List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

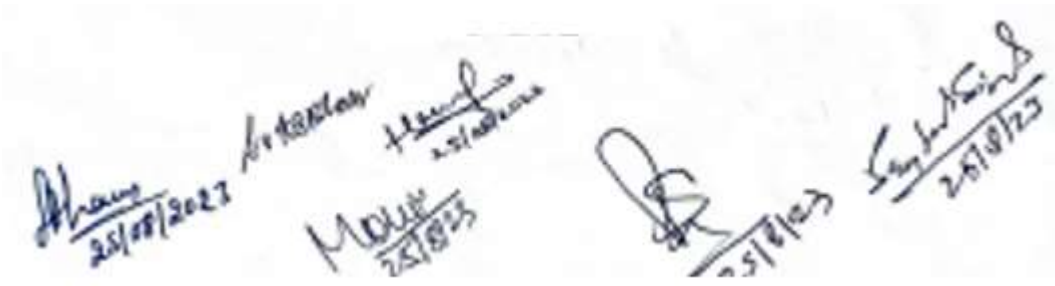
Department : *Zoology*

Programme Name : *B. Sc*

Academic Year : 2023-24

List of Courses Focus on Employability/ Entrepreneurship/Skill

Sr. No.	Course Code	Name of the Course
01.	Minor course	Animal diversity of non-chordates (Protista to Pseudocoelomate)
02.	SEC	Aquaculture
03.	Minor course	Animal diversity of non-chordates (Coelomates)
04.	SEC	Apiculture
05.	VAC	Food nutrition and health
05.	Minor course	Diversity of Chordates
06.	Major course	Cell Biology
07.	SEC-3	Sericulture



Scheme and Syllabus

SCHEME AND SYLLABUS

FOR

- **UG Certificate in Zoology: 1 year**
- **UG Diploma in Zoology: 2 years**
- **UG Degree in Zoology: 3 years**
- **UG (honours with research) in Zoology: 04 years**
- **UG (honours) in Zoology: 04 years**

Under

National Education Policy 2020

Department of Zoology, School Of Life Sciences
Guru Ghasidas Vishwavidyalaya, Bilaspur (CG)

2023-2024

Scheme and Syllabus for UG Courses in Zoology

Department of Zoology, School of Life Sciences,
Guru Ghasidas Vishwavidyalaya, Bilaspur

Semester	Courses	Name of courses	Number of courses	Level	Credits	Total Credits
I	Major	**Animal diversity of non chordates (Protista to Pseudocoelomate)**	1	2	3	20
		Lab Course			1	
	Minor	**Animal diversity of non chordates (Protista to Pseudocoelomate)** To be offer for students of other departments	1	2	3	
		Lab Course			1	
	Multid.	**Elementary Biology -I** To be offer for student of other disciplines (except Natural and Physical Sciences)	1	1	3	
	SEC	**Aquaculture** To be offer for student of Zoology/other departments at university level	1	1	2	
		Lab Course			1	
	VAC	**History of Indian science (Understanding India)** To be offer for student of Zoology/other departments at university level	2	1	2+2	
	AEC	**Language** To be offered by Hindi/English Department for student of Zoology	1	1	2	
II	Major	**Animal diversity of non chordates (Coelomates)**	1	2	3	20
		Lab Course			1	
	Minor	**Animal diversity of non chordates (Coelomates)** To be offer for student of other departments	1	2	3	
		Lab Course			1	
	Multid.	**Elementary Biology -II** To be offer for student of other disciplines (except Natural and Physical Sciences)	1	1	3	
	SEC	**Apiculture** To be offer for student of Zoology/other departments at university level	1	1	2	
		Lab Course			1	
	VAC	**Food nutrition and health (Health & wellness)** To be offer for student of Zoology/other departments at university level	2	1	2+2	
	AEC	**Language** To be offered by Hindi/English Department for student of Zoology	1	1	2	

The student must complete the 4 credit vocational course/Internship during summer term to get UG Certificate if he wishes to exit the program after first 2 semesters.

III	Major	**Diversity of chordates**	2	3	3	20
		Lab Course			1	
		Cell biology			3	
		Lab Course			1	
	Minor	**Diversity of chordates** To be offer for student of other departments	1	3	3	
		Lab Course			1	
	Multid.	**Elementary Biology-I/ Elementary Biology-II** To be offer for student of other disciplines (except Natural and Physical Sciences)	1	1	3	
	SEC	**Sericulture** To be offer for student of Zoology/other departments at university level	1	1	2	
		Lab Course			1	
	AEC	**Language** To be offered by Hindi/English Department for student of Zoology	1	1	2	
IV	Major	**Physiology of regulatory life process**	3	3	3	20
		Lab Course			1	
		Fundamental biochemistry			4	
		Lab Course			1	
		Ecosystem dynamics and conservation			4	
		Lab Course			1	
	Minor / Vocational	**Physiology of regulatory life process** To be offer for student of other departments	1	3	3	
		Lab Course			1	
		Medical diagnostics To be offer for student of Zoology/other departments at university level			3	
		Lab Course			1	
	AEC	**Language** To be offered by Hindi/English Department for student of Zoology	1	1	2	
The student must complete the 4 credit vocational course/Internship either after first year or second year during summer term to get UG Diploma if he wishes to exit the program after first 4 semesters.						
V	Major	**Physiology of basic life process**	3	4	4	21
		Lab Course			1	
		Bioinstrumentation			4	
		Lab Course			1	
		Principle of genetics and evolution			4	
		Lab Course			1	
	Minor / Vocational	**Physiology of basic life process** To be offer for the student of other departments	1	4	3	
		Lab Course			1	
		Ornamental fish culture To be offer for the student of Zoology/other departments at university level			3	
		Lab Course			1	
	Internship	During Winter Break	-	-	2	
VI	Major	**Parasitology and immunology**	3	4	4	19
		Lab Course			1	
		Elements of molecular biology			4	
		Lab Course			1	

Major Course:

Semester	Major Course	Course Title	Credits
I	1	Animal diversity of non chordates (Protista to Pseudocoelomate)	Theory: 03 Practical: 01

About the course

The course is a walk for the Bachelor's entrant through the amazing diversity of living forms from simple to complex one. It enlightens how each group of organisms arose and how did they establish themselves in the environment with their special characteristics. It also deals with the differences and similarities between organisms on the basis of their morphology and anatomy which led to their grouping into taxa and clades.

Course outcomes:

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

1. Develop understanding on the diversity of life with regard to protists to seudocoelomata.
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.

Course Outcomes and their mapping with Programme Outcomes:

COs	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	3	3	1	1
CO2	3	3	3	1	3	3	3	1	1
CO3	3	3	3	1	3	3	3	1	1
CO4	3	3	3	1	3	3	3		1
CO5	3	3	3	1	3	3	3		1

Weightage: 1- Slightly; 2- Moderately; 3- Strongly

Theory

Unit 1: Protista, Parazoa and Metazoa — **14 Lecture**

General characteristics and classification up to classes; Study of Euglena, Amoeba and Paramecium; Life cycle and pathogenicity of Plasmodium vivax and Entamoeba histolytica; Locomotion and Reproduction in Protista; Types of symmetry.

Unit 2: Porifera — **08 Lecture**

General characteristics and classification up to classes; Type study of Sycon; Canal system and spicules in sponges.

Unit 3: Cnidaria — **10 Lecture**

General characteristics and classification up to classes; Type study of Obelia; Polymorphism in Cnidaria; Corals and coral reefs.

Unit 4: Platyhelminthes **10 Lecture**

General characteristics and classification up to classes; Type study, larval forms and pathogenicity of Fasciola hepatica.

Unit 5: Nemathelminthes **8 Lecture**

General characteristics and classification up to classes; Type study of Ascaris lumbricoides; Life cycle and pathogenicity of Wuchereria bancrofti; Parasitic adaptations in helminthes.

Practical

1. Study of whole mount of *Euglena, Amoeba* and *Paramecium*
2. Binary fission and Conjugation in Paramecium
3. Examination of pond water collected from different places for diversity in Protista
4. Study of Sycon (T.S. and L.S.), *Hyalonema, Euplectella, Spongilla*
5. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora*
6. Study of adult Fasciola hepatica, *Taenia solium* and their life cycles (Slides/microphotographs)
7. Study of adult *Ascaris lumbricoides* and its life stages (slides/micro-photographs)
8. To submit a Project Report on any related topic on life cycles/coral/ coral reefs

Suggested readings:

1. Ruppert and Barnes (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Barnes RSK, Calow P, Olive PJW, Golding DW and Spicer JI (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
3. Barrington EJW (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

Major Courses:

Semester	Major Course	Course Title	Credit:
II	2	Animal diversity of non chordates (Coelomates)	Theory: 03 Practical: 01

About the course

To discuss representative lineages of the protostome coelomates, including molluscs, annelids and arthropods. Students will know how are these groups of animals similar? What morphological and developmental patterns do they have in common? How do they differ?

They will know the importance of segmentation in the annelids. Students will come to know why the animals in Phylum Arthropods are thought to be so successful.

Course Outcomes:

1. Compare the two groups (Acoelomate and Coelomates) of animals with true coeloms.
2. Compare the differences in development seen in these two groups.
3. Compare the protostomes and deuterostomes
4. Explain the characteristics of arthropods that have made them successful.
5. Review the diversity of arthropod groups, including trends in arthropod evolution.

Course Outcomes and their mapping with Programme Outcomes:

COs	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	3	3	1	1
CO2	3	3	3	1	3	3	3	1	1
CO3	3	3	3	1	3	3	3	1	1
CO4	3	3	3	1	3	3	3		1
CO5	3	3	3	1	3	3	3		1

Weightage: 1- Slightly; 2- Moderately; 3- Strongly

Theory

Unit 1: Introduction to Coelomates and Annelida — 12 Lecture

Evolution of coelom and metamerism.General characteristics and Classification up to classes; Type study of *Pheretima*; Metamerism in Annelids.

Unit 2: Arthropoda — 15 Lecture

General characteristics and Classification up to classes; Type study of *Periplaneta*; Vision and Respiration in Arthropoda; Larval forms in Arthropoda; Metamorphosis in Insects; Social life in bees.

Unit 3: Onychophora — 03 Lecture

General characteristics and Evolutionary significance with special reference to *Peripatus*.

Unit 4: Mollusca — 12 Lecture

General characteristics and Classification up to classes; Type study of *Pila*; Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves; Evolutionary significance of trochophore larva.

Unit 5: Echinodermata **10 Lecture**

General characteristics and Classification up to classes; Type study of *Asterias*; Water-vascular system in Asteroidea; Larval forms in Echinodermata; Affinities with Chordates.

Practical

1. Study of following specimens:
   Annelids: *Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria* etc.
   Arthropods : *Limulus, Palaemon, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta,* termites and honey bees etc.
   Onychophora: *Peripatus*
   Molluscs: *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus* etc.
   Echinodermates: *Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria* and *Antedon* etc.
2. Study of digestive system of earthworm
3. Study of septal nephridia and pharyngeal nephridia of earthworm
4. T. S. through pharynx, gizzard, and typhlosolar intestine of earthworm
5. Mount of mouth parts and dissection of digestive system of *Periplaneta*
6. Dissection of nervous system of *Periplaneta*
7. To submit a project report on any related topic to larval forms (crustacean, mollusc and echinoderm)

Suggested readings:

1. Ruppert and Barnes (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Barnes RSK, Calow P, Olive PJW, Golding DW and Spicer JI (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
3. Barrington EJW (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson.
4. Nigam (1997). Biology of Chordates, S. Chand.
5. Kotpal, Modern text book of Zoology: Vertebrates, Rastogi Publication.

Skill Enhancement Course (SEC):

Semester	SEC	Course Title	Credits
I	SEC-1	Aquaculture	Theory: 02 Practical: 01

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

Course outcomes:

After completing this course the learners will be able to

1. Understand the aquaculture systems
2. Understand pond management to increase fish production
3. Understand fish breeding and health management
4. Understand the environmental impacts on aquaculture

Course Outcomes and their mapping with Programme Outcomes:

COs	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	1	3	2	1	2	-	-	1
CO2	3	1	3	1	1	2	1	1	2
CO3	3	3	2	2	2	3	1	1	2
CO4	3	1	3	1	2	3	-	1	2

Weightage: 1- Slightly; 2- Moderately; 3- Strongly

Theory

Unit 1: Freshwater aquaculture systems — **08 Lecture**

Aquaculture concept, Culture systems: Freshwater prawn culture, fish culture in paddy fields, Culture of Catfishes. Composite fish culture: Techniques of composite culture. Composite fish farming in India. Mariculture: Brackish water prawn culture. Mussel culture. Culture of aquatic weeds.

Unit 2: Preparation and management of fish culture ponds — **08 Lecture**

Fish culture ponds. Pond management: Fish toxicants. Predatory and Weed fishes and their control. Aquatic insects and their control. Fish manures. Water quality. Culture: Pond culture. Monoculture. Monosex culture. Supplementary feeding. Harvesting: Fishing techniques, preservation & processing of fish.

Unit 3: Fish breeding, Transportation and Pathology — **09 Lecture**

Fish breeding: Natural and artificial. Fish transportion: Methods for packaging and transport of fish. Transport of fish seed and Brood fish. Causes of mortality in transport. Use of chemicals in live fish transport: Anaesthetic drugs. Antiseptics and Antibiotics. Fish diseases: Bacterial, fungal, protozoan and helminthes diseases. Non parasitic diseases.

Unit 4: Technologies in Fisheries development — **10 Lecture**

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.

Practical

1. Estimation of dissolved oxygen
2. Determination of pH of water samples
3. Measuring turbidity using a secchi disk
4. Measuring salinity of water
5. Total alkalinity measurement in natural waters
6. Phytoplankton analysis
7. Measurement of productivity
8. Study of major carps
9. Study of prawn species
10. Study of pearl oysters

Suggested readings:

1. Jingran, V. G. (1983) Fish and fisheries of India , Hindustan pub. corp. New Delhi.
2. Huet, 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.

Skill Enhancement Course (SEC):

Semester	SEC	Course Title	Credits
II	SEC-2	Apiculture	Theory: 02 Practical: 01

About the course

This course tells the students what tools and equipment will be needed, the main activities in the beekeepers year, the laws and by laws governing keeping bees; discover the principles of sustainable beekeeping and how these principles can guide your beekeeping into an enduring practice.

Course outcomes

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

1. Understand about bees and colony organization
2. Understand about beekeeping as a highly profitable occupation
3. Understand bee keeping technology and bee products
4. Understand about National Institutes and their contribution in beekeeping

Course Outcomes and their mapping with Programme Outcomes

COs	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	3	3	1	1
CO2	3	3	3	1	3	3	3	1	1
CO3	3	3	3	1	3	3	3	1	1
CO4	3	3	3	1	3	3	3		1

Weightage: 1- Slightly; 2- Moderately; 3- Strongly

Theory

Unit 1: Introduction to Apiculture — **08 Lectures**

History of Bees and Beekeeping. Bee species: Types of Bees. Morphology Caste system. Colony organization. Bee flora, Foraging.

Unit 2: Bee keeping as an occupation — **08 Lectures**

Extent of Beekeeping India. Limitations on the development of beekeeping. Advantages of extensive Beekeeping. Beekeeping equipments: Rearing appliances and initiation into keeping a colony. The future of beekeeping.

Unit 3: The first step in beekeeping — **10 Lectures**

Apiary site. Purchase and Establishment of a bee colony. Management and manipulation of bee colony. Bee products: Honey, Bees wax, Pollens, Royal Jelly, Propolis and Bee venom. Taking care of bee diseases and enemies.

Unit 4: Beekeeping techniques and Apiary management — **09 Lectures**

Routine and 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.

Practical

1. Study of different species of honey bee
2. Study of various host flowers of honey bee
3. Study of various caste of honey bee
4. Study of life cycle of honey bee
5. Study of Movable hive (Newton's hive) for apiculture
6. Study of various appliances used in apiculture
7. Study of foraging legs of honey bee
8. Preparation of temporary mount of mouth parts of honey bee
9. Preparation of temporary mount of sting apparatus of honey bee
10. Study of various diseases of honey bee affecting apiculture

Suggested readings:

1. Abrol , D. P. (1997) Bees and Beekeeping. Kalyani Publisher, New Delhi.
2. Abrol, D. P. (2010) A Comprehensive guide to Bees and Beekeeping. Scientific Publisher, New Delhi.
3. Withhead, S. B. (2010) Honey bees and their management Axis books Publisher, Jodhpur.
4. Nagaraja, N. and Rajagopal , D. (2013) Honey bees: Diseases, Parasites, Pests, Predator and their management. M.J.P Publisher, Chennai.
5. Dharamsing and Singh, D. P. A Handbook of Beekeeping, Agrobios India (Publisher), Jodhpur.

Value Added Courses:

Semester	VAC	Course Title	Credits
I	VAC-II	Food, Nutrition and Health	Theory: 02

About the course

The course covers the basic concepts of balanced diet for people of different ages besides focusing on the consequences of malnutrition and the deficiency diseases and the diseases caused due to poor hygiene.

Course outcomes:

1. Imparting the basic concept of food and nutrition including the concept of a balanced diet, nutrient needs, and dietary patterns for various groups.
2. Understanding the biochemistry of major food components and the effects of their deficiency on health and evaluating the effectiveness of nutrition interventions when dealing with certain health problems.
3. Understanding the importance of lifestyle-related diseases, their causes, and prevention through dietary and lifestyle modifications.
4. Understand the importance of food and water safety and methods associated with the preservation of food and purification of contaminated water and make students aware of food, nutrition, and health needs.

Course Outcomes and their mapping with Programme Outcomes:

COs	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	-	3	-	3	-	1
CO2	2	3	-	1	2	-	2	2	1
CO3	1	2	1	1	2	2	2	1	-
CO4	2	1	1	2	2	1	1	2	1

Weightage: 1- Slightly; 2- Moderately; 3- Strongly

Theory

Unit 1: Nutrition and dietary nutrients — **08 Lectures**

Basic concept of Food: Components and nutrients. Concept of balanced diet, nutrient requirements and dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people.

Unit 2: Macro nutrients and micronutrients — **09 Lectures**

Nutritional Biochemistry: Macronutrients. Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role. Micronutrients. Vitamins- Water-soluble and Fat-soluble vitamins- their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions.

Unit 3: Malnutrition and nutrient deficiency diseases — **10 Lectures**

Definition and concept of health: Common nutritional deficiency diseases- Protein Malnutrition (e.g., Kwashiorkor and Marasmus), Vitamin A deficiency, Iron deficiency and Iodine deficiency disorders- their symptoms, treatment, prevention and government initiatives, if any. Life style dependent diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention. Social health problems-

smoking, alcoholism, narcotics. Acquired Immuno Deficiency Syndrome (AIDS): causes, treatment and prevention. Other ailments viz., cold, cough, and fever, their causes and treatment.

Unit 4: Diseases caused by microorganisms **10 Lectures**

Food hygiene: Potable water- sources and methods of purification at domestic level. Food and Water-borne infections: Bacterial diseases: cholera, dysentery; typhoid fever, viral diseases: Hepatitis, Poliomyelitis etc., Protozoan diseases: amoebiasis, giardiasis; Parasitic diseases: teaniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention. Causes of food spoilage and its prevention.

Suggested readings:

1. Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed;; New Age International Publishers
2. Srilakshmi, B. (2002). Nutrition Science; New Age International (P) Ltd.
3. Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.
4. Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.
5. Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.
6. Wardlaw, G.M. and Hampl, J.S. (2007). Perspectives in Nutrition; Seventh Ed; McGraw Hill.
7. Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence.
8. Manay, M.S. and Shadakshharaswamy, M. (1998). Food-Facts and Principles; New AgeInternational (P) Ltd.
9. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.

Major Courses:

Semester	Major Course	Course Title	Credits
III	3	Diversity of chordates	Theory: 03 Practical: 01

About the course

By the study of diversity of chordates, it would be easy to know about the species of chordates surviving in different ecological areas of world. It would also be very useful that how these species may be harmful or useful for mankind.

Course outcomes:

1. To get information about the diversity of chordates
2. To have awareness about the beneficial and harmful chordates
3. To know about the endangered species of chordates
4. To know about the management of chordates
5. To understand how environment helps to acquire adaptation over a long period of time in different animals.

Course Outcomes and their mapping with Programme Outcomes:

COs	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	3	3	1	1
CO2	3	3	3	1	3	3	3	1	1
CO3	3	3	3	1	3	3	3	1	1
CO4	3	3	3	1	3	3	3		1
CO5	3	3	3	1	3	3	3		1

Weightage: 1- Slightly; 2- Moderately; 3- Strongly

Theory

Unit 1: Introduction and origin of Chordates — **05 Lecture**

General characteristics and outline classification, Dipleurula concept and the Echinoderm theory of origin of chordates, Advanced features of vertebrates over protochordates.

Unit 2: Protochordata — **08 Lecture**

General characteristics of Hemichordata, Urochordata and Cephalochordata, Study of larval forms in Protochordates, Retrogressive metamorphosis in Urochordata.

Unit 3: Agnatha and Pisces — **10 Lecture**

General characteristics and classification of cyclostomes up to orders; General characteristics of Chondrichthyes and Osteichthyes and Classification up to orders, Skin and Scales, Migration, Osmoregulation and Parental care in fishes.

Unit 4: Amphibia and Reptilia — **13 Lecture**

Origin of *Tetrapoda* (Evolution of terrestrial ectotherms), General characteristics and classification of Amphibia up to orders, Parental care in Amphibians; General characteristics and classification of Reptilia up to orders, Affinities of *Sphenodon*, Poisonous and non-poisonous snakes, Poison apparatus and biting mechanism.

Unit 5: Aves and Mammalia **16 Lecture**

General characteristics and classification of Aves up to orders, *Archaeopteryx*- a connecting link; Principles and aerodynamics of flight, Flight adaptations, Migration in birds; General characters and classification of Mammalia up to orders, Affinities of Prototheria, Metatheria, Adaptive radiation in mammals: locomotory appendages.

Practical

1. Study of following specimens:

   Protochordata:

   Balanoglossus, Herdmania, Branchiostoma,

   Colonial Urochordata,

   Agnatha and Fishes

   Petromyzon, Myxine, Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes,Labeo, Carla, Cirrhinus Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon, Diodon, Anabas, Flat fish.

   Amphibia and Reptilia

   Ichthyophis, Necturus, Rana, Bufo, Hyla, Alytes, Salamandra, Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus, Key for identification of poisonous and non-poisonous snakes.

   Aves and Mammalia

   Study of common birds from different orders,
   Types of beaks and claws,
   Sorex, Bat (Insectivorous and Frugivorous), Rattus, Funambulus, Loris, Herpestes, Erinaceous,
2. Sections of Balanoglossus through proboscis and branchiogenital regions.
3. Sections of Amphioxus through pharyngeal, intestinal and caudal regions.
4. Permanent slide of Herdmania spicules
5. Internal ear of scoliodon
6. Mount of weberian ossicles of Mystus/ pecten from Fowl head/Power point.
7. Study of afferent and efferent arteries of fish (scoliodon).

Suggested readings:

1. Young JZ (2004). The Life of Vertebrates. III Edition. Oxford university press.
2. Darlington PJ. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
3. Hall BK and Hallgrimsson B (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
4. Dorit, Walker and Barnes (1991). Zoology. Brooks Cole; 1 Edition.
5. Nigam (1997). Biology of Chordates, S. Chand.
6. Kotpal : Modern text book of Zoology: Vertebrates, Rastogi Publication.

Major Courses:

Semester	Major Course	Course Title	Credits
III	4	Cell biology	Theory: 03 Practical: 01

About the course
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.

Course outcomes:
After successfully completing this course, the students will be able to
1. Understand the functioning of nucleus and extra nuclear organelles
2. Understand the intricate cellular mechanisms involved.
3. Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.
4. 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.
5. Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.

Course Outcomes and their mapping with Programme Outcomes:

COs	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	3	3	1	1
CO2	3	3	3	1	3	3	3	1	1
CO3	3	3	3	1	3	3	3	1	1
CO4	3	3	3	1	3	3	3		1
CO5	3	3	3	1	3	3	3		1

Weightage: 1- Slightly; 2- Moderately; 3- Strongly

Theory

Unit 1: Overview of Cells and plasma membrane — 15 Lecture
Prokaryotic and Eukaryotic cells, Cell Theory, Virus, Viroids, Prions. Various models of plasma membrane, Structure and Function of Plasma Membrane. Transport across membranes: Active and Passive transport, Facilitated transport, Cell junctions: Tight junctions, Gap junctions.

Unit 2: Cellular Organelles and Endomembrane System — 10 Lecture
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Peroxisomes, Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis.

Unit 3: Cytoskeleton — 06 Lecture
Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.

Unit 4: Nucleus — 10 Lecture
Structure of and function of Nucleus. Chromatin: Euchromatin and Hetrochromatin and packaging

(nucleosome). Giant Chromosomes: Polytene and Lampbrush. Structure and types of DNA and RNA.

Unit 5: Cell division and Signaling **09 Lecture**

Cell cycle, cell division- mitosis and meiosis. Cell division check points and their regulation. Role of growth factors. Mutations in the genes that regulate cell cycle and division and their role in causing cancer. Programmed cell death (Apoptosis). Cell regulation and Cell signaling: Signaling molecules and their receptors. Functions of cell surface receptors.

Practical

1. Familiarization with the student's Light and dissecting microscope.
2. Staining of cell and different organelles (nucleus, mitochondria and chromosomes).
3. Permeability of plasma membrane - effect of isotonic, hypertonic solution.
4. Mitosis in onion root tips and permanent slide and chart.
5. Meiosis in grasshopper testis (from slides/photographs provided) and permanent slide.
6. Study of Polytene chromosomes in *Chironomous* larva.
7. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.

Suggested reading:

1. Karp (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition, John Wiley and Sons Inc.
2. De Robertis EDP and De Robertis EMF (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper GM and Hausman RE (2009). The Cell: A Molecular Approach. V Edition; ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009). The World of the Cell, VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Albert B, Dennis B, Julian L, Martin R, Keith R and James W (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.
6. Lodish et al (2008). Molecular Cell Biology, Freeman.

Skill Enhancement Course (SEC):

Semester	SEC	Course Title	Credits
III	SEC-3	Sericulture	Theory: 02 Practical: 01

About the course

The course gives insight into the principles of sustainable sericulture and how these principles can guide your silkmoth rearing into an enduring practice. The students will know about the laws and by laws governing keeping silkmoth.

Course Outcomes:

1. To know about importance of sericulture in the rural development and various species of silk moth.
2. To know biology of silkmoths and technologies used in sericulture.
3. To know about the pests and diseases of silkmoths and their control.
4. To know about the Institutions promoting sericultu re in rural areas.

Course Outcomes and their mapping with Programme Outcomes:

COs	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	3	3	1	1
CO2	3	3	3	1	3	3	3	1	1
CO3	3	3	3	1	3	3	3	1	1
CO4	3	3	3	1	3	3	3		1

Weightage: 1- Slightly; 2- Moderately; 3- Strongly

Theory

Unit 1: Silkworm distribution and races **08 Lecture**

The silkworms: Definition, history and present status of sericulture. World silk production and silk road. Distribution and types of races. Morphological characteristics. Mulberry and non-mulberry sericulture. Sericultural practices in tropical and temperate climate.

Unit 2: Biology of silkworm and technologies used in sericulture **08 Lecture**

Biology of silkworm: Life cycle of *Bombyx mori*. Structure of silk gland and Secretion of silk. Selection of mulberry variety. Propagation and establishment of mulberry garden, Rearing house and rearing appliances. Silkworm rearing technology: Early age and Late age rearing. Mounting. Spinning. Quality and storage of cocoons. Stifling. Reeling.

Unit 3: Diseases of silk worm and prevention and control **09 Lecture**

Diseases and Enemies of silkworm: Uzi fly, dermestid beetles and vertebrates. Protozoan, viral, fungal and bacterial diseases. Control and prevention of pests and diseases. Disinfectants: Formalin, bleaching powder RKO.

Unit 4: Prospects of Sericulture in India **10 Lecture**

Prospects of Sericulture in India. Silk industry in different states. Employment generation in sericulture. Role of women in sericulture. Sericulture organization in India; Role of state departments of Sericulture, Central Silk Board, Universities and NGOs in Sericulture development.

Practical

1. Study of various species of silkmoths
2. Study of different host plants of silkmoths
3. Identification of male and female silk moths and pupae
4. Study of life cycle of mulberry silkmoth
5. Study of 5th instar larva of silk moth
6. Study of rearing appliances used in sericulture
7. Dissection of Alimentary canal of silkmoth
8. Dissection of Silk gland
9. Preparation of temporary mount of mouthparts of silkmoth
10. Study of various diseases of silkmoths affecting sericulture

Suggested readings:

1. Manual on sericulture (1976). Rome: Food and Agriculture Organization of the United Nations, Agricultural Services Division.
2. Ullal, S.R. and . Narasimhanna, M.N. (1987) Handbook of Practical Sericulture: CSB, Bangalore
3. Silkworm Rearing and Disease of Silkworm (1956) Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, angalore
4. Jolly, M. S. (1986) Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
5. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1 (1972) Fuzi Pub. Co. Ltd., Tokyo, Japan.
6. Narasimhanna, M. N. (1988) Manual of Silkworm Egg Production;, CSB, Bangalore.
7. Sengupta, K. (1989) A Guide for Bivoltine Sericulture. CSR & TI, Mysore.