

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 2020

DAV UNIVERSITY, JALANDHAR

Programme Name: B.Sc (Hons.) Zoology

Programme Mission:

Zoology is the study of all animal life; from primitive microscopic malaria-causing protozoa to large advanced mammals, across all environmental spheres from red deer in mountain forests to dolphins in deep oceans, and from underground burrowing voles to golden eagles in the skies. Some of these animals are useful to us and we nurture them as pets or livestock; some are serious pests or disease-causing; and some are simply splendid and awe-inspiring. No matter what our relation with the animals is, we need to understand their behaviour, population dynamics, physiology and the way they interact with other species and their environments. The current curriculum provides students with the knowledge and skill base that would enable them to undertake further studies in Zoology and related areas or in multidisciplinary areas that involve advanced or modern biology and help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

Programme Learning Outcomes:

1. Knowledge and Understanding:

- i. After completing B.Sc (Hons.) in Zoology, the students will develop in-depth knowledge and understanding about the fundamental concepts, principles and processes underlying the academic field of Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases, apiculture, aquarium fish keeping, medical diagnostics, and sericulture)
- ii. The students will also acquire procedural knowledge that creates different types of professionals in the field of Zoology and related fields such as, apiculture, aquarium fish keeping, medical diagnostics, and sericulture, etc.
- iii. The students will also learn skills related to specialization areas within Zoology as well as within subfields of Zoology, including broader interdisciplinary subfields (Chemistry, Physics and Mathematics).

DAV UNIVERSITY, JALANDHAR

- iv. The current curriculum will make the students appreciate the complexity of life processes, their molecular, cellular and physiological processes, their genetics, evolution and behaviour and their interrelationships with the environment. They will study concepts, principles and theories related with animal behavior and welfare.
2. **Subject Specific Intellectual and Practical Skills:** The students will be able to
- i. Understand how organisms are classified and full and identified
 - ii. Demonstrate knowledge of basic zoological principles
 - iii. Use appropriate information with a critical understanding
 - iv. Learn basic laboratory and analytical skills
 - v. Use effective methods for modifying animal behavior
 - vi. Participate in animal management programs in an effective manner
 - vii. Work safely and effectively in the field, in laboratories and in animal facilities
 - viii. Demonstrate competence in handling and statistical analysis of data gained from practical.

Overall, the student will attain subject knowledge in terms of individual course as well as holistically. The core courses would fortify the students with in-depth subject knowledge concurrently; the discipline specific electives will add additional knowledge about applied aspects of the program as well as its applicability in both academia and industry. Generic electives will introduce integration among various interdisciplinary courses. The skill enhancement courses would further add additional skills related to the subject as well as other than subject. In brief, the students graduated with this curriculum would be able to disseminate subject knowledge along with necessary skills to suffice their capabilities for academia, entrepreneurship and Industry.

DAV UNIVERSITY, JALANDHAR

SCHEME OF COURSES

B.Sc. (Hons.) Zoology

Semester 1

S. No.	Course Code	Course Name	Course Type	L	T	P	Cr.
1	ZOO135	Diversity of Non Chordates	Core	4	0	0	4
2	ZOO136	Diversity of Chordates	Core	4	0	0	4
3	ZOO137	Animal Diversity Laboratory	Core	0	0	4	2
4	ZOO123	Perspectives in Ecology	Core	4	0	0	4
5	ZOO124	Perspectives in Ecology Laboratory	Core	0	0	3	2
6	ENG151B	Basic Communication Skills	Ability Enhancement Compulsory Course (AECC)	3	0	0	3
7	ENG152A	Basic Communication Skills Lab		0	0	2	1
8	Generic Elective-I						6
Total							26

GE (Generic Elective-I) (Choose one)

S.No.	Course Code	Course Name	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

DAV UNIVERSITY, JALANDHAR

Semester 2

S.No.	Course Code	Course Name	Course Type	L	T	P	Cr.
1	Z00132	Comparative Anatomy and Physiology of Non-Chordates	Core	4	0	0	4
2	Z00133	Comparative Anatomy and Physiology of Chordates	Core	4	0	0	4
3	Z00134	Anatomy and Physiology Laboratory	Core	0	0	4	2
4	EVS100	Environmental Science	AECC	4	0	0	4
5	SGS 107	Human Values and General Studies	AECC	4	0	0	4
6	Generic Elective-II						6
Total							24

GE (Generic Electives)-II (choose one)

S.No.	Course Code	Course Name	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

DAV UNIVERSITY, JALANDHAR

Semester 3

S.No.	Course Code	Course Name	Course Type	L	T	P	Cr.
1	ZOO127	Fundamentals of Cell Biology	Core	4	0	0	4
2	ZOO236	Genetics and Evolution	Core	4	0	0	4
3	ZOO237	Cell Biology, Genetics and Evolution Laboratory	Core	0	0	4	2
4	ZOO238	Animal Behaviour and Chronobiology	Core	4	0	0	4
5	ZOO239	Animal Behaviour and Chronobiology 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						6
Total							28

GE (Generic Electives-III) (choose one)

S.No.	Course Code	Course Name	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

DAV UNIVERSITY, JALANDHAR

Semester 4

S.No.	Course Code	Course Name	Course Type	L	T	P	Cr.
1	ZOO240	Microbiology, Parasitology and Immunology	Core	4	0	0	4
2	ZOO341	Fundamentals of Molecular Biology	Core	4	0	0	4
3	ZOO241	Biotechniques	Core	4	0	0	4
4	ZOO242	Biotechniques Laboratory	Core	0	0	3	2
5	BCH103`	Metabolism	Core	4	0	0	4
6	BCH104	Metabolism Laboratory	Core	0	0	3	2
7	Generic Elective-IV						6
Total							26

GE (Generic Electives)-IV (choose one)

S.No.	Course Code	Course Name	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

DAV UNIVERSITY, JALANDHAR

Semester 5

S.No	Course Code	Course Name	Course Type	L	T	P	Cr.
1	ZOO321	Fundamentals of Developmental Biology	Core	4	0	0	4
2	ZOO351	Biostatistics and Bioinformatics	Core``	4	0	0	4
3	ZOO352	Fundamentals of Developmental Biology and Bioinformatics Laboratory	Core	0	0	3	2
4	ZOO353	Applied Zoology	Core	4	0	0	4
5	ZOO354	Applied Zoology Laboratory	Core	0	0	3	2
6	Discipline Specific Elective-I						6
7	Discipline Specific Elective-II						6
	Total						28

DAV UNIVERSITY, JALANDHAR

Semester 6

S.No	Course Code	Course Name	Course Type	Cr.
1	ZOO355	Research Project/Skill Based Training (for one complete semester)	Elective	26
2.	ZOO356	Seminar/Group Discussion/Research Project/Skill based Training (at least for 15 days)		6
	Skill Enhancement Elective Course- I			4
	Skill Enhancement Elective Course- II			4
	Discipline Specific Elective-III			6
	Discipline Specific Elective-IV			6
Total				26

Note: In semester six, the students can opt for any one combination mentioned in S.No. 1 and 2.

DAV UNIVERSITY, JALANDHAR

List of Discipline Specific Elective Courses offered by the Department

S. No.	Course Code	Course Name	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	ZOO329	Biology of Insecta	4	0	0	4
	ZOO330	Biology of Insecta Laboratory	0	0	3	2
III	ZOO333	Basic Computational Biology	4	0	0	4
	ZOO334	Basic Computational Biology Laboratory	0	0	3	2
IV	ZOO335	Reproductive Biology	4	0	0	4
	ZOO336	Reproductive Biology Laboratory	0	0	3	2
V	ZOO337	Endocrinology	4	0	0	4
	ZOO338	Endocrinology Laboratory	0	0	3	2
VI	ZOO257	Human Physiology	4	0	0	4
	ZOO258	Human Physiology Laboratory	0	0	3	2
VII	ZOO358	Genetic Engineering and Biotechnology	4	0	0	4
	ZOO359	Genetic Engineering and Biotechnology Laboratory	0	0	3	2
VIII	ZOO327	Basics of Fish and Fisheries	4	0	0	4
	ZOO328	Basics of Fish and Fisheries Laboratory	0	0	3	2

DAV UNIVERSITY, JALANDHAR

LIST OF SKILL ENHANCEMENT COURSES

S.No.	Course Code	Course Name	L	T	P	Cr.
1	ZOO225	Apiculture	4	0	0	4
2	ZOO226	Aquarium fish keeping	4	0	0	4
3	ZOO227	Sericulture	4	0	0	4
4	ZOO232	Medical Diagnostics	4	0	0	4
5	ZOO233	Research Methodology	4	0	0	4
6	ZOO234	Swachh Bharat Internship Programme	4	0	0	4
7	ZOO361	Aquaculture	4	0	0	4

Note: The students can choose any MOOC course of equivalent credits in place of Discipline specific elective course or skill enhancement elective course after taking prior permission from the competent authority.

Syllabi

SEMESTER 1

Course Name: Diversity of Non-chordates

Course Code: ZOO135

L	T	P	Credits	Marks
4	0	0	4	100

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

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop understanding on the diversity of life with regard to non-chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen.

5.

UNIT-A

13 hours

- **Protista:** General characteristics of protozoans and their classification up to orders; Locomotion and reproduction in protozoans
- **Origin of Metazoans:** Diploblastic and triploblastic organization; symmetries; body cavities; protostomes and deuterostomes.
- **Porifera:** General characteristics and classification up to orders; Canal system and spicules in sponges.
- **Cnidaria:** General characteristics and classification up to orders; Metagenesis in *Obelia*; corals and coral reefs; polymorphism in Cnidaria.

UNIT-B

13 hours

- **Platyhelminthes:** General characteristics and classification up to orders. Adaptive radiations in flatworms.
- **Nemathelminthes:** General characteristics and classification up to orders; Adaptive Radiations in roundworms.

UNIT-C

13 hours

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

DAV UNIVERSITY, JALANDHAR

- **Arthropoda:** General characteristics and classification up to orders. Basic Organization and Adaptive Radiation in Arthropods. Metamorphosis in Insects; social life in bees and termites.

UNIT-D

13 hours

- **Mollusca:** General characteristics and classification up to orders; Respiration in Mollusca; Torsion and detorsion in Gastropoda.
- **Echinodermata:** General characteristics and classification up to classes; water vascular system in Asteroidea; Larval forms in Echinodermata. Affinities with Chordates.

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 Name: Diversity of Chordates

Course Code: ZOO136

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.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop understanding on the diversity of life with regard to chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
5. Understand how morphological change due to change in environment helps drive evolution over a long period of time.
6. The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen.

UNIT-A

13 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

13 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

13 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

13 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

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.

DAV UNIVERSITY, JALANDHAR

Course Name: Animal Diversity Laboratory

Course Code: ZOO137

L	T	P	Credits	Marks
0	0	4	2	50

1. General survey of representative organisms from all groups of invertebrates and chordates with the help of charts/models/e-resources.
2. Study of animals in nature during a survey of a National Park or Forest area and submission of report based on the survey.
3. Comparison of two species of birds belonging to same genus (Interspecific difference).
4. Comparison and weighting of characters of two birds belonging to same family but dissimilar genera.
5. Group discussion or Seminar presentation on one or two related topics from the list

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 Name: Perspectives in Ecology

Course 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.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Know the evolutionary and functional basis of animal ecology.
2. Understand what makes the scientific study of animal ecology a crucial and exciting endeavour.
3. Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.
4. Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice.
5. Solve the environmental problems involving interaction of humans and natural systems at local or global level.

UNIT-A

13 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

13 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

13 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

DAV UNIVERSITY, JALANDHAR

example of Nitrogen cycle; Human modified ecosystem

UNIT-D

13 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.
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.

DAV UNIVERSITY, JALANDHAR

Course Name: Perspectives in Ecology Laboratory

Course Code: ZOO124

L	T	P	Credits	Marks
0	0	3	2	50

1. To measure microclimatic variables viz., temperature, humidity and light conditions in a microhabitat.
2. Making an ecosystem in a wide-mouthed bottle.
3. Constructing a food web by observing and collecting organisms from a given area.
4. Preparing and clearly present an essay based on the evaluation of 4-7 publications.
5. Studying the impact of herbivore on plant species (planted in pots under specific conditions)
6. Constructing distribution map of species of a genus through GPS by estimating the coordinates.
7. Estimation of the ratio of the producers and consumers.
8. Studying insect diversity in a habitat.
9. Group discussion or Seminar presentation

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

SEMESTER 2

Course Code: ZOO132

Course Name: Comparative Anatomy and Physiology of

Non-Chordates

L	T	P	Credits
4	0	0	4

About the course: The course makes a detailed comparison of the anatomy of the different taxa of non-chordates. It also highlights how in the taxonomic hierarchy, there is an increase in the complexity of structure and function. The course thus gives an overview of the intricate life processes and adaptive radiations in non-chordates.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop an understanding of the characters used to classify besides being able to differentiate the organisms belonging to different taxa.
2. Acquire knowledge of the coordinated functioning of complex human body machine.
3. Have hands on experience of materials demonstrating the diversity of protists and non-chordates.
4. Understand the relative position of individual organs and associated structures through dissection of the invertebrate representatives.
5. Realize that very similar physiological mechanisms are used in very diverse organisms.
6. Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.
7. Undertake research in any aspect of animal physiology in future.

UNIT A

13 hours

Diversity of Tegment and Digestive system: Basic affinities and differences between prokaryotes and eukaryotes; protists and the non-chordate animals. Symmetry, Coelom development and diversity. Cell membrane in protists and its derivatives. Tegment in non-chordates and its derivatives. Nutrition and feeding modes in protists. Digestive system & feeding mechanism in non-chordates): Process of digestion from food vacuoles to complex digestive organs.

UNIT B

13 hours

Diversity of Locomotory, Respiratory, Circulatory and Excretory systems: Locomotion and diversity of locomotory organs in protists and non-chordates, muscle and locomotion, Structure and diversity of skeletal elements in protists and non-chordates. Respiration: diversity of respiratory organs, modes of respiration. Respiratory pigments and oxygen consumption rates of different organisms. Circulation and the diversity of circulatory system. Excretion (protists): endocytosis, exocytosis; Excretion and diversity of excretory organs in non-chordates.

UNIT C

13 hours

Diversity of Nervous and Reproductive systems: Nervous system with special reference to diversity in brain and nerve chord. Neuroendocrine systems, pheromones. Sense organs: Mechanoreceptors and their diversity in different taxa. Sense organs: photoreceptors, chemoreceptors, thigmoreceptors, rheoreceptors and proprioceptors in different taxa. Olfaction and sound perception in insects, etc. Diversity of the reproductive organs and accessory sex organs; modes of reproduction- asexual and sexual reproduction. Metamorphosis. Diversity of larval forms in non-chordates

UNIT D

13 hours

Evolution and characteristics of important Non Chordate taxa
Organization and affinities in fossils (such as trilobites). Affinities of living fossils, Limulus and Peripatus. Polymorphism and colony formation. Parasitic adaptations and life cycle patterns in parasites belonging to different taxa. The parasites listed by World Health Organization under preventive programmes. Structure and diversity of the pest organisms. Invertebrate model organisms and their importance. Taxa with special characteristics: Types of canal systems in sponges and their significance. Torsion and detorsion in Mollusca. Components of water vascular system in echinoderms.

Reference books:

1. Barrington, E J W. (1967) Invertebrate structure and function, Nelson, London. 39
2. Barnes, R. D. (1968) Invertebrate Zoology, 2nd Ed. Saunders, Philadelphia.
3. Hyman, L H. (1940-67). The Invertebrates, Vol. I-VI. McGraw-Hill, New York.
4. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
5. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Marshall, A.J and Williams, W.D. (1995) Text book of Zoology-Invertebrates. VII Ed., Vol. I, A.L.T.B.S. Publishers.
7. <http://abacus.bates.edu/acad/depts/biobook/AnimPhyl.pdf>

DAV UNIVERSITY, JALANDHAR

Course Code: ZOO133

Course Name: Comparative Anatomy and Physiology of Chordates

L	T	P	Credit
4	0	0	4

Course Objective: The course offers insight into the physiology of chordates while giving an account of their anatomy. This course also explores vertebrate morphology with the aims of understanding major events in the history of vertebrate evolution and integrating the morphology of vertebrates with their ecology, behaviour and physiological adaptation in diverse habitats. Thermal relations encountered in endo- and ectothermic animals will be explained. Selective pressures that shape to different physiological phenotypes will also be addressed in the course.

UNIT A

13 hours

Structure and function of integument, skeletal and muscular systems:

Structure of integument from fishes to mammals with an account on epidermal and dermal derivatives and their functional significance. Anatomy and physiology of axial and appendicular skeleton. Comparative anatomy of pelvic and pectoral girdles from fishes (cartilaginous and bony) to mammals. Types of muscles, physical properties and ultrastructural organization of skeletal muscle fibres, muscle contraction.

UNIT B

13 hours

Structure and function of digestive, circulatory and endocrine systems:

Comparative anatomy of jaw suspension, oral cavity, teeth (dentition mammals). Structure and diversity of alimentary canal and digestive glands in chordates. Biological significance of nutrients- carbohydrates, proteins, fats, vitamins and minerals. Physiology of digestion with special reference to enzymes involved. Evolution of aortic arches and their significance. Visceral arches and their functional significance in vertebrates. Structure and evolution of heart in vertebrates. Functional anatomy of heart, cardiac cycle, cardiac output, Integration of cardiovascular function, electrocardiogram. Composition of blood, blood groups, Mechanism of blood coagulation. Types and functional significance of endocrine glands and hormones.

UNIT C

13 hours

Structure and function of respiratory and excretory systems:

Aquatic and terrestrial respiration; transition from water to air breathing. Breathing and gas exchange, gas transport, Hb and O₂ dissociation, BMR. Comparative anatomy and functional significance of lungs in amphibians, reptiles, birds and mammals. Types and development of kidneys and their ducts in anamniotes and amniotes. Nephron- structure, types and their function. Physiology of excretion in vertebrates; urine formation, counter current mechanism, Role of ADH and RAAS in

excretion. Mechanisms of osmoregulation in fresh water and marine organisms, stenohalinity and euryhalinity.

UNIT D

13 hours

Structure and function of nervous and reproductive systems:

Introduction to central and peripheral nervous systems. Structural and functional evolution of brain and spinal cord in various classes of chordates. Peripheral nervous system- functional significance of somatic and autonomic nervous systems. Structure and functions of neuron, ionic basis of resting and action potentials, nerve impulse and its transmission, synapse and synaptic transmission, Reflex action. Types of sense organs- vision, hearing, taste, smell and touch in chordates. Mechanism of thermoregulation in homeotherms and poikilotherms. Comparative details of testes and ovaries from fishes to mammals; modes of reproduction; estrous and menstrual cycle, implantation, gestation, parturition, lactation and birth control.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop an understanding of the evolution of vertebrates thus integrating structure, function and development.
2. Have an overview of the evolutionary concepts including homology and homoplasy, and detailed discussions of major organ systems.
3. Understand how cells, tissues, and organisms function at different levels. The course content also provides the basis of understanding their abnormal function in animal and human diseases and new methods for treating those diseases.
4. Develop an understanding of the related disciplines, such as cell biology, neurophysiology, pharmacology, biochemistry etc.
5. Get a flavor of research besides improving their writing skills and making them well versed with the current trends. It will further enable the students to think and interpret individually due to different aspects chosen.
6. Undertake research in any aspect of animal physiology in future.

Reference Books

1. Weichert, C.K. (1970) Anatomy of Chordates (4th edition).
2. Jordan, E. L. and Verma, P. S. (2013) Chordate Zoology (14th edition).
3. Saxena, R. K. and Saxena, S. (2015) Comparative Anatomy of Vertebrates (2nd edition).
4. Vander, A.; Sherman, J. and Luciano, D. (2003) Human Physiology (9th edition).
5. Randall, D. et al. (2002) Eckert Animal Physiology (5th edition) Freeman.
6. Hill, R.W. et al. (2008) Animal Physiology (3rd edition) Sinaur Associates.
7. Guyton, A.C. et al. (2008) Textbook of Medical Physiology (12th edition) W.B. Saunders Co.
8. Withers, P.C. et al. (1992) Comparative Animal Physiology (1st edition) Brooks Cole.

DAV UNIVERSITY, JALANDHAR

Course Code: ZOO134

Course Name: Anatomy and Physiology Laboratory

L	T	P	Credit
0	0	4	2

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

Semester 3

Course Code: ZOO127

Course Name: Fundamentals of Cell Biology

L	T	P	Credit
4	0	0	4

Course Objective: The course provides a detailed insight into basic concepts of cellular structure and function. It also gives an account of the complex regulatory mechanisms that control cell function.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.
2. Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.
3. Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.
4. Get new avenues of joining research in areas such as genetic engineering of cells, cloning, vaccines development, human fertility programme, organ transplant, etc.
5. Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.

Unit A

13 hours

Cells and organelles: 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 B

13 hours

Molecule and Protein Trafficking: 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 C

13 hours

Nucleus and Cell Cycle: Genome organization, structure and function of nucleus, nuclear envelope, structure of chromatin, nucleosome and chromosome, cell cycle, mitosis and meiosis.

Unit D

13 hours

Eukaryotic cell organelles and functions: 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.

DAV UNIVERSITY, JALANDHAR

Course Code: Genetics and Evolution

Course Code: ZOO236

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. About the course. The course is designed to revise basic concepts of Genetics and then move on to advanced concepts. Some key aspects include the mechanism of inheritance, gene structure and function, sex chromosomal and autosomal anomalies, aspects of human genetics, etc. will be covered. A strong emphasis will be laid on the modern tools and techniques used in genetics.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Understand how DNA encodes genetic information and the function of mRNA and tRNA.
2. Apply the principles of Mendelian inheritance.
3. Understand the cause and effect of alterations in chromosome number and structure.
4. Relate the conventional and molecular methods for gene manipulation in other biological systems. Discuss and analyse the epigenetic modifications and imprinting and its role in diseases.
5. Get new avenues of joining research in related areas such as genetic engineering of cells, cloning, genetic disorders, human fertility programme, genotoxicity, etc

Unit A

13 hours

Concept of Gene and Genomics: Genetics: scope and importance. Elements of heredity and variation: Classical and Modern concept of Gene (Cistron, muton, recon), Alleles etc. Mendel's laws of inheritance, Chromosomal basis of inheritance and its applications. Exceptions to Mendelian Inheritance: Incomplete dominance, Codominance, Multiple allelism, Lethal alleles, Pleiotropy, Epistasis - Recessive, Double recessive and double dominant.

Unit B

13 hours

Recombination and Interaction of Genes: Linkage and crossing over, cytological basis of crossing over. Organelle inheritance (Mitochondrial) Extra-nuclear inheritance, Maternal Inheritance, Sex Chromosomes and sexlinkage: XX/XO, XX/XY, ZZ/ZW and haploidy/diploidy types, Gene dosage Compensation, Epigenetics. Structural and numerical alterations of chromosomes.

Unit C

13 hours

Gene Expressions and regulation: One gene-one enzyme hypothesis/one polypeptide hypothesis. Concept of operon of bacteria and bacteriophages. Bacterial transposons. Transformation, transfection and transduction. Genetic

complementation. Genetic mapping.

Unit D

13 hours

Population Genetics and Genetic Counselling: Pedigree analysis, Hardy Weinberg Law.

Life's beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism.

Product of evolution: Micro-evolutionary changes (Inter-population variations, Clines, Races), Species concept, Isolating mechanisms, Modes of speciation: Allopatric, Sympatric, Adaptive radiation/Macroevolution (Exemplified by Galapagos finches).

Evidences of evolution: Fossil record (types of fossils, transitional forms), Geological time scale.

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.

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.
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.
7. Douglas, J. Futuyma. *Evolutionary Biology*. Sinauer Associates, 1997.
8. Hall, B.K. and Hallgrimson, B. *Evolution* IV Edition. Jones and Barlett Publishers, 2008.

DAV UNIVERSITY, JALANDHAR

Course Code: Cell Biology, Genetics and Evolution

Laboratory

Course Code: ZOO237

L	T	P	Credits	Marks
0	0	4	2	50

1. Preparation of chromosome squashes from grasshopper/cockroach testes for the observation of stages of meiosis.
2. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak.
3. Demonstration of monohybrid and dihybrid crosses using seeds.
4. Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides/photographs.
5. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome).
6. Extraction of Genomic DNA from bacteria.
7. Study of fossils from models/ pictures.
8. Study of homology and analogy from suitable specimens.
9. Construction of phylogenetic trees with the help of bioinformatics tools and its interpretation.
10. Group discussion or Seminar presentation.

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: Animal Behaviour and Chronobiology

Course Code: ZOO238

L	T	P	Credits	Marks
4	0	0	4	100

About the course: The course aims to explain the natural behavior patterns, how the behavior varies among individuals and species (wild, domestic, and captive), how current and past environments and ecology influence not only behavior, but also the underlying gene environment interactions that shape it.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Learn a wide range of theoretical and practical techniques used to study animal behavior.
2. Develop skills, concepts and experience to understand all aspects of animal behavior.
3. Objectively understand and evaluate information about animal behavior and ecology encountered in our daily lives.
4. Understand and be able to objectively evaluate the role of behavior in the protection and conservation of animals in the wild.
5. Consider and evaluate behavior of all animals, including humans, in the complex ecological world, including the urban environment
- 6.

UNIT A

13 hours

Behaviour and the response invoking stimuli:

Animal behaviour: Scope and importance of study. Proximate and ultimate causes of behavior and the evolutionary approach to studying behavior.

Methods and recording of a behavior: Types of stimuli invoking response: internal and external cues.

Patterns of behaviour: Kinds of behaviour: foraging behaviour, Territorial behaviour. Mate selection and courtship behaviour. Parental care, defensive behaviour. Allelomimetic and maladaptive (abnormal) behaviour. Stereotyped Behaviours (Orientation, Reflexes); Innate/ Instinct behaviour. vs. Learnt Behaviour.

UNIT B

13 hours

Communication and regulation of behaviour: Social organization (e.g., Honey bee, Termites etc.). Communication in living in groups. Evolution of sociality, eusocial organisation. Genetic basis of behaviour. Regulation of behaviour: Neural control: kineses, taxes, simple reflexes. Sensory processing: toad prey capture, sound localization (owls), echolocation (bats). Hormonal

DAV UNIVERSITY, JALANDHAR

control. Biological clocks: Advantages of biological rhythms. Circadian and circannual rhythms. Photoperiodism, tidal, solar and lunar rhythms, entrainments. Biological oscillation: the concept of Average, amplitude, phase and period, Role of melatonin. Applications of Chronobiology. Chronopharmacology, Chronomedicine, Chronotherapy. Migratory behaviour in birds and fishes.

UNIT C

13 hours

Innate behavior; Evolution of reproductive behavior:

Innate behavior: Communication (primates, bees and ants). Decision making.

Motor Output: Leech swimming/crawling, escape behavior, cricket vocalizations.

Sensorimotor integration: Electric fish, bird song instinct and motivation. Territorial behaviour, schooling behaviour. Displacement activities, Ritualization, Habitat selection, food selection and foraging behaviour in African ungulates. Mimicry and colouration. Evolution of reproductive behavior, mating systems and parental care. Asymmetry in sex, sexual dimorphism.

Unit D

13 hours

Learning behaviour; conditioning; socio-biology:

Learning (Learnt behaviour): habituation, imprinting, conditioned reflex, trial and error learning, latent learning, insight learning.

Types of learning: Habituation, Imprinting and types of imprinting -filial and sexual, Classical conditioning, Instrumental learning and insight learning.

Social behaviour: Social and cultural transmission of Behaviour; aggregation, group selection, kin selection, altruism. Social organization (e.g., Honeybee, Naked Mole Rat and Monkey).

Elements of Socio-biology: Selfishness, cooperation, altruism, kinship and inclusive fitness

Reference Books

1. McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited, London, UK.
2. Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6th edition) Cambridge, University Press, UK
3. Alcock, J. (2005) Animal Behaviour (8th edition) Sinauer Associate Inc., USA.
4. Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition) Sinauer Associate Inc., Massachusetts, USA.
5. Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009) Chronobiology Biological Timekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.
6. Kumar, V. (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer Verlag, Germany.

DAV UNIVERSITY, JALANDHAR

Course Code: Animal Behavior and Chronobiology

Laboratory

Course Code: ZOO239

L	T	P	Credits	Marks
0	0	3	2	50

1. Orientation of an animal to light.
2. Constructing an ethogram.
3. Chemical communication in ants.
4. Selective predation of coloured prey items.
5. Predatory behaviour of a carnivorous animal.
6. Nests and nesting habits of the birds and social insects.
7. To study the behavioural responses of wood lice to dry and humid conditions.
8. To study geotaxis behaviour in earthworm.
9. To study the phototaxis behaviour in insect larvae.
10. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
11. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
12. Group discussion or Seminar presentation.

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

Semester 4

Course Name: Microbiology, Parasitology and Immunology

Course Code: ZOO240

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: This is a composite course with remarkable utility and importance. Microbiology being the study of microorganisms such as viruses, bacteria etc., covers theoretical studies and practical proficiency training which may help in their placement at a clinical microbiological laboratory. Parasitology component takes care of the parasites and parasitism, emphasizing the influence of parasites on the ecology and evolution of free living species, and the role of parasites in global, public, health. Immunology part provides the students with the fundamental knowledge of the immune system and its protective roles against diseases.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Carry out common procedures for culturing, purifying and diagnostics of micro-organisms understand the disease-causing potential of bacteria and viruses, and the responses of the immune system.
2. Summarise and orally present current microbiological problem areas.
3. Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms.
4. Diagnose the causative agents, describe pathogenesis and treatment for important diseases like malaria, leishmaniasis, trypanosomiasis, toxoplasmosis, schistosomiasis, cysticercosis, filariasis etc.
5. Assess the importance of incidence, prevalence and epidemiology in microbiological diagnostic activities.
6. Know how resistance development and resistance transfer occur.
7. Identify the major cellular and tissue components which comprise the innate and adaptive immune system.
8. Understand how are immune responses by CD4 and CD8 T cells, and B cells, initiated and regulated.
9. Understand how the immune system distinguishes self from non-self.
10. Gain experience at reading and evaluating the scientific literature in the area.

UNIT A

13 hours

Microbiology: A brief account of pathogenic bacteria, fungi and viruses.

Brief history of microbiology: germ theory of disease, discovery of penicillin.

Diversity of microbes: Viruses and bacteria.

Host pathogen interaction: Invasion, antigenic heterogeneity, toxins and enzymes secretions. Kinetics of bacterial growth and staining techniques.

Viral diseases: Polio, rabies, hepatitis, influenza, dengue, AIDS, chicken pox, swine flu, chikungunya with emphasis on their causative agents, pathogenesis, diagnosis,

DAV UNIVERSITY, JALANDHAR

prophylaxis and chemotherapy.

Bacterial diseases: *Bacillus anthracis*, *Streptococcus pyogenes*, *Streptococcus pneumoniae*, *Salmonella typhi*, *Escherichia coli*, *Helicobacter pylori*, *Mycobacterium tuberculosis*, *Vibrio cholerae*.

Fungal diseases: Ringworm infection, *Aspergillosis*, *candidiasis*.

UNIT B

13 hours

Parasitology: An overview of common parasitic infections.

Introduction to parasites and parasitic diseases: Mode of transmission, portal of entry and implications of parasitism. Parasitic adaptations. Concept of zoonotic diseases.

Protozoan diseases of medical importance: Amoebiasis, giardiasis, malaria, trypanosomiasis, leishmaniasis and toxoplasmosis.

Helminthic diseases of medical importance: Schistosomiasis, taeniasis, echinococcosis, ascariasis, enterobiasis, dracunculiasis and filariasis.

UNIT C

13 hours

Immunology: Immune mechanism and related pathways, Definition and classification. Cells and organs of immune system- primary and secondary lymphoid organs.

Innate immunity: First and second lines of defense. Characteristics of antigen-antigenicity and immunogenicity, epitopes, haptens, adjuvant. Factors influencing immunogenicity. Classical and molecular structure of immunoglobulin. Classification, properties and functions of immunoglobulins.

Antigenic determinants: isotype, allotype and idiotype. Antigen and antibody interactions, affinity, avidity. Complement system (Classical, alternative and lectin pathways).

UNIT D

13 hours

Acquired immunity, Hypersensitivity and autoimmune disorders:

Acquired immunity: Humoral and cell mediated immune response. Role of B and T cell in immunity. Receptors, activation and differentiation of B and T cells.

Cytokines: Properties and function. MHC complex and molecules with classification and function. Graft rejection. Antigen processing and their presentation.

Hypersensitivity: Gell and Coomb's classification with mechanism and examples.

Autoimmune disorders: Hybridoma technology, monoclonal antibodies, immunotoxins and their applications.

Reference Books

1. Jawetz, M. and Adelberg (2015) Medical Microbiology (27th edition).
2. Chatterjee, K.D (2015) Parasitology (13th edition).
3. Goldsby, R.A.; Kindt, T.J. and Kuby, J. (2006) Immunology (6th edition).
4. Roitt, I.; Brostoff, J. and Male, D. (2012) Immunology (8th edition).

DAV UNIVERSITY, JALANDHAR

Course Name: Fundamentals of Molecular Biology
Course Code: ZOO341

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The course provides an insight into the life processes at the subcellular and molecular levels. Other important aspects include DNA and molecular genetics including gene cloning, sequencing and gene mapping in addition to the powerful techniques that revolutionized the pharmaceutical, health and agricultural industries.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.
2. Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields.
3. Apply their knowledge in problem solving and future course of their career development in higher education and research.
4. Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.

UNIT A

13 hours

DNA structure and replication: 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 B

13 hours

DNA damage, repair and homologous recombination: 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 C

13 hours

Transcription and RNA processing: RNA structure and types of RNA, **Transcription in prokaryotes:** Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains.

DAV UNIVERSITY, JALANDHAR

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 D

13 hours

Regulation of gene expression and translation:

Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, amino acyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation n. 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 Name: Biotechniques

Course Code: ZOO241

L	T	P	Credits	Marks
4	0	0	4	100

Course objectives: This is the only laboratory course taught independently of lecture courses. It has full hands on approach to expose the students to modern techniques and methodologies. The diverse techniques from microscopy to spectroscopy, calorimetry, chromatography ELISA, tissue culture to cloning etc. are included to make the student well versed with these protocols and methods.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Understand the purpose of the technique, its proper use and possible modifications/ improvement.
2. Learn the theoretical basis of technique, its principle of working and its correct application.
3. Learn the construction repair and adjustment of any equipment required for a technique.
4. Learn the accuracy of technique.
5. Learn the maintenance laboratory equipments/ tools, safety hazards and precautions.
6. Understand the technique of cell and tissue culture. Learn the preparation of solution of given percentage and molarity.
7. Understand the process of preparation of buffer. Learn the techniques of separation of amino acids, proteins and nucleic acids.

UNIT A

13 hours

Microscopy: Introduction to Microscopy. Definitions-Resolving Power, Limit of Resolution and Magnification, Numerical Aperture. Types of microscopes; bright field, dark-field, phase contrast. Basic principles of Light, Electron, Fluorescence and Confocal Microscopy. Measurements, Drawings and photomicrography.

Microtomy: Tissue preparation, fixation, block preparation, sectioning, staining, dehydration and mounting.

UNIT B

13 hours

Tools and techniques in Biochemistry and Physiology: Physiological Salines, Buffers and the use of pH meter. Extraction of Tissue Glycogen, Proteins, Lipids and Nucleic Acids by Graaf's Method. Subcellular Fractionation by Differential Centrifugation. Basic Principle and Application of Colorimetry and Spectrophotometry, Beer-Lambert's Law.

Principle and applications of Electrophoresis: Separation of Biomolecules by Native PAGE, 2D PAGE. Agarose gel electrophoresis. Principle and Applications of Paper chromatography, Thin layer chromatography, Gel-

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filtration chromatography.

UNIT C

13 hours

Immunology and Endocrinology: Introduction to Antigens, Antibodies, Adjuvants. Raising Polyclonal and Monoclonal Antibodies. Antigen-Antibody Interactions- Immunodiffusion, Ouchterlony's Double Immunodiffusion, Counter-Current, Immunoelectrophoresis, Western Blotting, ELISA, RIA. Principle & Working of ELISA, Reader, and Hormones assay methods. Application of Immunological techniques in disease diagnosis.

Tracer techniques: Principle and Applications, Unit of radioactivity, half-life and measurement of radioactivity.

UNIT D

13 hours

Cell culture, maintenance of Laboratory animals Cell Culture and

Laboratory Animals: Cell culture and its basic requirements. Culture media; Nutrient and Non-nutrient, commonly used media for human cell lines. Sterilization of culture wares and Media, laminar flow. Types of animal cell culture, cell viability testing. Cryopreservation. Lymphocyte culture. Cell harvesting and Storage Methods. In Vitro culture of *Entamoeba histolytica*, *Coenorhabditis elegans*. Maintenance and Handling of laboratory rats and rabbits. Bioethics.

Reference Books

1. Boyer, R. (2000) Modern Experimental Biochemistry (3rd edition) Benjamin-Cummings.
2. Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical and applied, Volume I-III, Churchill-Livingstones.
3. Plummer, D. (2017) An Introduction to Practical Biochemistry (3rd edition) McGraw Hill.
4. Wilson, K. and Walker, J. (2010) Experimental Biochemistry, Cambridge.

DAV UNIVERSITY, JALANDHAR

Course code: ZOO242

Course Name: Biotechniques Laboratory

L	T	P	Credits	Marks
0	0	3	2	50

1. Preparation of buffer and determination of pH.
2. Identification of amino acids in the mixture using paper chromatography.
3. Verification of laws of spectrophotometry.
4. Separation of proteins using SDS-PAGE.
5. Tissue fixation, paraffin block preparation, sectioning.
6. Preparation of permanent slides of microscopic organisms/ small insects.
7. Demonstration of ELISA and Immunodiffusion
8. Working and Principle of light microscope and phase contrast microscope.
9. Demonstration of PCR
10. Identification of blood groups

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

Semester 5

Course Name: Fundamentals of Developmental Biology

Course 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.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing the course, the students will be able to:

1. Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
2. Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
3. Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
4. Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
5. Understand the relevance of developmental biology in medicine or its role in development of diseases.

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 13 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 13 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) 13 hours
- **Post Embryonic Development:** Metamorphosis-Changes, hormonal regulations in amphibians and insects; Regeneration- Modes of

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regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing-Concepts and Theories.

UNIT-D

- **Implications of Developmental Biology:** Teratogenesis: Teratogenic agents and their effects on embryonic development; *In vitro* fertilization, Stem cell (ESC), Amniocentesis. 13 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.
5. Lewis Wolpert. *Principles of Development*. II Edition, Oxford University Press, 2002.

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Course Name: Biostatistics and Bioinformatics

Course Code: ZOO351

L	T	P	Credits	Marks
4	0	0	4	100

Course objectives: The course is aimed at introducing the application of bioinformatics and statistics in biology. The course gives an insight into the key concepts and methods used in bioinformatics; and computer storage, retrieval, analysis, visualization and distribution of information data related to biological macromolecules like DNA, RNA and proteins. It provides foundation on statistical methods to enable students to compute and interpret basic statistical parameters. As an interdisciplinary field it integrates biology, computer science, chemistry and statistics together sequence analysis structure analysis and functional analysis of biological data.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Know the theory behind fundamental bioinformatics analysis methods.
2. Be familiar with widely used bioinformatics databases.
3. Know basic concepts of probability and statistics.
4. Describe statistical methods and probability distributions relevant for molecular biology data.
5. Know the applications and limitations of different bioinformatics and statistical methods.
6. Perform and interpret bioinformatics and statistical analyses with real molecular biology data.
7. Acquire knowledge of various databases of proteins, nucleic acids. Primary, secondary and composite databases. BLAST, FASTA, DOT PLOT.
8. Make phylogenetic predictions or prediction of structure of proteins and nucleic acids.
9. Develop understanding in Primer designing.
10. Understand data mining tool and its practical application in a case study.
11. Apply the knowledge in future course of their career development in higher education and research.

UNIT A

13 hours

Data collection, distribution, presentation, authentication and analysis
Collection and classification of data.

Probability theory: Binomial distribution, Poisson distributions.

Measures of dispersion: Variance, Standard deviation and Standard error, Concept of Coefficient of variation.

Graphical representation of data: Pie chart, Bar diagram, Histogram, Frequency polygon. Cumulative frequency curve (Ogive), Box plot.

Measures of central tendency: Arithmetic Mean, Median, Mode.

UNIT B

13 hours

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Correlation: Types of correlation, Calculation of correlation in continuous data and ordinal data.

Regression: Linear regression, regression coefficient.

Analysis of variance (ANOVA): One way, post-hoc tests.

Hypothesis testing: Parametric tests (Paired and unpaired t-test, z-test, F-test) & Non Parametric tests (Chi-square test, Mann-Whitney U-test)

UNIT C

13 hours

Introduction and scope of bioinformatics: concept of digital laboratory. Basics of information technology, computer, operating systems, network. Concept of internet protocol (TCP/IP), hypertext, home-page, web-page and uniform resource locators (URL). Introduction to data archiving systems (FASTA format, Accession, and GINumber)

UNIT D

13 hours

Data base management: Software, packages and tools.

Basic features and management systems of following: Nucleic acid sequences databases, Genome databases, Protein sequence, structures and interacting proteins databases, Literature databases, Biodiversity and ecosystem based databases. Introduction to data retrieval systems, Search engines, Entrez, sequence retrieval system (SRS) and protein identification resource (PIR). Introduction to molecular sequence analysis software packages and tools, Prediction of motifs, folds and domains, Sequence alignments (BLAST and Clustal W) and phylogenetic trees (PHYLIP).

Applications of bioinformatics: Clinical informatics, Cheminformatic resources and pharmaco informatics.

Reference Books

1. Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences (10th edition) John Wiley.
2. Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and Health Sciences (2nd edition) McGraw Hill.
3. Zar, J.H. (2013) Biostatistical Analysis (5th edition) Pearson.
4. Barnes, M.R. and Gray, I.C. (2003) Bioinformatics for geneticists, Wiley.
5. Mount, D.W. (2006) Bioinformatics (2nd edition) CBS.

DAV UNIVERSITY, JALANDHAR

Course Name: Fundamentals of Developmental Biology and Bioinformatics Laboratory

Course Code: ZOO352

L	T	P	Credits	Marks
0	0	3	2	50

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

1. 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)
2. 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)
3. Study of the developmental stages and life cycle of *Drosophila/Tribolium*
4. Study of different sections of placenta
5. Project report on development of any insect.
6. Nucleotide sequence download from NCBI
7. Sequence Alignment tools
8. Designing of Primers for PCR
9. Phylogenetic tools

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 Name: Applied Zoology

L	T	P	Credits	Marks
4	0	0	4	100

Course Code: ZOO353

Course objectives: The course is unique in highlighting the commercial and industrial significance/value of animals. It discusses the techniques/ methods of rearing of animals for commercial usage and the prerequisites for their successful maintenance and sustenance.

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Understand the culture techniques of prawn, pearl and fish. □ Understand silkworms rearing and their products.
2. Understand the Bee keeping equipment and apiary management.
3. Understand dairy animal's management, the breeds and diseases of goats and learn the testing of egg and milk quality.
4. Learn various concepts of lac cultivation.
5. Be aware of a broad array of career options and activities in human medicine, biomedical research and allied health professions.

UNIT A

13 hours

Aquaculture:

Prawn culture: Culture of fresh water prawn; culture of marine prawn; preparation of farm. Preservation and processing of prawn. Export of prawn.

Pearl Culture, protocol followed; Fish Culture, Breeding Pond, Fish Seed, Hatching pond. Transport of fish fry to rearing ponds. Harvesting, preservation of fish. Composite fish farming. By products of fishing industry and common fish diseases.

UNIT B

13 hours

Apiculture: Species of honey bees in India. Life history of Apis. Methods of Bee keeping. Bee products and their uses. Natural enemies and their control. Morphology and Biology of honey bees; social behavior of honey bees. Bee keeping and ancillary industries. Newton's Bee hive Extraction of honey. Medicinal value of honey; bee products. Importance of bee colonies in crop pollination.

Lac culture: Lac insect and its life cycle. Cultivation of lac insect, host plants, processing and uses of lac.

Sericulture: Types of silk; Silkworms and their host plants; Mulberry silkworm culture; Life history of silkworm; Natural enemies and their control

UNIT C

13 hours

Dairy: Introduction to common dairy animals. Techniques of dairy management. Milk and milk products. Cattle Diseases.

Poultry: Types of breeds. Rearing method. Diseases and control measures. Breeds of

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fowl, Housing and Equipment, Deep litter System, Laying cages, Methods of brooding and Rearing, Debeaking. Management of growers, Layers, Broilers; Feed formulations for chicks, Diseases of fowl. Nutritive value of egg and meat. Incubation and hatching of eggs.

UNIT D

13 hours

Vermiculture: Biology of *Eisenia foetida*. Rearing of earthworms, Equipments, devices used in vermiculture, Vermicompost Technology. Methods and products, Vermiwash Collection, Composition and use. Introduction and importance. Health care and maintenance of reared animals. Methods for analysis of blood. Methods for analysis of urine. Infectious diseases. Non-infectious diseases

Reference Books

1. Shukla, G.S. and Upadhyaya, V.B. (1999-2000). Economic Zoology (Rastogi Publishers).
2. Mani, M.S. (2006). Insects, NBT, India.
3. Jabde, P.V. (2005) Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture.

DAV UNIVERSITY, JALANDHAR

Course Name: Applied Zoology Laboratory

Course Code: ZOO354

L	T	P	Credits	Marks
0	0	3	2	50

1. Morphological characterization of common fish species.
2. Identification of two major carps – Labeo rohita and Catla catla and their life cycles.
3. Mounting of the sting apparatus.
4. Castes (through charts/specimens) study of bees.
5. Worker honey bee with emphasis on leg modifications (through specimens/charts) and whole mount preparation of the 3 pairs of legs.
6. Life cycle of mulberry silkworm, Bombyx mori (model/chart/specimens) and life cycle of tasar silkworm, Antheraea mylitta.
7. External morphology and nomenclature of dairy animals. Determination of the specific gravity of milk by using a mercury lactometer.

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.

Discipline Specific Elective Courses (Semester 5 and 6)

Course Name: Principles of Wild Life Conservation and Management

L	T	P	Credits	Marks
4	0	0	4	100

Course Code: ZOO323

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

Teaching Methodology: Class room Lectures, practicals, models, charts, power point presentations, and activities.

Learning Objectives: After successfully completing this course, the students will be able to:

1. Develop an understanding of how animals interact with each other and their natural environment.
2. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.
3. Develop the ability to work collaboratively on team-based projects.
4. Demonstrate proficiency in the writing, speaking, and critical thinking skills needed to become a wildlife technician.
5. Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.
6. Develop an ability to analyze, present and interpret wildlife conservation management information

UNIT-A

13 hours

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

13 hours

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

13 hours

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.

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Management of excess population: Bio-telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

UNIT-D

13 hours

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

1. Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5 th edition. The Wildlife Society, Allen Press.
2. Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.
3. 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.
4. Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences
5. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Co-existence?* Cambridge University.

DAV UNIVERSITY, JALANDHAR

Course Name: Principles of Wild Life Conservation and Management Laboratory

L	T	P	Credits	Marks
0	0	3	2	50

Course Code: ZOO324

1. Identification of mammalian fauna, avian fauna, herpeto-fauna
2. 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)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna
5. 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.
6. 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 Name: Biology of Insecta

Course 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.

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning Objectives: After successfully completing this course, the students will be able to:

1. Understand the systematic position of Insects.
2. Understand the morphology and physiology of insects.
3. Understand the behaviour of social insects.
4. Understand the role of insects as vectors for parasitic diseases.

UNIT-A

13 hours

Introduction: General features of insects; Distribution and success of insects on the Earth.

Insect Taxonomy: Basis of insect classification; Classification of insects up to orders.

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.

UNIT-B

13 hours

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

UNIT-C

13 hours

Insect Society: Group of social insects and their social life; Social organization and social behaviour (any one example)

Insect Plant Interactions: Theory of co-evolution, role of allelochemicals in host plant mediation; Host-plant selection by phytophagous insects, Insects as plant pests

UNIT-D

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

Reference books

1. Bernays, E. A., and Chapman, R. F., Chapman and Hall, *Host Selection by Phytophagous insects*, New York, USA.

DAV UNIVERSITY, JALANDHAR

2. Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M *Introduction to the study of insects*, Saunders College Publication, USA.
3. Chapman, R. F., *The Insects: Structure and function*, Cambridge University Press, UK.
4. Gullan, P. J. , and Cranston, P. S *The Insects*, An outline of Entomology,, Wiley Blackwell, UK.
5. Imms , A. D., *A general text book of entomology*, Chapman & Hall, UK , 1977.
6. Klowden, M. J., *Physiological system in Insects*, Academic Press, USA.
7. Nation, J. L., *Insect Physiology and Biochemistry*, CRC Press, USA.
8. Snodgrass, R. E., *Principles of Insect Morphology*, Cornell Univ. Press, USA.
9. Wilson, E. O., *The Insect Societies*, Harward Univ. Press, UK

DAV UNIVERSITY, JALANDHAR

Course Name: Biology of Insecta Laboratory

Course Code: ZOO330

L	T	P	Credits	Marks
0	0	3	2	50

1. Study of one specimen from each insect order
2. Study of different kinds of antennae, legs and mouth parts of insects
3. Study of head and sclerites of any one insect
4. Study of insect wings and their venation.
5. Study of insect spiracles
6. Methodology of collection, preservation and identification of insects.
7. Morphological studies of various castes of *Apis*, *Camponotus* and *Odontotermes*
8. Study of any three insect pests and their damages
9. Study of any three beneficial insects and their products
10. 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Basic Computational Biology

Course Code: ZOO333

L	T	P	Credits	Marks
4	0	0	4	100

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

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning Objectives: After successfully completing this course, the students will be able to:

1. Learn the basic concepts of Bioinformatics.
2. Understand the biological databases.
3. Learn to use the Bioinformatics tools for research.

UNIT-A

13 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).

UNIT-B

13 hours

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).

UNIT-C

13 hours

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.

UNIT-D

13 hours

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.

Reference books

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

DAV UNIVERSITY, JALANDHAR

Course Name: Basic Computational Biology Laboratory

Course Code: ZOO334

L	T	P	Credits	Marks
0	0	3	2	50

1. Accessing biological databases.
2. Retrieval of nucleotide and protein sequences from the databases.
3. To perform pair-wise alignment of sequences (BLAST) and interpret the output.
4. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences.
5. Predict the structure of protein from its amino acid sequence.
6. To perform a “two-sample t- test” for a given set of data
7. 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.

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Course Name: Reproductive Biology

Course Code: ZOO335

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

L	T	P	Credits	Marks
4	0	0	4	100

Learning outcomes: Upon successful completion of this course, students should be able to:

1. Explain and contrast the processes of spermatogenesis, oogenesis.
2. Demonstrate an understanding of the hormonal control of reproduction in males and how this is regulated.
3. Distinguish between the main stages of embryonic, foetal and neonatal development and causes of foetal disorders.
4. Understand the origin and characteristics of common congenital malformations.
5. Know how sexually transmitted diseases may contribute to altered neonatal or reproductive function.
6. Critically assess relevant scientific literature in Human Reproductive Biology and present their argument in oral and written work.

UNIT-A

13 hours

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.

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

UNIT-C

13 hours

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

UNIT-D

13 hours

Reproductive Health: Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection,

DAV UNIVERSITY, JALANDHAR

sperm banks, frozen embryos, *in vitro* fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

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)

DAV UNIVERSITY, JALANDHAR

Course Name: Reproductive Biology Laboratory

Course 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. Ovaryectomy, 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Endocrinology

Course Code: ZOO337

L	T	P	Credits	Marks
4	0	0	4	100

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

Learning outcomes: Upon successful completion of this course, students should be able to:

1. Understand neurohormones and neurosecretions.
2. Learn about hypothalamo and hypophysial axis.
3. Understand about different endocrine glands and their disorders.
4. Understand the mechanism of hormone action.

UNIT-A 13 hours

Introduction to Endocrinology: History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

UNIT-B 13 hours

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.

UNIT-C 13 hours

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

UNIT-D 13 hours

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

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 Name: Endocrinology Laboratory

Course 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Human Physiology

Course 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.

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Understand the process of digestion and its control.
2. Develop understanding in muscle structure and contraction mechanism.
3. Learn the process of respiration and transport of gases.
4. Understand kidney structure and regulation of urine formation.
5. Understand heart structure and functioning.
6. Understand function of endocrine glands and formation of gametes.

UNIT-A 13 hours

Nutrition: Types of nutrition and nutrients; sources and functions of nutrients and the diseases associated with their excess or lesser intake.

Digestive System: Alimentary canal; Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and Hormonal control of Digestion

UNIT-B 13 hours

Respiratory System: Ventilation; External and Internal Respiration; Transport of oxygen and carbon dioxide in blood; Factors affecting transport of gases.

Circulatory System: Composition of blood; Lymph; Blood groups; Blood coagulation; Structure of heart; co-ordination of heart beat, Cardiac cycle; ECG

Excretory System: Functional anatomy of kidney; Mechanism and regulation of urine formation.

UNIT-C 13 hours

Endocrine System: Structure of pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, testes; and the diseases associated with them.

Reproductive System: Spermatogenesis; Oogenesis; Physiology of male and female reproductive systems; hormonal and neuronal control

UNIT-D 13 hours

Nervous System: Structure of Neuron; Propagation of nerve impulses (myelinated and non-myelinated nerve fibres); neuromuscular junctions

Muscular system: Structure of skeletal muscle, Mechanism of muscle contraction (sliding filament theory)

Reference books

DAV UNIVERSITY, JALANDHAR

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., 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Human Physiology Laboratory

Course 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.

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 Name: Genetic Engineering and Biotechnology

Course Code: ZOO358

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives: This course gives an insight into the direct manipulation of DNA to alter the characteristics of an organism in a particular way. It envisages concepts, mechanisms, biological designs, functions and evolutionary significance of genetic modification or manipulation in special organisms and also discusses the recent advance in recombinant DNA technology.

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop an understanding of the fundamental molecular tools and their applications of DNA modification and cloning.
2. Appreciate shifting their orientation of learning from a descriptive explanation of biology to a unique style of learning through graphic designs and quantitative parameters to realize how such research and innovations have made science interdisciplinary and applied.
3. Develop future course of their career development in higher education and research with a sound base.
4. Apply their knowledge with problem solving approach to recommend strategies of genetic engineering for possible applications in Biotechnology and allied industry.

UNIT A

13 hours

Introduction to Genetic Engineering and Biotechnology: Enzymes as Tools for Genetic Engineering: Restriction Enzymes, Restriction-Modification System, DNA-modifying enzymes, T4 and E. coli DNA Polymerase (Klenow), DNA-methylase, Polynucleotide Kinase, DNA-ligase, Taq DNA polymerase, Reverse Transcriptase, T7 and T3 RNA polymerases. Vehicles for DNA cloning: Plasmid DNA vectors, bacteriophage lambda derived vectors.

UNIT B

13 hours

Recombination and cloning DNA (Gene) cloning, recombinant DNA, cDNA library, genomic library. Isolation of gene from gene library. Screening and identification of recombinant DNA clone from gene library. Expression of recombinant protein from a DNA clone in bacteria and purification of the protein. Some examples of the useful recombinant proteins: Insulin, Streptokinase, enzymes, antibodies, vaccines.

UNIT C

13 hours

Polymerase Chain Reaction (PCR) and Site-directed, Restriction enzyme digestion. Transgenic animals, Ligation, Cloning, Transformation, Calculation of transformation efficiency. Mutagenesis. Recent trends in Gene technology. Gene Targeting: Knock-ins and Knock-outs. Targeted Genome Editing: ZFNs, TALENs, and CRISPRs etc.

UNIT D

13 hours

Genomic studies: ethical issues in genetic engineering DNA Sequencing and Genome Analysis, Model Genomes. Human Genome Project and Human Genome Sequences. Applications of Genetic Engineering and Biotechnology in agriculture, medicine and its economic and social implications, Ethical precautions.

Reference Books

1. Primrose, S.B. and Twyman, R. (2006) Principles of Gene manipulation and Genomics (7th edition) Blackwell Publishing.
2. Nicholl, D.S.T. (2008) An introduction to Genetic Engineering (3rd edition) Cambridge University Press.
3. Watson, J.D. (2006) Recombinant DNA (3rd edition) Cold Spring Harbor Laboratory Press.
4. Brown, T.A. (2001) Gene Cloning and DNA Analysis: An Introduction.
5. A PBS Documentary entitled, "Playing God" [History of Genetic Engineering].

DAV UNIVERSITY, JALANDHAR

**Course Name: Genetic Engineering and Biotechnology
Laboratory**

Course Code: ZOO359

L	T	P	Credits	Marks
0	0	3	2	50

1. Video-graphic demonstrations on the above mentioned topics.
2. Models and Presentations by students on the topics: Microbial degradation of waste materials, Antibiotics from microorganisms, Transgenic Tomato and Rice, Recombinant Interferon, Growth Hormone, Insulin, Colony Stimulating Factor, Streptokinase, Industrial Enzymes.
3. Restriction enzyme digestion.
4. Separation of molecules using electrophoresis, Cloning.
5. Transformation, Calculation of transformation efficiency.
6. Group discussion or Seminar presentation.

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 Name: Basics of Fish and Fisheries

Course 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.

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: After completing this course the learners will be able to:

1. Understand the aquaculture systems.
2. Understand conditioning factors and how they can be manipulated.
3. Describe water depuration mechanisms.
4. Understand the environmental impacts of aquaculture

UNIT-A 13 hours

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.

UNIT-B 13 hours

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

UNIT-C 13 hours

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

UNIT-D 13 hours

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

Fish in research: Transgenic fish, Zebrafish as a model organism in research

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
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.

DAV UNIVERSITY, JALANDHAR

Course Name: Basics of Fish and Fisheries Laboratory

Course Code: ZOO328

L	T	P	Credits	Marks
0	0	3	2	50

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

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.

Skill enhancement courses (Semester 6)

Course Name: Apiculture

Course Code: ZOO225

L	T	P	Credits	Marks
4	0	0	4	100

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

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: Upon successful completion of this course, the student should be able to:

1. Explain what the prerequisite to get started in beekeeping are.
2. Describe the laws around beekeeping in Vancouver.
3. Discuss the responsibilities of urban beekeepers.
4. Identify where to purchase equipment and demonstrate how to assemble it.
5. Name and identify major parts of the honeybee such as the stinger or mandibular parts.
6. Describe bee biology and anatomy from the perspective of managing bees.
7. Describe the importance of wax and identify what to look for in comb during hive inspections

UNIT-A

13 hours

Introduction: History of Bees and Beekeeping, Systematics, Bee species, Bee morphology, Colony organization, Polymorphism, Caste system, Division of labour, Bee flora, Foraging and Honey flow periods.

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

13 hours

Apiary management: Routine management, Seasonal management, Migratory beekeeping, Harvesting and marketing of bee products.

Important Institutions pertinent to Apiculture: National Bee Board, Bee research and Training Institute, Apiaries. Economics and extension of Bee keeping.

Diseases and Enemies: Bee Diseases-brood diseases; Bacterial, viral, protozoan and fungal. Enemies of honey bee: Greater wax moth, ants, wasps etc.

UNIT-C

13 hours

Bee Economy: Purchase of a colony, the Apiary site, how to manage a colony, the manipulation of a colony. Bee products: Honey, Bees wax, Pollens, Royal Jelly, Propolis and Bee venom. taking care of bee diseases and enemies. Establishment of a colony. Bee flora and planned pollination services.

UNIT-D

13 hours

Entrepreneurship in Apiculture: Extent of Beekeeping in India, Limitations on the development of beekeeping, Advantages of extensive Beekeeping. Beekeeping equipment: Bee box and tools and initiation into keeping a colony, the future of beekeeping.

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.

DAV UNIVERSITY, JALANDHAR

Course Name: Aquarium Fish Keeping

Course Code: ZOO226

L	T	P	Credits	Marks
4	0	0	4	100

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

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: After completing this course the learners will be able to:

1. To learn the scientific method of setting an aquarium.
2. To learn the culture breeding and marketing techniques of common indigenous ornamental fishes

UNIT-A

16 hours

Designing and preparation of aquaria with all accessories: Importance and history of aquarium fish keeping.

Design and construction of aquaria: aquarium fabrication- shape, size, volume, type of glass tank, cutting of glass, preparation of glass tank, strengthening and supporting of tank, fitting of tanks into room settings; aquarium floor setting – type and size of pebbles, gravels, granites used for bed setting and its advantages. Filters- biological, chemical and mechanical.

UNIT-B

16 hours

Aquarium accessories like aerators, decorative, lighting, heating and feeding trays. Water quality management in aquarium systems – sources of water, containers, storage, temperature, pH, dissolved carbon dioxide, ammonia, hardness, turbidity and ozone in aquarium. Aquarium plants: Uses of aquarium plants, different varieties of plants like submerged plants (tubers, rooted plants, cutting plants) and emerged plants.

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. Exotic and Endemic species of Aquarium Fishes

UNIT-C

10 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

10 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Sericulture

Course Code: ZOO227

L	T	P	Credits	Marks
4	0	0	4	100

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

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: Upon successful completion of this course, the student should be able to:

1. Generation of skilled man power in the field of sericulture.
2. To impart training in extension management and transfer of technology.
3. To impart training in Post Cocoon Technology.
4. To provide field exposure

UNIT-A

13 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: Mulberry and non-mulberry Sericulture. Biology of silkworm. Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances. Silkworm rearing technology: Early age and Late age rearing Selection of silkworm races/breeds for rearing. Incubation- definition, requirement of environmental conditions, incubation devices; identification of stages of development; black boxing and its importance.

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

16 hours

Diseases of silkworm: Disinfectants: Formalin, bleaching powder RKO. Types of mountages, Spinning, harvesting and storage of cocoons. Introduction; classification of silkworm diseases.

Protozoan disease: symptomatology due to Nosema bombycis infection, source, mode of infection and transmission, cross infectivity, prevention and control.

Bacterial, Viral, Fungal diseases: causative agents, symptoms, transmission prevention and control.

UNIT-D

10 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 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Medical Diagnostics

Course Code: ZOO232

L	T	P	Credits	Marks
4	0	0	4	100

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

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: Upon successful completion of this course, the student should be able to:

1. Learn about different serological tests.
2. Learn about molecular diagnosis methods.
3. Learn about different urine analysis techniques.

UNIT-A 13 hours

Introduction to Medical Diagnostics and its Importance.

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.).

Serological tests: ELISA, IFA, Immunodiffusion, Immunoblotting.

UNIT-B 10 hours

Diagnostic Methods Used for Urine Analysis: Urine Analysis: Physical characteristics; Abnormal constituents, Biochemical testing.

UNIT-C 13 hours

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

UNIT-D 16 hours

Infectious Diseases: Types, causes, symptoms, diagnosis and prevention of Tuberculosis, Malaria, Leishmaniasis and Hepatitis.

Tumours: Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

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*

DAV UNIVERSITY, JALANDHAR

Course Name: Research Methodology
Course Code: ZOO233

L	T	P	Credits	Marks
4	0	0	4	100

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

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: At the end of the course the students will be able to:

1. Understand the concept of research and different types of research in the context of biology.
2. Have basic awareness of data analysis-and hypothesis testing procedures.
3. Develop laboratory experiment related skills.
4. Have basic knowledge on qualitative research techniques.
5. Develop competence on data collection and process of scientific documentation.
6. Analyze the ethical aspects of research.
7. Evaluate the different methods of scientific writing and reporting

UNIT-A

13 hours

Basic Concepts of Research: Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

UNIT-B

13 hours

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.

UNIT-C

13 hours

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.

UNIT-D

13 hours

Ethical Issues and Art of Scientific Writing: Authors, acknowledgements, reproducibility, plagiarism, Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Power-point presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

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

DAV UNIVERSITY, JALANDHAR

Course Name: Aquaculture

Course Code: ZOO361

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives: This course will give the students an understanding of the principles of aquaculture, including production systems, water quality, nutrition, spawning, larval culture and culture methodologies with special reference to fish, and prawn. The course will include an opportunity to conduct hands-on activities related to culture and husbandry of animals.

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: After completing this course the learners will be able to:

1. Understand the aquaculture systems.
2. Understand conditioning factors and how they can be manipulated.
3. Describe water depuration mechanisms.
4. Understand the environmental impacts of aquaculture

Unit A

13 hours

Culture systems: Freshwater prawn culture, fish culture in paddy fields, Brackish water culture.

Mari culture: Oyster culture, Crab culture, Lobster culture, mussel culture, culture of Eels, Culture of aquatic weeds.

Composite fish culture: Definition and various patterns. Mixed fish farming in India. Techniques of composite culture. Culture of buffalo fish. Culture of Catfishes. Culture of miscellaneous fishes. Cray fish culture.

Unit B

13 hours

Nursery ponds: Predatory and Weed fishes and their control. Fish toxicants. Fertilization. Aquatic insects and their control. Fish food organisms and their production. Supplementary feeding. Transport of fish seed and Brood fish. Causes of mortality in transport. Methods for packaging and transport. Open systems. Closed systems. Use of chemicals in live fish transport. Anesthetic drugs. Antiseptics and Antibiotics.

Unit C

Fish pathology: Parasitic infections, Fungus infections. Protozoan diseases: suryodata; Worm diseases, Non parasitic diseases. Rearing ponds, Stocking ponds.

Fish breeding: Natural and artificial.

Harvesting: Fishing techniques, preservation & processing of fish. Fresh water prawn culture. Introduction. Breeding characteristics. Juvenile prawn migration. Seasonal & regional distribution of seeds. Identification of juveniles. Controlled

breeding.

Culture: Ponds, Monoculture. Mixed culture.

UNIT D

13 hours

Technologies in Fisheries development: Role of hard water in culture of Macro brachium species.

Fertilization & feeds. Pearl culture: Introduction, Pearl producing mollusks, pearl formation, collection of oysters, Rearing of oysters, insertion of nucleus, harvesting of pearls, composition & quality of pearl. Recirculation technology, Geographic Information System (GIS) technology, passive Acoustics in fisheries, Use of Information Communication Technology (ICT) in fishes: production aspects, marketing aspects.

Reference Books

1. Jingran, V. G. (1983) Fish and fisheries of India , Hindustan pub. corp. New Delhi.
2. Hute, M. and Kahn, H. (2000) Textbook of fish culture, Blackwell Scientific Publication, Australia.
3. Srinivasulu, M., Reddy, K.R.S., Rao, S. (1999) Text book of Aquaculture, Discovery Publishing House New Delhi.
4. Yawn Mehta, Fisheries & Aquaculture Biotechnology (2011) Campus Books International, Prahalad street, Ansari Road, Durga Ganj, New Delhi.

DAV UNIVERSITY, JALANDHAR

Course Code: BCH101

Course Name: 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.

DAV UNIVERSITY, JALANDHAR

Course Code: BCH102

Course Name: 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Metabolism

Course 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 Name: Metabolism Laboratory

Course 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.

Courses offered to other Departments

SEMESTER 1

Course Name: Animal Diversity I

Course 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.

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop understanding on the diversity of life with regard to non-chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen.

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.

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UNIT-D

Mollusca: torsion and detorsion

15 hours

Echinodermata: water vascular system and larval forms.

Hemichordata: affinities with invertebrates and vertebrates, Test or tunic, Endoskeleton and Larval forms

Reference books:

1. Dhama, P.S. and Dhama, 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 Name: Animal Diversity I

Laboratory

Course 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*

Hemichordata: *Balanoglossus*

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.

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Course Name: Animal Diversity II

Course 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.

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop understanding on the diversity of life with regard to chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
5. Understand how morphological change due to change in environment helps drive evolution over a long period of time.

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
Urochordata: development, affinities, retrogressive metamorphosis.	
Cephalochordata: development, affinities.	5 hours
	5 hours

UNIT-B

Cyclostomata: affinities with protochordate and Vertebrate, migration.	5 hours
Chondrichthyes: Scale	5 hours
Osteichthyes: 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.

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Mammals: Integument, Dentition, Respiration, Reproduction

10 hours

Reference books

1. Dhami, P.S., Dhami, J.K., Chordate Zoology, 5th ed., R. Chand & Co., New Delhi, 2006.
2. Kotpal, R.L., Text Book of Zoology- Vertebrates, Rastogi Publications, Meerut, 2012.
3. 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.
4. Dodson, E.O., A Text Book of Zoology, CBS Publishers & Distributors, Delhi, 1976.

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Course Name: Animal Diversity II Laboratory

Course Code: ZOO104

L	T	P	Credits	Marks
0	0	3	2	50

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

- Protochordata - *Herdmania*, pharynx and spicules of *Herdmania* and *Branchiostoma*, T.S. *Branchiostoma* through different regions
- Cyclostomata – *Myxine*, *Petromyzon* and *Ammocoetes* larva.
- Chondrichthyes - *Zygaena*, *Pristis* and *Trygon*.
- Osteichthyes: Protopterus, lungfish, *Polypterus*, *Amia*, *Labeo rohita*, *Hippocampus*, *Syngnathus*, *Exocoetus*, *Diodon*, *Echeneis* and *Anguilla*.
- 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*, *Crocodylus*, *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

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 Name: Zoo diversity

Course 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.

Teaching Methodology: Classroom lectures, practicals, models, charts, PowerPoint presentations and activities.

Learning outcomes: After successfully completing this course, the students will be able to:

1. Develop understanding on the diversity of life with regard to protists, non-chordates and chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
5. Understand how morphological change due to change in environment helps drive evolution over a long period of time.

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

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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

1. Kotpal, R.L., Modern Text Book of Zoology Invertebrates, 10th ed., Rastogi Publishers, Meerut, 2012.
2. Kotpal, R.L., Minor phyla, 5th ed., Rastogi Publishers, Meerut, 2006.
3. Dhama, P.S. and Dhama, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.
4. 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.
5. Hyman L.H. The Invertebrates. Vol. I, II, III, IV and V. McGraw Hill Book Company. Inc., New York. London. Toronto, 1959.
6. Barnes, R.D. Invertebrate Zoology. Saunders College Pub. USA., 1992.
7. Ruppert, Fox and Barnes. Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole , 2006.
8. Campbell and Reece . Biology, Pearson Education, (Singapore) Pvt. Ltd, 2005
9. Kardong, K. V. Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi, 2002.
10. Raven, P. H. and Johnson, G. B. Biology, 6th edition, Tata McGraw Hill Publications. New Delhi, 2004.

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Course Name: Zoo diversity Laboratory

Course 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

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.

Ability Enhancement Compulsory Courses

Course Name: 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)

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(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:

- a. **Grammar:** Grammar must be taught descriptively in socio-cultural context. The contextual teaching of grammar helps a learner understand the application of grammar

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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.

- 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.

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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.
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 Name: 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/>

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Course Name: Environmental Studies

Course 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 Name: Human Values and General Studies

Course Code: SGS107

L	T	P	Cr.
4	0	0	4

Course Objectives

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

Part - A

Human Values

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

Being Good and Responsible

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

Part - B

Value – based living

- Vedic values of life **2 Hrs**
- Karma Yoga* and *Jnana Yoga* **2 Hrs**
- 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.

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 Name: 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: 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 Name: 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 Name: 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 Alexader: *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 Name: 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 Name: Biochemical Correlations in Diseases

Course 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 Name: Biochemical Correlations in Diseases
Laboratory
Course 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 Name: 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.

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Course Code: BOT242

**Course Name: 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 Name: Gene Organization, Expression and Regulation

Course 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

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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 Name: Gene Organization, Expression and Regulation Laboratory
Course 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.

L	T	P	Credit
4	0	0	4

Course Code: CHE257

Course Name: General Chemistry – II

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 Name: 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)

DAV UNIVERSITY, JALANDHAR

Course Name: Biology of Insecta

Course 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.

Learning Objectives: After successfully completing this course, the students will be able to:

UNIT-A 13 hours

Introduction: General features of insects; Distribution and success of insects on the Earth.

Insect Taxonomy: Basis of insect classification; Classification of insects up to orders.

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.

UNIT-B 13 hours

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

UNIT-C 13 hours

Insect Society: Group of social insects and their social life; Social organization and social behaviour (any one example)

Insect Plant Interactions: Theory of co-evolution, role of allelochemicals in host plant mediation; Host-plant selection by phytophagous insects, Insects as plant pests

UNIT-D

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

Reference books

10. Bernays, E. A., and Chapman, R. F., Chapman and Hall, *Host Selection by Phytophagous insects*, New York, USA.
11. Borror, D. J., Triplehorn, C. A., and Johnson, N. F., *M Introduction to the study of insects*, Saunders College Publication, USA.

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12. Chapman, R. F., *The Insects: Structure and function*, Cambridge University Press, UK.
13. Gullan, P. J. , and Cranston, P. S *The Insects*, An outline of Entomology,, Wiley Blackwell, UK.
14. Imms , A. D., *A general text book of entomology*, Chapman & Hall, UK , 1977.
15. Klowden, M. J., *Physiological system in Insects*, Academic Press, USA.
16. Nation, J. L., *Insect Physiology and Biochemistry*, CRC Press, USA.
17. Snodgrass, R. E., *Principles of Insect Morphology*, Cornell Univ. Press, USA.
18. Wilson, E. O., *The Insect Societies*, Harward Univ. Press, UK

DAV UNIVERSITY, JALANDHAR

Course Name: Biology of Insecta Laboratory

Course Code: ZOO330

L	T	P	Credits	Marks
0	0	3	2	50

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

DAV UNIVERSITY, JALANDHAR

Course Name: Basic Computational Biology

Course 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 Name: Basic Computational Biology Laboratory

Course 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 Name: Reproductive Biology

Course 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

5. Drickamer & Vessey: *Animal Behaviour, Concepts, Processes and Methods* (Wadsworth)
6. Grier: *Biology of animal behaviour* (Mosby College)
7. Immelmann: *Introduction to Ethology* (Plenum Press)

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8. McFarland: *Animal Behaviour, Psychology, Ethology and Evolution* (Pitman)

Course Name: Reproductive Biology Laboratory

Course 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. Ovaryectomy, 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Endocrinology

Course 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

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

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Course Name: Endocrinology Laboratory

Course 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Human Physiology

Course 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

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

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Cambridge University Press, 1983.

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

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Course Name: Human Physiology Laboratory
Course 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Basics of Fish and Fisheries

Course 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

6. C.B.L. Srivastava, *Fish Biology*, Narendra Publishing House
7. 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

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8. J.R. Norman, *A history of Fishes*, Hill and Wang Publishers
9. Q Bone and R Moore, *Biology of Fishes*, Talyor and Francis Group, CRC Press, U.K.
10. S.S. Khanna and H.R. Singh, *A text book of Fish Biology and Fisheries*, Narendra Publishing House.

DAV UNIVERSITY, JALANDHAR

Course Name: Basics of Fish and Fisheries Laboratory

Course Code: ZOO328

L	T	P	Credits	Marks
0	0	3	2	50

21. Morphometric and meristic characters of fishes
 22. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
 23. Study of different types of scales (through permanent slides/ photographs).
 24. Study of crafts and gears used in Fisheries
 25. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
 26. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
 27. Demonstration of induced breeding in Fishes (video)
 28. 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.

ZOO358

Genetic Engineering and Biotechnology

About the course

This course gives an insight into the direct manipulation of DNA to alter the characteristics of an organism in a particular way. It envisages concepts, mechanisms, biological designs, functions and evolutionary significance of genetic modification or manipulation in special organisms and also discusses the recent advance in recombinant DNA technology.

Learning outcomes

After successfully completing this course, the students will be able to: □ Develop an understanding of the fundamental molecular tools and their applications of DNA modification and cloning. □ Appreciate shifting their orientation of learning from a descriptive explanation of biology to a unique style of learning through graphic designs and quantitative parameters to realize how such research and innovations have made science interdisciplinary and applied. □ Develop future course of their career development in higher education and research with a sound base. □ Apply their knowledge with problem solving approach to recommend strategies of genetic engineering for possible applications in Biotechnology and allied industry.

Theory

UNIT I: Scope of genetic engineering 13 Lectures

Introduction to Genetic Engineering and Biotechnology. Enzymes as Tools for Genetic Engineering: Restriction Enzymes, Restriction-Modification System, DNA-modifying enzymes, T4 and E. coli DNA Polymerase (Klenow), DNA-methylase, Polynucleotide Kinase, DNA-ligase, Taq DNA polymerase, Reverse Transcriptase, T7 and T3 RNA polymerases. Vehicles for DNA cloning: Plasmid DNA vectors, bacteriophage lambda derived vectors.

88

UNIT II: Recombination and cloning 13 Lectures DNA (Gene) cloning, recombinant DNA, cDNA library, genomic library. Isolation of gene from gene library. Screening and identification of recombinant DNA clone from gene library. Expression of recombinant protein from a DNA clone in bacteria and purification of the protein. Some examples of the useful recombinant proteins: Insulin, Streptokinase, enzymes, antibodies, vaccines. **UNIT III: Recent advances in gene technology 13 Lectures**

Polymerase Chain Reaction (PCR) and Site-directed, Restriction enzyme digestion. Transgenic animals, Ligation, Cloning, Transformation, Calculation of transformation efficiency. Mutagenesis. Recent trends in Gene technology. Gene Targeting: Knock-ins and Knock-outs. Targeted Genome Editing: ZFNs, TALENs, CRISPRs etc.

UNIT IV: Genomic studies; ethical issues in genetic engineering 13 Lectures DNA Sequencing and Genome Analysis, Model Genomes. Human Genome Project and Human Genome Sequences. Applications of Genetic Engineering and Biotechnology in agriculture, medicine and its economic and social implications, Ethical precautions.

Recommended readings

- 1. Primrose, S.B. and Twyman, R. (2006) Principles of Gene manipulation and Genomics (7th edition) Blackwell Publishing.**
- 2. Nicholl, D.S.T. (2008) An introduction to Genetic Engineering (3rd edition) Cambridge University Press.**
- 3. Watson, J.D. (2006) Recombinant DNA (3rd edition) Cold Spring Harbor Laboratory Press.**
- 4. Brown, T.A. (2001) Gene Cloning and DNA Analysis: An Introduction.**
- 5. A PBS Documentary entitled, "Playing God" [History of Genetic Engineering]**

**Practical
ZOO359**

Genetic Engineering and Biotechnology Laboratory

- 1. Video-graphic demonstrations on the above mentioned topics.**
 - 2. Models and Presentations by students on the topics: Microbial degradation of waste materials, Antibiotics from microorganisms, Transgenic Tomato and Rice,**
- 89**

Recombinant Interferon, Growth Hormone, Insulin, Colony Stimulating Factor, Streptokinase, Industrial Enzymes. 3. Restriction enzyme digestion. 4. Separation of molecules using electrophoresis, Cloning. 5. Transformation, Calculation of transformation efficiency.

Group discussion or Seminar presentation on one or t

Skill enhancement courses

Course Name: Apiculture

Course 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:

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

DAV UNIVERSITY, JALANDHAR

Course Name: Aquarium Fish Keeping

Course 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:

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

DAV UNIVERSITY, JALANDHAR

Course Name: Sericulture

Course 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:

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

DAV UNIVERSITY, JALANDHAR

Course Name: Medical Diagnostics

Course 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*

DAV UNIVERSITY, JALANDHAR

Course Name: Research Methodology
Course 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

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

DAV UNIVERSITY, JALANDHAR

Zoo361 aquaculture

About the course This course will give the students an understanding of the principles of aquaculture, including production systems, water quality, nutrition, spawning, larval culture and culture methodologies with special reference to fish, and prawn. The course will include an opportunity to conduct hands-on activities related to culture and husbandry of animals

Learning outcomes After completing this course the learners will be able to understand the aquaculture systems Understand conditioning factors and how they can be manipulated Describe water depuration mechanisms Understand the environmental impacts of aquaculture

Unit I : Freshwater aquaculture systems

13 Lectures

Aquaculture concept, Culture systems: Freshwater prawn culture, fish culture in paddy fields, Brackish water culture, Mariculture: Oyster culture, Crab culture, Lobster culture, mussel culture, culture of Eels, Culture of aquatic weeds. Composite fish culture: Definition and various patterns. Mixed fish farming in India. Techniques of composite culture. Culture of buffalo fish ..Culture of Catfishes. Culture of miscellaneous fishes. Cray fish culture.

Unit II: Preparation and management of fish culture ponds

13 Lectures

Nursery ponds. Predatory and Weed fishes and their control. Fish toxicants. Fertilization. Aquatic insects and their control. Fish food organisms and their production. Supplementary feeding. Transport of fish seed and Brood fish. Causes of mortality in transport. Methods for packaging and transport. Open systems. Closed systems. Use of chemicals in live fish transport. Anesthetic drugs. Antiseptics and Antibiotics.

Unit III: Fish pathology

13 Lectures

Parasitic infections. Fungus infections. Protozoan diseases.suryodata; Worm diseases. Non parasitic diseases. Rearing ponds, Stocking ponds. Fish breeding: Natural and artificial. Harvesting: Fishing techniques, preservation & processing of fish. Fresh water prawn culture. Introduction. Breeding characteristics. Juvenile prawn migration. Seasonal & regional distribution of seeds. Identification of juveniles. Controlled breeding. Culture: Ponds, Monoculture. Mixed culture.

Unit IV: Technologies in Fisheries development

13 Lectures

Role of hard water in culture of Macrobrachium species. Fertilization & feeds. Pearl culture: Introduction, Pearl producing mollusks, pearl formation, collection of oysters, Rearing of oysters, insertion of nucleus, harvesting of pearls, composition & quality of pearl. Recirculation technology, Geographic Information System (GIS) technology, passive Acoustics in fisheries, Use of Information Communication Technology (ICT) in fishes: production aspects, marketing aspects.

Recommended readings I. Jingran, V. G. (1983) Fish and fisheries of India , Hindustan pub. corp. New Delhi. 2. Hute, M. and Kahn, H. (2000) Textbook of fish culture, Blackwell Scientific Publication, Australia. 3. Srinivasulu, M., Reddy, K.R.S., Rao, S. (1999) Text book of Aquaculture, Discovery Publishing House New Delhi. 4. Yawn Mehta, Fisheries & Aquaculture Biotechnology (2011) Campus Books International, Prahalad street, Ansari Road, Durga Ganj, New Delhi.

DAV UNIVERSITY, JALANDHAR

Course Code: BCH101

Course Name: 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

DAV UNIVERSITY, JALANDHAR

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.

DAV UNIVERSITY, JALANDHAR

Course Code: BCH102

Course Name: 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.

Course Name: Metabolism

Course 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 Name: Metabolism Laboratory

Course 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.

DAV UNIVERSITY, JALANDHAR

SEMESTER 5

Courses offered to other Departments

SEMESTER 1

Course Name: Animal Diversity I

Course 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.
- **Hemichordata:** affinities with invertebrates and vertebrates, Test or tunic, Endoskeleton and Larval forms

Reference books:

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

Course Name: Animal Diversity I

Laboratory

Course 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*
- **Hemichordata:** *Balanoglossus*

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 Name: Animal Diversity II

Course 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**
- Urochordata: development, affinities, retrogressive metamorphosis. **5 hours**
- Cephalochordata: development, affinities. **5 hours**

UNIT-B

- Cyclostomata: affinities with protochordate and Vertebrate, migration. **5 hours**
- Chondrichthyes: Scale **5 hours**
- Osteichthyes: 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Animal Diversity II Laboratory

Course Code: ZOO104

L	T	P	Credits	Marks
0	0	3	2	50

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

- Protochordata - *Herdmania*, pharynx and spicules of *Herdmania* and *Branchiostoma*, T.S. *Branchiostoma* through different regions
- Cyclostomata – *Myxine*, *Petromyzon* and *Ammocoetes* larva.
- Chondrichthyes - *Zygaena*, *Pristis* and *Trygon*.
- Osteichthyes: Protopterus, lungfish, *Polypterus*, *Amia*, *Labeo rohita*, *Hippocampus*, *Syngnathus*, *Exocoetus*, *Diodon*, *Echeneis* and *Anguilla*.
- 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*, *Crocodylus*, *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 Name: Zoodiversity

Course 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Zoodiversity

Course Code: ZOO155

L	T	P	Credits	Marks
0	0	3	2	50

4. 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.*

5. Study of insect and amphibian metamorphosis

6. Study of the following through e-resources:

- Digestive system of Cockroach.
- Digestive system of Rat

Ability Enhancement Compulsory Courses

Course Name: 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

2. Applied Grammar (in Socio-Cultural Context)

- Tenses
- Passives
- Reported/Reporting Speech

Unit – B

3. Reading (Communicative Approach to be Followed)

- Nissim Ezekiel : The Patriot (Poem)

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

4. 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

2. 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

3. Reading (Communicative Approach to be Followed)

Alleen Pace Nilsen: Sexism in English (Prose)

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

4. Writing

Letter Writing: Formal and Informal

Teaching Methodology:

- d. **Grammar:** Grammar must be taught descriptively in socio-cultural context. The contextual teaching of grammar helps a learner understand the application of grammar

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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.

- e. **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.

- f. **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:

e. Books

20. Eschholz, Paul and Rosa, Alfred (ed.), *Subject and Strategy*. NY: St. Martin's Press, 1978. Print.
21. Ezekiel, Nissim. *Collected Poems 1952-1988*. New Delhi: Oxford University Press, 1999. Print.
22. Hosler, Mary Margaret. *English Made Easy*. Delhi: McGraw, 2013. Print.
23. Koneru, Aruna. *Professional Communication*. Delhi: McGraw, 2008. Print.

DAV UNIVERSITY, JALANDHAR

24. Mahanand, Anand. *English for Academic and Professional Skills*. Delhi: McGraw, 2013. Print.
25. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. *A Workbook on English Grammar and Composition*. Delhi: McGraw, 2016. Print.
26. Rizvi, M. Ashraf. *Effective Technical Communication*. Delhi: McGraw, 2018. Print.
27. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. Delhi: McGraw, 2013. Print.
28. Tyagi, Kavita and Padma Misra. *Basic Technical Communication*. Delhi: PHI Learning, 2013. Print.

f. Websites

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

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Course Name: 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

g. Books

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

h. Websites

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

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Course Name: Environmental Studies

Course 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 Name: Human Values and General Studies

Course Code: SGS107

L	T	P	Cr.
4	0	0	4

Course Objectives

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

Part - A

Human Values

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

Being Good and Responsible

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

Part - B

Value – based living

4. Vedic values of life **2 Hrs**
5. *Karma Yoga* and *Jnana Yoga* **2 Hrs**
6. *Ashta Marga* and *Tri-Ratna* **2 Hrs**

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Ethical Living:

- | | |
|------------------------|-------|
| 4. Personal Ethics | 2 Hrs |
| 5. Professional Ethics | 3 Hrs |
| 6. 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:

24. Human Values, A N Tripathi, New Age International Publishers, New Delhi, Third Edition, 2009
25. Professional Ethics, R. Surbhiramanian, Oxford University Press, New Delhi, 2013.
26. Human Values and Professional Ethics, Rishabh Anand, Satya Prakashan, New Delhi, 2012
27. Human Values and Professional Ethics, Sanjeev Bhalla, Satya Prakashan, New Delhi, 2012.
28. Human Values and Professional Ethics, Ritu Soryan Dhanpat Rai & Co. Pvt. Ltd., First Edition, 2010.
29. Human Values and Professional Ethics by Suresh Jayshree, Raghavan B S, S Chand & Co. Ltd. , 2007.
30. Human Values and Professional Ethics, Yogendra Singh, Ankur Garg, Aitbs publishers, 2011.
31. Human Values and Professional Ethics, Vrinder Kumar, Kalyani Publishers, Ludhiana, 2013.

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32. Human Values and Professional Ethics, R R Gaur, R. Sangal, GP Bagaria, Excel Books, New Delhi 2010.
33. Values and Ethics, Dr. Bramwell Osula, Dr. Saroj Upadhyay, Asian Books Pvt. Ltd., 2011.
34. Indian Philosophy, S. Radhakrishnan, George Allen & Unwin Ltd., New York: Humanities Press INC, 1929.
35. Essentials of Hinduism, Jainism and Buddhism, A N Dwivedi, Books Today, New Delhi – 1979
36. Dayanand : His life and work, Suraj Bhan, DAVCMC, New Delhi – 2001.
37. Esence of Vedas, Kapil Dev Dwivedi, Katyayan Vedic Sahitya Prakashan, Hoshiarpur, 1990.
38. Vedic Concepts, Prof. B B Chaubey, Katyayan Vedic Sahitya Prakashan, Hoshiarpur, 1990.
39. Advance Objective General Knowledge, R. S. Aggarwal, S. Chand Publisher (2013)
40. Concise General Knowledge Manual 2013, S. Sen, Unique Publishers,2013
41. Encyclopedia of General Knowledge and General Awareness by R P Verma, Penguin Books Ltd (2010)
42. General Knowledge Manual 2013-14, Edgar Thorpe and Showick Thorpe, The Pearson, Delhi.
43. General Knowledge Manual 2013-14, Mukhtikanta Mohanty, Macmillan Publishers India Ltd., Delhi.
44. India 2013, Government of India (Ministry of Information Broadcasting), Publication Division, 2013.
45. Manorama Year Book 2013-14, Mammen Methew, Malayalam Manorama Publishers, Kottayam, 2013.
46. 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.

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 Name: 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

L	T	P	Credit
0	0	3	2

Course Name: Introduction to Microbiology Laboratory

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 Name: 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 Name: 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 Name: Biochemical Correlations in Diseases

Course 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.

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**Course Name: Biochemical Correlations in Diseases
Laboratory
Course 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.

DAV UNIVERSITY, JALANDHAR

Course Code: BOT241

L	T	P	Credit
4	0	0	4

Course Name: 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 Name: 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.

DAV UNIVERSITY, JALANDHAR

Course Name: Gene Organization, Expression and Regulation

Course 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

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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.

DAV UNIVERSITY, JALANDHAR

Course Name: Gene Organization, Expression and Regulation Laboratory
Course 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.

L	T	P	Credit
4	0	0	4

Course Code: CHE257

Course Name: General Chemistry – II

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).

DAV UNIVERSITY, JALANDHAR

Course Code: CHE258

Course Name: 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)