List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : *Zoology*

Programme Name : *B. Sc*

Academic Year : 2024-25

List of Courses Focus on Employability/ Entrepreneurship/Skill

Sr. No.	Course Code	Name of the Course
01.	**ZOUAMJT1**	Animal diversity of non-chordates (Protista to Pseudocoelomate)
02.	**ZOUASET1**	Aquaculture
03.	**ZOUBMJT1**	Animal diversity of non-chordates (Coelomates)
04.	**ZOUBSET1**	Apiculture
05.	**ZOUBVOT1**	Ornamental fish culture
05.	**ZOUBVAT1**	Food nutrition and health
06.	**ZOUCMJT1**	Diversity of Chordates
07.	**ZOUCMJT2**	Cell Biology
08.	**ZOUCSET1**	Sericulture
09.	**ZOUCVOT1**	Histological techniques and light microscopy
10.	**ZOUDMJT1**	Microbiology and Parasitology
11.	**ZOUDMJT2**	Fundamentals of Biochemistry
12.	**ZOUCVOT1**	Medical diagnostics

SCHEME AND SYLLABUS

FOR

- UG Certificate in Zoology: 1 year
- UG Diploma in Zoology: 2 years
- UGDegree 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)

2024-25

Scheme and Syllabus for UG Courses in Zoology

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

Semester	Courses	Name of courses	Code	Number of courses	Level	Credits	Total Credits
I	Major	**Animal Diversity of Non chordates (Protista to Pseudocoelomate)**	ZOUAMJT1	1	2	3	18
		Lab Course	ZOUAMJL1			1	
	Minor	**Minor 1** To be offered to the students of other departments	ZOUAMNT1	1	2	3	
		Lab Course	ZOUAMNL1			1	
	Multidisciplinary	**Multidisciplinary 1** To be offered to the students of other disciplines (except Natural and Physical Sciences)	ZOUAMDT1	1	1	3	
	SEC	**SEC 1** To be offered to students of Zoology/other departments at University level	ZOUASET1	1	1	2	
		Lab Course	ZOUASEL1			1	
	VAC	**VAC 1** To be offered tothe students of Zoology/other departments at University level	ZOUAVAT1	2	1	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)**	ZOUBMJT1	1	2	3	18
		Lab Course	ZOUBMJL1			1	
	Minor / Vocational	**Minor 2** To be offered to the students of other departments	ZOUBMNT1	1	2	3	
		Lab Course	ZOUBMNL1			1	
		Vocational 1 To be offered to the students of Zoology/other departments at University level	ZOUBVOT1			1	
		Ornamental Fish Culture Lab Course	ZOUBVOL1			3	
	Multidisciplinary	**Multidisciplinary 2** To be offered to the students of other disciplines (except Natural and Physical Sciences)	ZOUBMDT1	1	1	3	
	SEC	**SEC 2** To be offered to the students of Zoology/other departments at University level	ZOUBSET1	1	1	2	
		Lab Course	ZOUBSEL1			1	
	VAC	**VAC 2** To be offered to the students of Zoology/other departments at University level	ZOUBVAT1	2	1	2	
	AEC	**Language** To be offered by Hindi/English Department for student of Zoology		1	1	2	
The student must complete the 4 credits vocational course/Internship during summer term to get UG Certificate if he wishes to exit the program after first 2 semesters.							

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III	Major	**Diversity of Chordates**	ZOUCMJT1	2	3	3	20
		Lab Course	ZOUCMJL1			1	
		Cell biology	ZOUCMJT2			3	
		Lab Course	ZOUCMJL2			1	
	Minor / Vocational	**Minor3** To be offered to the students of other departments	ZOUCMNT1	1	3	3	
		Lab Course	ZOUCMNL1			1	
		Vocational 2 To be offered to the student of Zoology/other departments at University level	ZOUCVOT1			1	
		Histological Techniques and Light Microscopy-Lab Course	ZOUCVOL1			3	
	Multidisciplinary	**Multidisciplinary 2** To be offered to the students of other disciplines (except Natural and Physical Sciences)		1	1	3	
	SEC	**SEC 3** To be offered to the students of Zoology/other departments at University level	ZOUCSET1	1	1	2	
		Lab Course	ZOUCSEL1			1	
	AEC	**Language** To be offered by Hindi/English Department for student of Zoology		1	1	2	
IV	Major	**Microbiology and Parasitology**	ZOUDMJT1	3	3	3	20
		Lab Course	ZOUDMJL1			1	
		Fundamental Biochemistry	ZOUDMJT2			3	
		Lab Course	ZOUDMJL2			2	
		Ecosystem Dynamics and Conservation / Complex ecosystem Dynamics (MOOCS)	ZOUDMJT3			3	
		Lab Course	ZOUDMJL3			2	
	Minor / Vocational	**Minor 4** To be offered to the students of other departments	ZOUDMNT1	1	3	3	
		Lab Course	ZOUDMNL1			1	
		Vocational 3 To be offered to the students of Zoology/other departments at University level	ZOUDVOT1			1	
		Medical diagnostics Lab Course	ZOUDVOL1			3	
	AEC	**Language** To be offered by Hindi/English Department for student of Zoology		1	1	2	
The student must complete the 4credits 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**	ZOUEMJT1	3	4	3	21
		Lab Course	ZOUEMJL1			2	
		Bioinstrumentation	ZOUEMJT2			3	
		Lab Course	ZOUEMJL2			2	
		Principle of Genetics and Evolution	ZOUEMJT3			3	
		Lab Course	ZOUEMJL3			2	
	Minor	**Minor 5** (To be offered to the students of other departments)	ZOUEMNT1	1	4	3	
		Lab Course	ZOUEMNL1			1	

As per NEP-2020, Department of Zoology will offer minor courses, multidisciplinary courses (MDC), ability enhancement courses (AEC), skill enhancement courses (SEC), value added courses (VAC) and vocational courses (VOC) to students of other departments.
Similarly, student of Department of Zoology will study these courses from the courses offered by other departments/ as per University decision.
Pool for minor course, multidisciplinary course, AEC, SEC, VAC and vocational course will be given by University.
Two AEC courses are compulsory in first 2 semesters (One in each semester).
Three SEC courses are compulsory in first 3 semesters (One in each semester).
Three Multidisciplinary courses are compulsory in first 3 semesters (One in each semester).
Four VAC courses are compulsory in first 2 semesters (Two in each semester).
One vocational course for certificate and diploma courses, three vocational courses for 3/ 4 year degree are compulsory.
List of minor courses, multidisciplinary courses, AEC, SEC, VAC and vocational courses offered by the department of zoology (in University pool) is as follows:

Minor Courses

S. N.	Title	Course Name
1.	Minor 1	Animal Diversity of Non chordates (Protista to Pseudocoelomate)
2.	Minor 2	Animal Diversity of Non chordates (Coelomates)
3.	Minor 3	Diversity of Chordates
4.	Minor 4	Microbiology and Parasitology
5.	Minor 5	Physiology of Basic Life Processes
6.	Minor 6	Physiology of Regulatory Life Process
7.	Minor 7	Immunology
8.	Minor 8	Research Methodology and Biostatistics
9.	Minor 9	Applied Zoology

Multidisciplinary Courses

S. N.	Title	Course Name
1.	Multidisciplinary 1	Introductory Zoology
2.	Multidisciplinary 2	Essentials of Zoology

Skill Enhancement Courses

S. N.	Title	Course Name
1.	SEC 1	Aquaculture
2.	SEC 2	Apiculture
3.	SEC 3	Sericulture

Value Added Courses

S. N.	Title	Course Name
1.	VAC 1	Bhartiya Vigyan Ka Itihas
2.	VAC 2	Food Nutrition and Health (Health & wellness)

Vocational Courses

S. N.	Title	Course Name
1.	VOC 1	Ornamental Fish Culture
2.	VOC 2	Histological Techniques and Light Microscopy
3.	VOC 3	Medical Diagnostics

Department may offer at least one paper in whole UG program on MOOC's platform and it will be compulsory to all students.
Summer and/or winter internship: duration will be 2-4 weeks (minimum 90 working hours).

Abbreviations:
AEC= Ability enhancement course; SEC= Skill enhancement course; VAC= Value added course
(Subject to approval by the competent authority)

Major Course: ZOUAMJT1 and ZOUAMJL1

Semester	Major Course	Course Title	Credits
1	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 pseudocoelomata.
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.

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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/microphotographs).
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

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Major Courses: ZOUBMJT1 and ZOUBMJL1

Semester	Major Course	Course Title	Credits
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 coelom.
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 **12Lectures**

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

Unit2: Arthropoda **15Lectures**

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.

Unit3: Onychophora **05 Lectures**

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

Unit4: Mollusca **12 Lectures**

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.

Unit5: Echinodermata **10 Lectures**

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

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Practical

1. Study of followingspecimens:
   Annelids: *Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria* etc.
   Arthropods: *Limulus, Palamnaeus, 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 ofearthworm
3. Study of septal nephridia and pharyngeal nephridia ofearthworm
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 InternationalEdition.
2. BarnesRSK,CalowP,OlivePJW,GoldingDWandSpicerJI(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, RastogiPublication.

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Major Courses: ZOUCMJT1 and ZOUCMJL1

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.

Unit2: Protochordata **08 Lectures**

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

Unit 3: Agnatha and Pisces **10 Lectures**

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 Lectures**

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 Lectures**

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.

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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, Catla, 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.

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Major Courses: ZOUCMJT2 and ZOUCMJL2

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 Lectures**

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 andEndomembraneSystem — **12 Lectures**

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Peroxisomes, Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis.

Unit3: Cytoskeleton — **08 Lectures**

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.

Unit4: Nucleus — **10 Lectures**

Structure of and function of Nucleus. Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosomic). Giant Chromosomes: Polytene and Lampbrush. Structure and types of DNA and RNA.

Unit 5: Cell division and Signaling — **12 Lectures**

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.

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Practical

1. Familiarization with the student's Light and dissectingmicroscope.
2. Staining of cell and different organelles (nucleus, mitochondria and chromosomes).
3. Permeability of plasma membrane - effect of isotonic, hypertonicsolution.
4. Mitosis in onion root tips and permanent slide andchart.
5. Meiosis in grasshopper testis (from slides/photographs provided) and permanentslide.
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 readings

1. Karp (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition, John Wiley and SonsInc.
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, SanFrancisco.
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 andLondon.
6. Lodish et al (2008). Molecular Cell Biology, Freeman.

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Major Courses: ZOUDMJT1 and ZOUDMJL1

Semester	Major Course	Course Title	Credits
IV	5	**Microbiology and Parasitology**	**Theory: 03** **Practical: 01**

About the course

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.

Course outcomes

- Carry out common procedures for culturing, purifying and diagnostics of micro-organisms and understand the disease-causing potential of bacteria and viruses.
- Describe the mechanism for transmittance, virulence, and pathogenecity in pathogenic micro-organisms.
- Diagnose the causative agents, describe pathogenesity and treatment for diseases like malaria, leishmaniasis, trypanosomiasis, toxoplasmosis, schistosomiasis, cysticercosis, filariasis etc.
- Understand the variation amongst parasites, parasitic invasion in both plants and animals; applicable to medical and agriculture aspects.
- Help to know the stages of the life cycles of the parasites and the respective infective stages. Develop ecological model, know population dynamics of parasite, establishment of parasite population in host body, adaptive radiations and methods adopted by parasite to combat with the host immune system.

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	2	3	3	1	1
CO2	3	3	1	-	1	1	3	1	1
CO3	3	2	3	-	1	1	3	1	-
CO4	3	2	1	-	-	-	2	-	-
CO5	3	2	1	-	-	-	2	-	-

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

Theory

Unit 1: Microbiology: A brief account of pathogenic bacteria. **13 Lectures**

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.

Unit 2: Microbiology: A brief account of pathogenic viruses **13 Lectures**

Viral diseases: polio, rabies, hepatitis, influenza, dengue, AIDS, chicken pox, swine flu with emphasis on their causative agents, pathogenesis, diagnosis, prophylaxis. Bacterial diseases caused by Streptococcus pneumoniae, Salmonella typhi, Escherichia coli, Helicobacter pylori, Mycobacterium tuberculosis, Vibrio cholerae. Fungal diseases: Ringworm infection, aspergillosis, candidiasis.

Unit 3: Introduction to Parasitology **13 Lectures**

Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship, Population dynamics of parasite and establishment of parasite population in host body, evolution of parasitism, evolution and coevolution of parasite with respect to host strategy.

Unit 4: Parasitic Protists and Platyhelminthes **12 Lectures**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax, Fasciolopsis buski, Schistosoma haematobium, Taenia solium.*

Unit 5: Parasitic Nematodes and Arthropoda **12 Lectures**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis*. Biology, importance and control of ticks, mites, *Pediculus humanus* (Head andBody louse), *Xenopsylla cheopis* and *Culex fatigans*

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Practical

Practical

1. Study of permanent slides and specimens of parasitic protozoans and helminthes.
2. Pathological examination of sputum, blood, urine and stool.
3. Blood: Erythrocyte Sedimentation Rate (ESR), Haematocrit.
4. Staining and identification of Gram positive and Gram negative bacteria.
5. Preparation of thin and thick blood films to diagnose Plasmodium infections.
6. Preparation of temporary and permanent slides of faecal matter by saline preparation and concentration techniques to identify cysts of parasitic protozoans and helminthes eggs.
7. Group discussion or Seminar presentation on one or two related topics to those provided in the list.
8. Study of life stages of Entamoeba histolytica, Giardia intestinalis, *Trypanosoma gambiense*, *Leishmania donovani* and *Plasmodium vivax* through permanents lides/micro photographs.
9. Study of adult and life stages of *Fasciolopsis buski*, *Schistosoma haematobium* and *Taenia solium* through permanents lides/microphotographs.
10. Study of adult and life stages of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/microphotographs.
11. Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs.
12. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as by product]

Recommended readings

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).
5. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
6. Noble, E.R. and Noble, G.A. (1982) Parasitology: The Biology of Animal Parasites. V Edition, Lea & Febige

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Major Courses: ZOUDMJT2 and ZOUDMJL2

Semester	Major Course	Course Title	Credits
IV	6	Fundamental Biochemistry	Theory: 03 Practical: 02

About the course

Course is aimed to provide molecular structure of biological macromolecules (Carbohydrates, protein, and lipids) and their significance in living system. How enzymes work to perform biochemical reaction during metabolism.

Course Outcomes

To analyses and understand the basic concept of chemical reaction occur in living system that enables them to explore the applied science beneficial for mankind.

1. Understand about the importance and scope of biochemistry.
2. Understand the structure and biological significance of carbohydrates, proteins andlipids.
3. Understand the concept of enzyme, its mechanism of action and regulation.
4. Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids.
5. Learn measurement of enzyme activity and its kinetics.

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: Biomolecules — **04 Lectures**

Chemistry of Living system: Scope and importance; Biomolecules: Organizational principle, Configuration and conformation; Water as a biological solvent.

Unit 2: Carbohydrates — **10 Lectures**

Structure and Biological importance of carbohydrates. Aldose, ketose, chiral centre, polarized light and Fischer's nomenclature, cyclization reaction of glucose, anomers, pyranose, furanose, glycosidic linkage, reducing and non-reducing sugars.Sequence of reactions and regulation of glycolysis, Citric acid cycle, Pentose Phosphate pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis.

Unit 3: Lipids — **08 Lectures**

Structure and Significance: saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids.β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis.

Unit 4: Proteins — **14 Lectures**

Proteins: Bonds stabilizing protein structure; Denaturation; Simple and conjugate proteins.

Amino acids: Structure, Classification and properties of α-amino acids; essential and non-essential α-amino acids. Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C- skeleton of Glucogenic and Ketogenic amino acids.

Unit 5: Enzymes — **14 Lectures**

Nomenclature and classification; Cofactors; Specificity of enzyme action; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.

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Practical

1. Qualitative tests of functional groups in carbohydrates: Benedict's test for reducing sugars, Iodine test for starch
2. Qualitative tests of proteins
3. Qualitative tests of lipids.
4. Paper chromatography of amino acids.
5. Action of salivary amylase under optimum conditions.
6. Effect of pH, temperature and inhibitors on the action of salivary amylase.
7. Structural study of biomolecules through models/ charts/PPT.
8. Preparation and roles of phosphate and bicarbonate buffers.

Suggested reading

1. Cox MM and Nelson DL (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
2. Berg JM, Tymoczko JL and Stryer L (2007). Biochemistry, VIEdition, W.H. Freeman and Co., New York.
3. Murray RK, Bender DA, Botham KM, Kennelly PJ, Rodwell VW and Well PA (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill CompaniesInc.
4. Hames BD and Hooper NM (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd.,U.K.
5. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, PearsonPub.

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