Unit 1 Introduction

No. of Hours: 4

Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa

Unit 2 Immune Cells and Organs

No. of Hours: 7

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

Unit 3 Antigens

No. of Hours: 4

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants

Unit 4 Antibodies

No. of Hours: 6

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies

Unit 5 Major Histocompatibility Complex

No. of Hours: 5

Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways)

Unit 6 Complement System

No. of Hours: 4

Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation

Unit 7 Generation of Immune Response

No. of Hours: 10

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance

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Unit 8 Immunological Disorders and Tumor Immunity

No. of Hours: 10

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers.

Unit 9 Immunological Techniques

No. of Hours: 10

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, RIA, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry, Immunoelectron microscopy.

SUGGESTED READINGS

1. Abbas AK, Lichtman AH, Pillai S. *Cellular and Molecular Immunology*. 6th edition Saunders Publication, Philadelphia. 2007. Print
2. Delves P, Martin S, Burton D, Roitt IM. *Roitt's Essential Immunology*. 11th edition Wiley-Blackwell Scientific Publication, Oxford. 2006. Print
3. Goldsby RA, Kindt TJ, Osborne BA. *Kuby's Immunology*. 6th edition W.H. Freeman and Company, New York. 2007. Print
4. Murphy K, Travers P, Walport M. *Janeway's Immunobiology*. 7th edition Garland Science Publishers, New York. 2008. Print
5. Peakman M, and Vergani D. *Basic and Clinical Immunology*. 2nd edition Churchill Livingstone Publishers, Edinberg. 2009. Print

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Course Code: MIC334

Course Title: IMMUNOLOGY LABORATORY

L	T	P	Credit
0	0	3	2

Experiments:

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum from the blood sample (demonstration).
5. Perform immunodiffusion by Ouchterlony method.
6. Perform DOT ELISA.
7. Perform immunoelectrophoresis.

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Course Title: Endocrinology

Paper Code: ZOO337

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The acquaint students with cell, tissue and organ culture techniques.

UNIT-A

- **Introduction to Endocrinology:** History of endocrinology, 12 hours
Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

UNIT-B

- **Epiphysis, Hypothalamo-hypophysial Axis:** Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction; Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands, Feedback mechanisms; Structure of pituitary gland, Hormones and their functions, Hypothalamohypophysial portal system, Disorders of pituitary gland. 15 hours

UNIT-C

- **Peripheral Endocrine Glands:** Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis; Hormones in homeostasis, Disorders of endocrine glands 18 hours

UNIT-D

- **Regulation of Hormone Action:** Hormone action at Cellular level: Hormone receptors, transduction and regulation; Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action 15 hours

Reference books

1. *Endocrinology: An Integrated Approach*; Stephen Nussey and Saffron Whitehead. Oxford: BIOS Scientific Publishers, 2001.
2. *General Endocrinology* C. Donnell Turner Pub- Saunders Toppan
3. Hadley, M.E. and Levine J.E. *Endocrinology*, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey, 2007.

DAV UNIVERSITY, JALANDHAR

Course Title: Endocrinology Laboratory

Paper Code: ZOO338

L	T	P	Credits	Marks
0	0	3	2	50

- Dissect and display of Endocrine glands in laboratory bred rat
- Study of the permanent slides of all the endocrine glands
- Compensatory ovarian/ adrenal hypertrophy *in vivo* bioassay in laboratory bred rat
- Demonstration of Castration/ ovariectomy in laboratory bred rat
- Estimation of plasma level of any hormone using ELISA
- Designing of primers of any hormone

Note: The above mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

Courses offered to other Departments

SEMESTER 1

Course Title: Animal Diversity I

Paper Code: ZOO101

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To acquaint students with the general characters and classification of invertebrate phyla and the affinities between different groups. To impart knowledge regarding the morphological, anatomical and physiological make up of a few representative organisms from each phylum.

UNIT-A

- Description of animal diversity. Principles of classification-salient features and classification upto orders in non-chordates. Structural organization in different classes of non-chordates. 12 hours
- **Protozoa:** locomotion, osmoregulation, nutrition and reproduction in Protozoa.

UNIT-B

- **Porifera:** skeleton and canal system. 19 hours
- **Coelenterata:** corals and coral reefs, polymorphism in Hydrozoa.
- **Platyhelminthes:** reproduction, variation in life cycles
- **Nematoda:** pseudocoelom
- Parasitic adaptations in Platyhelminthes and nematodes

UNIT-C

- **Annelida:** coelom, metamerism, excretion. 15 hours
- **Arthropoda:** vision, respiration and larval forms. Social life in insects.

UNIT-D

- **Mollusca:** torsion and detorsion 15 hours
- **Echinodermata:** water vascular system and larval forms.

Reference books:

1. Dhami, P.S. and Dhami, J.K. *Invertebrate Zoology*. 5th ed. New Delhi: R. Chand & Co.,
2. Hyman L.H. *The Invertebrates*. Vol. I, II, III, IV and V. McGraw Hill Book Company. Inc., 1959.
3. Kotpal, R.L. *Minor phyla*. 5th ed. Meerut: Rastogi Publishers, 2006.
4. Kotpal, R.L. *Modern Text Book of Zoology Invertebrates*. 10th ed., Rastogi Publishers, Meerut, 2012.

DAV UNIVERSITY, JALANDHAR

Course Title: Animal Diversity I

Laboratory

Paper Code: ZOO102

L	T	P	Credits	Marks
0	0	3	2	50

1. General survey of invertebrate phyla:

- **Protozoa:** *Amoeba, Euglena, Paramecium, Vorticella, Balantidium, Opalina*
- **Porifera:** *Sycon, Euplectella, Hyalonema, Euspongia*, gemmules and spicules of *Sycon*.
- **Coelenterata:** *Hydra, Obelia, Physalia, Aurelia, Metridium, Tubipora, Bougainvillea*.
- **Platyhelminthes:** *Planaria, Fasciola (W.M.)*, larval stages of *Fasciola, Taenia* (scolex, proglottids-mature and gravid),
- **Nemathelminthes:** *Ascaris lumbricoides* (male and female).
- **Annelida:** *Pheretima, Nereis, Heteronereis, Aphrodite, Chaetopterus, Arenicola, Hirudinaria*
- **Arthropoda:** *Peripatus, Lepisma, Palaemon, Palamnaeus, Julus, Scolopendra, Cyclops, Daphnia*.
- **Mollusca:** *Anodonta, Pila, Sepia, Octopus, Nautilus, Chiton*; Glochidium larva and radula of *Pila*.
- **Echinodermata:** *Asterias, Holothuria, Ophiothrix, Antedon*

2. Demonstration of anatomy of the following animals through charts/models/e-resources

- Earthworm: digestive and reproductive system
- Cockroach: digestive and urinary systems; mouth parts of Cockroach
- *Pila*: digestive and nervous systems; Radula of *Pila*
- *Asterias*: Aristotle's lantern, tube feet.

Note: The above-mentioned practicals are in accordance with the guidelines of UGC. Practical involving animal material will be conducted using models/charts/e-resources. Minor modifications in the curriculum are allowed subject to the availability of resources.

DAV UNIVERSITY, JALANDHAR

Course Title: Animal Diversity II

Paper Code: ZOO103

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the general characters and classification of chordates and the affinities between different groups.

UNIT-A

- Origin and general characters of chordates with detailed classification of each animal group with special emphasis on salient features and interrelationships 5 hours
- Hemichordata: Hemichordates as link between non-chordates and chordates 5 hours
- Urochordata: development, affinities, retrogressive metamorphosis. 5 hours
- Cephalochordata: development, affinities. 5 hours

UNIT-B

- Cyclostomata: migration. 5 hours
- Pisces: scales, fins, migration, parental care. 5 hours

UNIT-C

- Amphibia: Respiration, Parental care. 6 hours
- Reptilia: Terrestrial adaptations, parental care. 6 hours

UNIT-D

- Aves: Respiration, Flight, Endothermy. 8 hours
- Mammals: Integument, Dentition, Respiration, Reproduction 10 hours

Reference books

7. Dhama, P.S., Dhama, J.K., Chordate Zoology, 5th ed., R. Chand & Co., New Delhi, 2006.
8. Kotpal, R.L., Text Book of Zoology- Vertebrates, Rastogi Publications, Meerut, 2012.
9. Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vertebrates, 7th ed. Vol. II (eds. A.J. Marshall & Williams, W.D.), Mac Millan, London, 1972.
10. Dodson, E.O., A Text Book of Zoology, CBS Publishers & Distributors, Delhi, 1976.

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Course Title: Animal Diversity II Laboratory

Paper Code: ZOO104

L	T	P	Credits	Marks
0	0	3	2	50

General survey of chordates through charts/models and e-resources:

- Hemichordata: *Balanoglossus*
- Protochordata - *Herdmania*, pharynx and spicules of *Herdmania* and *Branchiostoma*, T.S. *Branchiostoma* through different regions
- Cyclostomata – *Myxine*, *Petromyzon* and *Ammocoetes* larva.
- Chondrichthyes - *Zygaena*, *Pristis*, *Trygon*
- Actinopterygii – *Polypterus*, *Labeo rohita*, *Hippocampus*, *Syngnathus*, *Exocoetus*, *Diodon*, *Echeneis* and *Anguilla*.
- Dipneusti (Dipnoi) – Any of the lungfishes.
- Amphibia – *Necturus*, *Proteus*, *Salamandra*, *Ambystoma*, *Triton*, *Hyla*, *Rhacophorus*, *Ichthyophis* and *Axolotl* larva.
- Reptilia- Tortoise, Turtle, *Hemidactylus*, *Calotes*, *Draco*, *Chamaeleon*, *Python*, *Ptyas*, *Bungarus*, *Naja*, *Hydrus*, *Vipera*, *Crocodilus*, *Gavialis* and *Alligator*.
- Aves : *Anas*, *Ardea*, *Milvus*, *Pavo*, *Tyto*, *Alcedo*, *Eudynamis*, *Casuaris*; and *Struthio*.
- Mammalia – *Echidna*, *Ornithorhynchus*, *Macropus*, *Sorex*, *Loris*, *Macaca*, *Manis*, *Hystrix*, *Funambulus*, *Felis*, *Canis*, *Herpestes*, *Pteropus* and *Leo*.

Demonstration of anatomy of the following animals through charts/models/e-resources

Labeo: Digestive and reproductive systems

Rana: Digestive, arterial, venous and reproductive systems.

Varanus: Digestive, arterial, venous and reproductive systems.

Gallus: Digestive, arterial, venous and reproductive systems.

Rattus: Digestive, arterial, venous, urinogenital systems

DAV UNIVERSITY, JALANDHAR

Course Title: Zoodiversity

Paper Code: ZOO154

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the general characters of invertebrates and chordates emphasizing on the special characters of each group.

UNIT-A 12 hours

- **Protozoa:** General characters of Protozoa; life cycle of *Plasmodium*
- **Porifera:** General characters of Porifera; canal system in Porifera.
- **Radiata:** General characters of Coelenterata; Polymorphism.

UNIT-B 10 hours

- **Acoelomates:** General characters of Helminthes; Life cycle of *Taenia solium*
- **Pseudocoelomates:** General characters of Nematodes; Parasitic adaptations

UNIT-C 15 hours

- **Coelomate Protostomes:** General characters of Annelida; Metamerism
- **Arthropoda:** General characters of Arthropoda; social life in insects
- **Mollusca:** General characters of Mollusca; Pearl formation
- **Coelomate Deuterostomes:** General characters of Echinodermata; Water vascular system in star fish

UNIT-D 18 hours

- **Protochordata:** Salient features
- **Pisces:** Osmoregulation. Migration of Fishes
- **Amphibia:** General characters, Adaptations for terrestrial life, Parental care in Amphibia
- **Reptilia:** Amniotes, origin of reptiles, terrestrial adaptations in reptiles
- **Aves:** Migration in birds; flight adaptations
- **Mammalia:** Early evolution of mammals; Primates; Dentition in mammals

Reference books

DAV UNIVERSITY, JALANDHAR

5. Kotpal, R.L., Modern Text Book of Zoology Invertebrates, 10th ed., Rastogi Publishers, Meerut, 2012.
6. Kotpal, R.L., Minor phyla, 5th ed., Rastogi Publishers, Meerut, 2006.
7. Dhama, P.S. and Dhama, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.
8. Parker, T.J. and Haswell, W.A., Text book of Zoology, Invertebrates, 7th ed., Vol. I (eds. A.J. Marshall & W.D. Williams), CBS Publishers & Distributors., Delhi, 1992.
9. Hyman L.H. The Invertebrates. Vol. I, II, III, IV and V. McGraw Hill Book Company. Inc., New York. London. Toronto, 1959.
10. Barnes, R.D. Invertebrate Zoology. Saunders College Pub. USA., 1992.
11. Ruppert, Fox and Barnes. Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole , 2006.
12. Campbell and Reece . Biology, Pearson Education, (Singapore) Pvt. Ltd, 2005
13. Kardong, K. V. Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi, 2002.
14. Raven, P. H. and Johnson, G. B. Biology, 6th edition, Tata McGraw Hill Publications. New Delhi, 2004.

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Course Title: Zoodiversity

Paper Code: ZOO155

L	T	P	Credits	Marks
0	0	3	2	50

1. Study of following specimens with the help of charts/models/e-resources;

Non Chordates: *Amoeba, Euglena, Paramecium, Volvox, Sycon, Physalia, Tubipora, Obelia, Fasciola, Taenia, Ascaris, Nereis, Earthworm, Leech, Peripatus, Limulus, Millipede, Centipede, Beetle, Apis, Pila, Dentalium, Octopus, Asterias, and Holothuria.*

Chordates: *Balanoglossus, Herdmania, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Rhacophorus, Draco, Uromastix, Naja, Viper, any three common birds-(Crow, duck, Owl), Squirrel and Bat.*

2. Study of insect and amphibian metamorphosis

3. Study of the following through e-resources:

- Digestive system of Cockroach.
- Digestive system of Rat

DAV UNIVERSITY, JALANDHAR

Course Title: Human Physiology

Paper Code: ZOO257

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the functioning of all systems of the human body.

UNIT-A

- **Nutrition:** Types of nutrition and nutrients; sources and functions of nutrients and the diseases associated with their excess or lesser intake. 2 hours
- **Digestive System:** Alimentary canal; Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and Hormonal control of Digestion 10 hours

UNIT-B

- **Respiratory System:** Ventilation; External and Internal Respiration; Transport of oxygen and carbon dioxide in blood; Factors affecting transport of gases. 6 hours
- **Circulatory System:** Composition of blood; Lymph; Blood groups; Blood coagulation; Structure of heart; co-ordination of heart beat, Cardiac cycle; ECG 10 hours
- **Excretory System:** Functional anatomy of kidney; Mechanism and regulation of urine formation. 8 hours

UNIT-C

- **Endocrine System:** Structure of pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, testes; and the diseases associated with them 7 hours
- **Reproductive System:** Spermatogenesis; Oogenesis; Physiology of male and female reproductive systems; hormonal and neuronal control 7 hours

UNIT-D

- **Nervous System:** Structure of Neuron; Propagation of nerve impulses (myelinated and non-myelinated nerve fibres); neuromuscular junctions 5 hours
- **Muscular system:** Structure of skeletal muscle, Mechanism of muscle contraction (sliding filament theory) 5 hours

Reference books

1. Guyton, A.C., Hall, J.E. Text Book of Medical Physiology, XIIth edition, Harcourt Asia Pvt. Ltd./W.B. Saunders Company, 2011
2. Best, J.P., Best and Taylor's physiological basis of medical practice, 11th ed., William and Wilkins, 1985.
3. Hoar, W.S., General and comparative physiology, Adaptation and Environment, 3rd ed.,

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Cambridge University Press, 1983.

4. Rhoades, R.A., Tanner, G.A., Medical Physiology, 2nd ed., Lippincott Williams and Wilkins, 2003.
5. Tortora, G.J., Derrickson, B.H. Principles of Anatomy and Physiology, XII Edition, John Wiley and Sons, Inc., 2009.

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Course Title: Human Physiology Laboratory

Paper Code: ZOO258

L	T	P	Credits	Marks
0	0	3	2	50

- Identification of food stuffs-starch, sucrose, glucose, proteins and fats.
- Demonstration of osmosis and diffusion.
- Demonstration of the presence of amylase enzyme in saliva. Effect of pH and temperature on enzyme action.
- Determination of coagulation and bleeding time of blood.
- Determination of blood groups of human blood samples.
- Recording of blood pressure of man.
- Enumeration of red blood corpuscles and white blood corpuscles of man.
- Estimation of haemoglobin content in blood.

Ability Enhancement Compulsory Courses

Course Title: Basic Communication Skills

Course Code: ENG151 B

L	T	P	Credits
3	1	0	3

Course Objectives:

- To enhance students' vocabulary and comprehension skills through the prescribed texts.
- To hone students' reading and writing skills.
- To teach the rules of English grammar descriptively.
- To make students aware about the socio-cultural aspect of English.

Learning Outcomes: Students will

- Have developed a wide vocabulary and be able to summarize ideas.
- Be able to read and analyze texts and display competence in written communication.
- Show a considerable understanding of English Grammar.
- Demonstrate sensitivity to cultural differences while communicating

Unit – A

1. Applied Grammar (in Socio-Cultural Context)

- Tenses
- Passives
- Reported/Reporting Speech

Unit – B

1. Reading (Communicative Approach to be Followed)

- Nissim Ezekiel : The Patriot (Poem)

(Sub-topic: Basic Introduction to Indianisms and Difference between Indian English & Standard English)

2. Writing

- Paragraph Writing : Topic Sentence, Inductive logic, and Deductive logic
- Essays: Narrative, Descriptive, Expository, and Persuasive
- Notice: Format, Characteristics, and 5 W's,
- Email: Structure, Characteristics of Effective Emails, and Advantages

Unit – C

1. Applied Grammar (in Socio-Cultural Context)

- Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, and Interjection
- Modals: Can, Could, May, Might, Will, Would, Shall, Should, and Must

Unit – D

1. Reading (Communicative Approach to be Followed)

Alleen Pace Nilsen: Sexism in English (Prose)

(Sub-topic: Relationship between Society & Language and Sexist Language)

2. Writing

Letter Writing: Formal and Informal

Teaching Methodology:

- Grammar:** Grammar must be taught descriptively in socio-cultural context. The contextual teaching of grammar helps a learner understand the application of grammar rules in real life situations. The learner who learns grammar in isolation is unable to use the language fluently, whereas the learner who learns grammar in context uses the language confidently and fluently in real life situations.

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- b. **Literary Texts:** Communicative approach should be followed to teach the texts. Classroom activities guided by the communicative approach are characterised by trying to produce meaningful and real communication, at all levels. As a result there may be more emphasis on skills than systems, lessons are more learner-centred, and there may be use of authentic materials.

Teachers can introduce the topic or theme of the text, pre-teach essential vocabulary items and use prediction tasks to arouse the interest and curiosity of students.

- c. **Writing:** Some of the strategies that should be adopted are as follows:

- Regularly assign brief writing exercises in your classes.
- Provide guidance throughout the writing process, i.e. Pre-Writing, Drafting, Revising, Editing, and Publishing.
- Give students opportunities to talk about their writing.
- Encourage students to revise their work.

Testing: The examinations will be conducted as per the norm of the university.

References:

a. Books

1. Eschholz, Paul and Rosa, Alfred (ed.), *Subject and Strategy*. NY: St. Martin's Press, 1978. Print.
2. Ezekiel, Nissim. *Collected Poems 1952-1988*. New Delhi: Oxford University Press, 1999. Print.
3. Hosler, Mary Margaret. *English Made Easy*. Delhi: McGraw, 2013. Print.
4. Koneru, Aruna. *Professional Communication*. Delhi: McGraw, 2008. Print.
5. Mahanand, Anand. *English for Academic and Professional Skills*. Delhi: McGraw, 2013. Print.
6. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. *A Workbook on English Grammar and Composition*. Delhi: McGraw, 2016. Print.

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7. Rizvi, M. Ashraf. *Effective Technical Communication*. Delhi: McGraw, 2018. Print.
8. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. Delhi: McGraw, 2013. Print.
9. Tyagi, Kavita and Padma Misra. *Basic Technical Communication*. Delhi: PHI Learning, 2013. Print.

b. Websites

1. www.youtube.com (to watch standard videos)
2. <http://learnenglish.britishcouncil.org/en>
3. <https://owl.english.purdue.edu/>

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Course Title: Basic Communication Skills Lab.

Course Code: ENG152A

L	T	P	Credits
0	0	2	1

Course Objectives:

- To improve the preparation and presentation competencies necessary for oral communication in a variety of contexts, as both a speaker and a listener.
- To improve pronunciation.
- To promote interactive skills through Group Discussions and role plays.

Learning Outcomes: Students will be able to:

- Develop proper listening skills
- Articulate and enunciate words and sentences clearly and efficiently
- Show confidence and clarity in public speaking projects

Unit – A Speaking and Listening
• IPA for Language Learning - Basic Phonetics
• Movie-Clippings
• Role Plays
• Group Discussions
• Mock Interviews

Project File: Each student will prepare a project file on any of the topics given by class teacher. Student should be able to justify the contents of his/her scrap file. The file must be handwritten, not typed. Students must acknowledge all the sources of information in his/her scrap file.

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Testing: The end term lab. examination will be conducted as per the norm of the university. The distribution of marks in the end-term lab. examination is as follows:

Component	Weightage
Project File Marks will be given for originality, creativity and presentation. Student will receive credit for his/her command of the language also.	30 %
Lab. Activity It may include dialogue writing (Dialogue to Prose and Prose to Dialogue), writing about a picture/some object, writing a report, writing on a topic of general interest, listening exercise, English phonetic exercise, etc. It will be decided by examiner on the spot.	30%
Viva Voce Questions will be based on the project file. Examiner may ask other non-technical questions related to student's life and interests.	40%
Total	100%

For the final result, marks will be calculated as per the criterion laid down by the university:

Component	Weightage
Marks Obtained in the lab examination	80%
Continuous Assessment (Based on Student's Regularity & Class Performance)	20%
Total	100%

Reference Books

c. Books

10. Crystal, David. *The Gift of the Gab – How Eloquence Works*. Connecticut: Yale University, 2016. Print.
11. Gangal, J. K. *A Practical Course in Spoken English*. India: Phi Private Limited, 2012. Print.
12. Hosler, Mary Margaret. *English Made Easy*. Delhi: McGraw, 2013. Print.
13. Koneru, Aruna. *Professional Communication*. Delhi: McGraw, 2008. Print.
14. Mahanand, Anand. *English for Academic and Professional Skills*. Delhi: McGraw, 2013. Print.
15. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. *A Workbook on English Grammar and Composition*. Delhi: McGraw, 2016. Print.
16. Rizvi, M. Ashraf. *Effective Technical Communication*. Delhi: McGraw, 2018. Print.
17. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. Delhi: McGraw, 2013. Print.
18. Suzana, Roopa. *A Practical Course in English Pronunciation*. Delhi: McGraw Hill Education, 2017. Print.
19. Tyagi, Kavita and Padma Misra. *Basic Technical Communication*. Delhi: PHI Learning, 2013. Print.

d. Websites

4. www.youtube.com (to watch standard videos)
5. <http://learnenglish.britishcouncil.org/en>
6. <https://owl.english.purdue.edu/>

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Studies

Paper Code: EVS100

L	T	P	Credits
4	0	0	4

Course Objective: This course aims at understanding the students in aspects of environmental problems, its potential impacts on global ecosystem and its inhabitants, solutions for these problems as well as environmental ethics which they should adopt to attain sustainable development.

Unit 1

The multidisciplinary nature of environmental studies (2 Hours)

Definition, scope and importance, Need for public awareness

Natural Resources: Renewable and non-renewable resources: (8 Hours)

Natural resources and associated problems.

- (a) **Forest resources:** Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- (b) **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- (c) **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- (d) **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- (e) **Energy resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
- (f) **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
 - Role of an individual in conservation of natural resources.
 - Equitable use of resources for sustainable lifestyles.

Ecosystem: (4 Hours)

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem

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- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem:

- a. Forest ecosystem
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

Unit II

Biodiversity and its conservation

4 Hours

- Introduction – Definition: Genetic, Species and Ecosystem Diversity
- Bio-geographical classification of India
- Value of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option values
- Biodiversity at global, national and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity, global and national efforts.

Environmental Pollution

8Hours

- Definition, causes, effects and control measures of:
 - a. Air pollution
 - b. Water pollution
 - c. Soil pollution
 - d. Marine pollution
 - e. Noise pollution
 - f. Thermal pollution
 - g. Nuclear pollution
- Solid waste management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides

Unit III

Social Issues and the Environment

7 Hours

- Population growth, variation among nations, Population explosion – Family Welfare Programmes.
- Environment and human health,
- From unsustainable to sustainable development
- Urban problems and related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation
- Consumerism and waste products
- Environmental Laws: The Environment Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and control of Pollution) Act 1974; The Wildlife Protection Act, 1972; Forest Conservation Act, 1980.
- Issues involved in enforcement of environmental legislation
- Public Awareness

Unit IV

Human Population and Environment 5 Hours

- Population Growth and Variations among Nations
- Population Explosion
- Human Rights
- Value Education
- HIV / AIDS
- Women and Child Welfare
- Role of Information Technology in Environment and Human Health
- Case Studies

Field Work

5 Hours

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- Visit to a local area to document environmental assets river/ forest/ grassland/hill/mountain
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds
- Study of simple ecosystems-Pond, river, hill slopes, etc (Field work equal to 5 lecture hours)

Suggested Readings:

1. Odum, EP. *Basic Ecology*. Japan: Halt Saundurs, 1983.
2. Botkin, DB, and Kodler EA. *Environmental Studies: The Earth as a living planet*. New York: John Wiley and Sons Inc., 2000.
3. Singh, JS, Singh, SP, and Gupta SR. *Ecology, Environment and Resource Conservation*. New Delhi: Anamaya Publishers, 2006.
4. De, AK. *Environmental Chemistry*. New Delhi: Wiley Eastern Ltd., 1990.
5. Sharma, PD. *Ecology and Environment*. Meerut Rastogi Publications, 2004

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Course Title: Human Values and General Studies

Course Code: SGS107

L	T	P	Cr.
4	0	0	4

Course Objectives

- a) To sensitize students about the role and importance of human values and ethics in personal, social and professional life.
- b) To enable students to understand and appreciate ethical concerns relevant to modern lives.
- c) To prepare a foundation for appearing in various competitive examinations
- d) To sensitize the students about the current issues and events of national and international importance
- e) To provide opportunity to the students to study inter disciplinary subjects like Geography, Science, Economy, Polity, History, International Relations etc.

Part - A

Human Values

1. **Concept of Human Values:** Meaning, Types and Importance of Values. **2 Hrs**
2. **Value Education :** Basic guidelines for value education **2 Hrs**
3. **Value crisis and its redressal** **1 Hrs**

Being Good and Responsible

1. Self Exploration and Self Evaluation **2 Hrs**
2. Acquiring Core Values for Self Development **2 Hrs**
3. Living in Harmony with Self, Family and Society **3 Hrs**
4. Values enshrined in the Constitution: Liberty, Equality **3 Hrs**
Fraternity and Fundamental Duties.

Part - B

Value – based living

1. Vedic values of life **2 Hrs**
2. *Karma Yoga* and *Jnana Yoga* **2 Hrs**
3. *Ashta Marga* and *Tri-Ratna* **2 Hrs**

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Ethical Living:

- | | |
|------------------------|-------|
| 1. Personal Ethics | 2 Hrs |
| 2. Professional Ethics | 3 Hrs |
| 3. Ethics in Education | 2 Hrs |

Part-C

General Geography

World Geography **3 Hrs**

The Universe, The Solar System, The Earth, Atmosphere, The World we live in, Countries rich in Minerals, Wonders of the World, Biggest and Smallest.

Indian Geography **3 Hrs**

Location, Area and Dimensions, Physical Presence, Indian States and Union Territories, Important sites and Monuments, Largest-Longest and Highest in India.

General History **3 Hrs**

Glimpses of India History, Ancient Indian, Medieval India, Modern India, Various Phases of Indian National Movement, Prominent Personalities, Glimpses of Punjab history with special reference to period of Sikh Gurus

Glimpses of World History **3 Hrs**

Important Events of World History, Revolutions and Wars of Independence, Political Philosophies like Nazism, Fascism, Communism, Capitalism, Liberalism etc.

Indian Polity: Constitution of India **3 Hrs**

Important Provisions, Basic Structure, Union Government, Union Legislature and Executive, State Government: State Legislature and Executive, Indian Judiciary, The Election Commission, Panchayati Raj System, RTI etc.

General Economy **3 Hrs**

The process of liberalization, privatization, globalization and Major World Issues, Indian Economy, Indian Financial System, Major Economic Issues, Economic Terminology.

Part-D

General Science **3 Hrs**

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General appreciation and understandings of science including the matters of everyday observation and experience, Inventions and Discoveries

Sports and Recreation

3 Hrs

The World of Sports and recreation, Who's Who is sports, Major Events, Awards and Honours. Famous personalities, Festivals, Arts and Artists

Current Affairs

3 Hrs

National and International Issues and Events in News, Governments Schemes and Policy Decisions

Miscellaneous Information

Who is who

2 Hrs

Books and Authors, Persons in News, Awards and Honours, Abbreviations and Sports

References:

1. Human Values, A N Tripathi, New Age International Publishers, New Delhi, Third Edition, 2009
2. Professional Ethics, R. Surbhiramanian, Oxford University Press, New Delhi, 2013.
3. Human Values and Professional Ethics, Rishabh Anand, Satya Prakashan, New Delhi, 2012
4. Human Values and Professional Ethics, Sanjeev Bhalla, Satya Prakashan, New Delhi, 2012.
5. Human Values and Professional Ethics, Ritu Soryan Dhanpat Rai & Co. Pvt. Ltd., First Edition, 2010.
6. Human Values and Professional Ethics by Suresh Jayshree, Raghavan B S, S Chand & Co. Ltd. , 2007.
7. Human Values and Professional Ethics, Yogendra Singh, Ankur Garg, Aitbs publishers, 2011.
8. Human Values and Professional Ethics, Vrinder Kumar, Kalyani Publishers, Ludhiana, 2013.

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9. Human Values and Professional Ethics, R R Gaur, R. Sangal, GP Bagaria, Excel Books, New Delhi 2010.
10. Values and Ethics, Dr. Bramwell Osula, Dr. Saroj Upadhyay, Asian Books Pvt. Ltd., 2011.
11. Indian Philosophy, S. Radhakrishnan, George Allen & Unwin Ltd., New York: Humanities Press INC, 1929.
12. Essentials of Hinduism, Jainism and Buddhism, A N Dwivedi, Books Today, New Delhi – 1979
13. Dayanand : His life and work, Suraj Bhan, DAVCMC, New Delhi – 2001.
14. Esence of Vedas, Kapil Dev Dwivedi, Katyayan Vedic Sahitya Prakashan, Hoshiarpur, 1990.
15. Vedic Concepts, Prof. B B Chaubey, Katyayan Vedic Sahitya Prakashan, Hoshiarpur, 1990.
16. Advance Objective General Knowledge, R. S. Aggarwal, S. Chand Publisher (2013)
17. Concise General Knowledge Manual 2013, S. Sen, Unique Publishers,2013
18. Encyclopedia of General Knowledge and General Awareness by R P Verma, Penguin Books Ltd (2010)
19. General Knowledge Manual 2013-14, Edgar Thorpe and Showick Thorpe, The Pearson, Delhi.
20. General Knowledge Manual 2013-14, Muktikanta Mohanty, Macmillan Publishers India Ltd., Delhi.
21. India 2013, Government of India (Ministry of Information Broadcasting), Publication Division, 2013.
22. Manorama Year Book 2013-14, Mammen Methew, Malayalam Manorama Publishers, Kottayam, 2013.
23. Spectrum's Handbook of General Studies – 2013-14, Spectrum Books (P) Ltd., New Delhi

CURRENT AFFAIRS

Magazines

Economic and Political Weekly, Yojna, the Week, India Today, Frontline, Spectrum.

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Competition Success Review, Competition Master, Civil Services Chronicle, Current Affairs,
World Atlas Book

Newspapers

The Hindu, Times of India, The Hindustan Times, The Tribune

Generic Elective Courses

Paper: Plant Diversity

Course Code: BOT131

L	T	P	Credits	Marks	Min. Marks
4	0	0	4	100	40

Objective:

To acquaint the students about the morphology, biology and importance of prokaryotes, eukaryotes, algal organisms, fungal organisms, lichens, bryophytes and pteridophytes.

Learning Outcome

The course will enable students to know the earlier plants, their vegetative and reproductive structures and their importance.

UNIT 1

Viruses: Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

UNIT 2

Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae.

Fungi: Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

UNIT 3

Introduction to Archegoniate: Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

UNIT 4

Pteridophytes: General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.

Gymnosperms: General characteristics; Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. Ecological and economical importance.

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Paper: Plant Diversity Laboratory

Course Code: BOT132

L	T	P	Credits	Marks	Min. Marks
0	0	3	2	50	20

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Oedogonium*, *Vaucheria*, *Fucus** and *Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
5. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. *Alternaria*: Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberryleaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores(temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m.microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).

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14. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
15. *Pteris*- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

Reference Books:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

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This syllabus has been designed as per national syllabus suggested by UGC for CBCS guidelines as per requisite of honour degree.

Course Code: MIC111

L	T	P	Credit
4	0	0	4

Course Title: Introduction to Microbiology

Unit 1 History of Development of Microbiology

No. of Hours: 15

Development of microbiology as a discipline. Spontaneous generation vs. biogenesis.

Contributions of

Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming

Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman

Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit 2 Diversity of Microbial World

No. of Hours: 40

A. Systems of classification

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms

B. General characteristics of different groups: **Acellular** microorganisms (Viruses, Viroids, Prions) and **Cellular** microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

• Algae

History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Applications of algae in agriculture, industry, environment and food.

• Fungi

Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism.

Economic importance of fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration and mycotoxins.

• Protozoa

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General characteristics with special reference to *Amoeba*, *Paramecium*, *Plasmodium*, *Leishmania* and *Giardia*

Unit 3 An overview of Scope of Microbiology

No. of Hours: 5

SUGGESTED READING

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
4. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
5. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
6. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

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Course Code: MIC112

Course Title: Introduction to Microbiology Laboratory

L	T	P	Credit
0	0	3	2

1. Microbiology Good Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for bacterial cultivation.
4. Sterilization of medium using Autoclave and assessment for sterility
5. Sterilization of glassware using Hot Air Oven and assessment for sterility
6. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
7. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
8. Study of *Rhizopus*, *Penicillium*, *Aspergillus* using temporary mounts
9. Study of *Spirogyra* and *Chlamydomonas*, *Volvox* using temporary Mounts
10. Study of the following protozoans using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*

Course Code: CHE157

Course Title: General Chemistry - I

L	T	P	Credit
4	0	0	4

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Section A: Inorganic Chemistry-1 (30 Periods)

Atomic Structure: Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers n , l and m . Shapes of s , p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s - s , s - p and p - p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including

idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approaches.

Section B: Organic Chemistry-I (30 Periods)

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L *cis – trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff rule); *cis* alkenes (Partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions:* *cis*-addition (alk. KMnO₄) and *trans*-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC₂ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO₄ ozonolysis and oxidation with hot alk. KMnO₄

Reference Books:

- J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
- F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
- Douglas, McDaniel and Alexander: *Concepts and Models in Inorganic Chemistry*, John Wiley.

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- James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
- T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons*.
- Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
- E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
- I. L. Finar: *Organic Chemistry (Vol. I & II)*, E. L. B. S.
- R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
- Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand

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Course Code: CHE158

Course Title: General Chemistry – I Laboratory

L	T	P	Credit
0	0	3	2

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ with internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements).
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given):
 - (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
 - (b) Identify and separate the sugars present in the given mixture by paper chromatography.

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Course Title: Biochemical Correlations in Diseases

Paper Code: BCH403

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives: This course introduces students to the biochemistry underlying various diseases and the mechanisms of pathogenesis.

Unit A(15 hours)

Inborn errors of metabolism

Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders.

Nutritional deficiency based diseases

Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease.

Unit B(15 hours)

Lifestyle diseases

Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD).

Hormonal Imbalances

Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism.

Unit C(15 hours)

Autoimmune diseases

Concepts in immune recognition - self and non self discrimination, organ specific autoimmune diseases – Hashimoto's thyroiditis, Grave's disease, myasthenia gravis;. Systemic diseases - SLE, rheumatoid arthritis; Diabetes Mellitus-I.

Diseases caused due to misfolded proteins

Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell anaemia, Thalessemia.

Unit D(15 hours)

Infectious diseases

Viral infection (polio, measles, mumps, influenza, HIV); Bacterial infections (tetanus, diphtheria, tuberculosis, typhoid, cholera); Protozoan (Plasmodium and Trypanosoma) and parasitic infections. Vaccines against diseases. General strategies in the design and development of vaccines.

Reference Books

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7
3. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.
4. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

**Course Title: Biochemical Correlations in Diseases
Laboratory
Paper Code: BCH404**

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Glucose tolerance test.
2. Lipid profile: triglycerides and total cholesterol.
3. Obesity parameters.
4. RBC counting and haemoglobin estimation.
5. Blood pressure measurements.
6. Bone density measurements (visit to a nearby clinic).
7. T4/TSH assays.

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Course Code: BOT241

L	T	P	Credit
4	0	0	4

Course Title: Plant Physiology and Metabolism

UNIT 1

Plant-water relations: Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

Mineral nutrition: Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

UNIT 2

Translocation in phloem: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C₃, C₄ and CAM pathways of carbon fixation; Photorespiration.

UNIT 3

Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Nitrogen metabolism: Biological nitrogen fixation; Nitrate and ammonia assimilation.

UNIT 4

Plant growth regulators: Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

SUGGESTED READINGS

1. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

DAV UNIVERSITY, JALANDHAR

Course Code: BOT242

**Course Title: Plant Physiology and Metabolism
Laboratory**

L	T	P	Credit
0	0	3	2

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1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O₂ evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

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Course Title: Gene Organization, Expression and Regulation

Paper Code: BCH401

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives: This course introduces students to the biochemistry underlying the genetic machinery of the cell.

Unit A (15 hours)

Structure of genes and chromosomes

No. of Hours : 8

Definition of a gene, chromosomal organization of genes in viruses, bacteria and eukaryotes. Supercoiling of DNA.

Replication of genomes

No. of Hours : 12

General features of DNA replication, properties of prokaryotic and eukaryotic DNA polymerases. Replication of DNA and telomeres in linear chromosomes. Replication of RNA genomes.

Unit B (15 hours)

Recombination of DNA

No. of Hours : 4

Homologous genetic recombination, Holliday model, proteins and enzymes mediating recombination.

Gene mutations and repair

No. of Hours : 6

Molecular basis of mutations, multiple repair systems, mismatch repair, base excision repair, nucleotide excision repair, direct repair and translesion DNA synthesis.

Transcription of genes

No. of Hours : 10

General features of gene transcription, prokaryotic and eukaryotic RNA polymerases, stages of transcription, initiation, elongation and termination. Inhibitors of transcription.

RNA processing

No. of Hours : 4

Processing of eukaryotic mRNA, splicing of introns, alternate splicing and editing, ribosomal and tRNA processing.

Protein synthesis

No. of Hours : 10

Features of the genetic code, amino acylation of tRNAs, structure and assembly of ribosomes; three stages of protein synthesis - initiation, elongation and termination. Inhibitors of protein synthesis.

Regulation of gene expression

No. of Hours : 6

Regulation of transcription in prokaryotes, concept of operons. Lac operon - control by negative and positive regulatory proteins, Trp operon - control by attenuation. Regulation of transcription in eukaryotes, regulatory sequences - enhancers, silencers response elements, nucleosome alterations, DNA-protein interactions and RNA interference.

Recommended books

1. Nelson DL & Cox M.M., Lehninger Principles of Biochemistry, 5th Edition, WH Freeman & Company, New York, 2008.
2. Voet D & Voet JG, Biochemistry, 3rd Edition, John Wiley & Sons Inc., Singapore, 2004.
3. Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's Illustrated Biochemistry, 27th Edition, McGraw Hill Company Inc. Singapore, 2006.

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**Course Title: Gene Organization, Expression and Regulation
Laboratory
Paper Code: BCH402**

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Quantitative determination of DNA and RNA by absorbance at 260 nm and using A_{260}/A_{280} ratio to distinguish between them.
2. To study the viscosity of DNA solutions.
3. Isolation of chromosomal DNA from E. coli.
4. Isolation of total RNA from yeast cells.

Course Code: CHE257

Course Title: General Chemistry – II

L	T	P	Credit
4	0	0	4

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I

Section A: Physical Chemistry-1 (30 Lectures)

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Chemical Equilibrium:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG° , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Section B: Organic Chemistry-2 (30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).

Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 or NaNH_2 .

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols: *Preparation:* Preparation of primary, secondary and tertiary alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO_4 , acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, NaHSO_3 , NH-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemmensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

Reference Books:

- T. W. Graham Solomons: *Organic Chemistry, John Wiley and Sons.*
- Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry, Orient Longman.*
- I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: *Organic Chemistry, Prentice Hall.*
- Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry, S. Chand.*
- G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).

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- G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
- J. C. Kotz, P. M. Treichel & J. R. Townsend: *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
- R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

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Course Code: CHE258

Course Title: General Chemistry – II Laboratory

L	T	P	Credit
0	0	3	2

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3 , NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH .

Ionic equilibria

pH measurements

- a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
- b) Preparation of buffer solutions:
 - (i) Sodium acetate-acetic acid
 - (ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done.
 - (a) Bromination of Phenol/Aniline
 - (b) Benzoylation of amines/phenols
 - (c) Oxime and 2, 4 dinitrophenylhydrazone of aldehyde/ketone

Reference Books

- A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
- F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

BIOTECHNOLOGY AND HUMAN WELFARE

Course Code: BTY243

L	T	P	Credits	Marks
4	0	0	4	100

UNIT I

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II

Agriculture: N₂ fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT IV

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT V

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in *E.coli*, human genome project.

BIOTECHNOLOGY AND HUMAN WELFARE- Lab

L	T	P	Credits	Marks
4	0	0	4	100

Course Code: BTY244

PRACTICALS

1. Perform of ethanolic fermentaion using Baker's yeast
2. Study of a plant part infected with a microbe
3. To perform quantitative estimation of residual chlorine in water samples
4. Isolation and analysis of DNA from minimal available biological samples
5. Case studies on Bioethics (any two)