

**PG & RESEARCH DEPARTMENT OF
ZOOLOGY**



HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-2

Affiliated to Bharathidasan University
 Nationally Accredited (4th cycle) with A++ grade (CGPA 3.75/4) by NAAC
 College with Potential for Excellence, Tiruchirappalli - 620 002, Tamil Nadu

SCHOOL OF LIFE SCIENCES

PG & RESEARCH DEPARTMENT OF ZOOLOGY

CHOICE BASED CREDIT SYSTEM

UG COURSE PATTERN B.Sc. ZOOLOGY (Specialization in Biotechnology)

(For students admitted from the Academic Year 2020 onwards)

PROGRAMME – B.Sc. ZOOLOGY

PO NO.	PROGRAMME OUTCOMES
	Upon completion of the B.Sc. Degree programme, the graduate will be able to
PO-1	Gain knowledge in basic biological principles and understands the interdependence among various organisms and the environment.
PO-2	understand the scientific methods, apply the knowledge of internal structure of cells, its functions in control of various metabolic functions
PO-3	Do systematic investigations in order to establish facts and reach new Conclusions
PO-4	Apply the knowledge and understanding of zoology to one's own life and work
PO-5	Develop responsibility and concern towards the fauna and its conservation

PSO NO.	PROGRAMME SPECIFIC OUTCOMES
	Upon completion of these courses the student would
PSO-1	Know the fundamental concepts of zoological sciences and biotechnology
PSO-2	Be able to comprehend and apply accurately and creatively the principles of taxonomy, cellular and molecular biology, genetics, ecology and evolution.
PSO-3	Perform experimental procedures and interpret the results in the areas of physiology, animal behavior, ecology, cell biology, genetics, applied zoology, biochemistry, animal biotechnology, immunology and research methodology

PSO-4	Acquire critical interrogatory skills on various biological and environmental issues and apply the concepts of biochemistry, immunology and developmental biology.
PSO-5	Acquire knowledge on microbes, biotechnology, bioinformatics and biostatistical tools and implement it in biological and medical fields
PSO-6	Be prepared to successfully compete in graduate programs, job placement, and become a socially responsible citizen

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PG AND RESEARCH DEPARTMENT OF ZOOLOGY

UG COURSE PATTERN B.Sc. ZOOLOGY (Specialization in Biotechnology)

CHOICE BASED CREDIT SYSTEM

(For Candidates admitted from June 2020 onwards)

Semester	Part	Course	Title of the Course	Code	Hours/ Week	Credits	Marks
I	I	Language	Tamil Paper I/ Hindi Paper I/ French Paper I	U20TL1TAM01/ U20HN1HIN01/ U20FR1FRE01	3	3	100
	II	English	General English I	U20EL1GEN01	3	3	100
	III	Major Core -1	Animal Diversity 1- Invertebrata	U20ZO1MCT01	4	4	100
		Major Core -2	Animal Diversity 2- Chordata	U20ZO1MCT02	4	4	100
		Major Core -3	Main Practical I (Animal Diversity 1 & 2)	U20ZO1MCP03	5	3	100
		Allied – 1	Chemistry paper -1	U20CH1ALT01	4	2	100

		Allied – 2	Chemistry paper -2	U20CH1ALT02	4	2	100
IV		Environmental Studies	Environmental studies	U20RE1EST01	2	1	100
		Value Education	Ethics I/ Bible Studies I/ Catechism I	U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01	1	-	-
VI		Extension	Service Oriented Course	-	-	-	-
		Internship / Field Work / Field Project 30 Hours - Extra Credit		U20SP1ECC01	-	2(Extra Credit)	100
		Total			30	22+2EC	800+100

Semester	Part	Course	Title of the course	Code	Hours/Week	Credits	Marks
II	I	Language	Tamil Paper II/ Hindi Paper II/ French Paper II	U20TL2TAM02/ U20HN2HIN02/ U20FR2FRE02	3	3	100
	II	English	General English II	U20EL2GEN02	3	3	100
	III	Major Core - 4	Cell and Molecular Biology	U20ZO2MCT04	5	4	100
		Major Core - 5	Biological Techniques	U20ZO2MCT05	4	4	100
		Major Elective -1	Courses offered within School: Developmental Biology / Genetic Counselling	U20ZO2MET01/ U20ZO2MET02	4	3	100
		Major Skill based Elective- 1	Animal Behaviour and Chronobiology/ Apiculture	U20ZO2SBT01/ U20ZO2SBT02	2	1	100
		Allied – 3	Chemistry paper - 3	U20CH2ALT03	4	2	100

	IV	Skill Based Course (SBC) – 1	Soft Skills Development	U20RE2SBT01	2	1	100
		Skill Based Course (SBC) – 2	Sustainable Rural Development and Student Social Responsibility	U20RE2SBT02	2	1	100
		Value Education	Ethics I / Bible Studies I / Catechism I	U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01	1	1	100
	VI	Extension	Service Oriented Course	-	-	-	
		Internship / Field Work / Field Project 30 Hours - Extra Credit		U20SP2ECC02		2(Extra Credit)	100
		Total			30	23+2EC	1000+100

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SCHOOL OF LIFE SCIENCES

PG & RESEARCH DEPARTMENT OF ZOOLOGY

I B.Sc. ZOOLOGY (Specialization in Biotechnology)

(For the candidates admitted from 2020 onwards)

First Year - Semester I

Course Title	MAJOR CORE – 1: ANIMAL DIVERSITY1- INVERTEBRATA
Total Hours	60
Hours/Week	4
Code	U20ZO1MCT01
Course Type	Theory
Credits	4
Marks	100

General Objective:

The student will be able to acquire knowledge of the classification of invertebrates up to order, describe their organization with examples of biological importance and analyze the coral wealth of India.

Course Objectives:

The student will be able to

CO 1	understand the classification, characteristics and analyze the structural organization of Protozoa, Porifera and Coelenterata
CO 2	understand the classification, characteristics and analyze the structural organization of Platyhelminthes, Aschelminthes, Nematode and Annelids
CO 3	understand the classification, characteristics and analyze the structural organization of Arthropods
CO 4	understand the classification, characteristics and analyze the structural organization of Mollusca and Echinodermata
CO 5	understand the classification, characteristics and analyze the structural organization of Hemichordate, phylogeny and levels of organization in invertebrates

Outline classification and general characters of all phyla (Applicable to all 5 units)

UNIT I: Protozoa to Coelenterata

(12hrs)

Phylum: Protozoa, Type study: Paramecium

Phylum: Porifera, Type study: Sponge

Phylum: Coelenterata, Type study: Obelia

Extra Reading/Key words: *Coral reefs, identification of sponges*

UNIT II: Platyhelminthes to Annelida

(12hrs)

Phylum: Platyhelminthes, Type study: Tape worm

Phylum: Aschelminthes, Type study: *Ascaris*

Nematode Parasites of Man – *Enterobius, Ancylostoma, Wuchereria, Dracunculus* Phylum: Annelida, Type study: Leech

Extra Reading/Key words: *Feeding habits in Leech*

UNIT III: Arthropoda**(12hrs)**

Phylum: Arthropoda- Classification of Phylum up to Classes

Class: Insecta – Classification up to Orders, Type study: Cockroach

Extra Reading/Key words: *Identification of insects in the area around us***UNIT IV: Mollusca and Echinodermata****(12hrs)**

Phylum: Mollusca, Type study: Pila

Phylum: Echinodermata, Type study: Starfish

Extra Reading/Key words: *Report on star fishes in Rameswaram***UNIT V Hemichordata****(12hrs)**

Phylum: Hemichordata, Type study: Balanoglossus.

Extra Reading/Key words: *Evaluate the phylogeny of any Arthropod***Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	Outline the Classification and characterize structural organization of Protozoa, Porifera and Coelenterate	1,2,3,6	U, An
CO-2	Identify and classify the various organisms belonging to Protozoa, Porifera and Coelenterate	2,3,6	U, An
CO-3	Outline the Classification and characterize the structural organization of Platyhelminthes, Aschelminthes, Nematode and Annelid	2,3,6	U, An
CO-4	Identify and classify the various organisms belonging to Platyhelminthes, Aschelminthes, Nematode and Annelid	2,3,6	U, An

CO-5	Outline the Classification and characterize structural organization of Arthropods, Mollusca, Echinodermata and Hemichordate	2,3,6	U, An
CO-6	Identify and classify the various organisms belonging to Arthropods, Mollusca, Echinodermata and Hemichordate	2,3,6	U, An

Text Book:

- Ekambaranatha Ayyar.M and Ananthakrishnan.T.N. (1994). Manual of Zoology, Vol I, Part –I, S. Viswanathan Pvt. Ltd. Madras.
- Shipley, A. E. (2013). *Zoology of the Invertebrata: A Text-Book; For Students*. London: Forgotten Books. (Original work published 1929)

Books for Reference:

- Agarwal, V.K. (2000) Invertebrate Zoology. S. Chand & Co. New Delhi.
- Agarwal, V.K. and Gupta U. (2004) Animal Taxonomy. S. Chand & Co. New Delhi
- Jordan, E.L. and Verma, P.S. (2009), Invertebrate Zoology 14th Ed, S. Chand & Co., New Delhi
- Kotpal, R.L.(2011).Modern Text Book of Zoology, Invertebrates Animal Diversity – I,10th Ed. Rastogi Publications
- Mukerji, D (1977) Textbook of Zoology Vol I & II The New book stall, Calcutta.

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First Year - Semester I

Course Title	MAJOR CORE – 2: ANIMAL DIVERSITY 2 - CHORDATA
Total Hours	60
Hours/Week	4
Code	U20ZO1MCT02
Course Type	Theory
Credits	4
Marks	100

General Objective:

To enable the student to acquire knowledge of chordates and their outline classification upto order.

Course Objectives :

The student will be able to

CO 1	Understand Geological Time Scale and Structural organisation of Amphioxus; analyse and classify prochordates.
CO 2	Understand the outline classification of Pisces with Shark as an example; analyse the few locally available fishes of aquacultural importance
CO 3	Understand the outline classification of Amphibia and Reptiles with Frog and Calotes as an example; identify poisonous and non poisonous snakes.
CO 4	Understand the outline classification of Aves with Pigeon as an example; analyse the significance of Archaeopteryx.

CO 5	Understand the general characters and outline classification of prototheria, metatheria and Eutheria with Rabbit as an example.
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Outline classification and general characters of all phyla up to order with suitable examples of biological interest (Applicable to all 5 units)

UNIT I: Origin of Chordates and classification of Prochordates (12hrs)

Geological time scale, Origin of chordates, Vertebrate relationships and basic structure.

Type study: Amphioxus. Prochordates- Classification, characters and relationship.

Extra Reading/Key words: *Study of 2 extinct species*

UNIT II: Pisces (12 hrs)

Type study: Shark.

Identification and study of a few locally available fishes and fishes of aquaculture importance (Lab Cum theory).

Extra Reading/Key words: *Methods of culturing locally available fishes.*

UNIT III: Amphibia and Reptilia (12hrs)

Type study: Frog and Calotes.

Identification and study of a few Poisonous and non-poisonous snakes.

Extra Reading/Key words: *Poisonous and non-poisonous snakes in the locality.*

UNIT IV: Aves**(12hrs)**

Type study: Pigeon

Archaeopteryx, Significance of Archaeopteryx, Flightless birds.

Extra Reading/Key words: *Finding out endangered birds in the locality***UNIT V: Mammalia****(12hrs)**

Prototheria, Metatheria and Eutheria

Type study: Rabbit

Differences between Prototheria, Metatheria and Eutheria.

Extra Reading/Key words: *Parental care in mammals.***Note: Texts given in the Extra Reading / Key words must be tested only through Assignment and Seminars; (Skeletal system is excluded)** (Applicable to all 5 units).

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Compare era, epoch and period.	PSO 2	U
CO-2	List the characters of Prochordate.	PSO 1, 2	R
CO-3	List the characters of Pisces.	PSO 1, 2	R
CO-4	Construct a table with the characters of locally available fishes to help in its identification	PSO 2	Ap
CO-5	Explain why frog belongs to the class Amphibia	PSO 2	U
CO-6	Identify the given snake as poisonous or non poisonous by analyzing its characters.	PSO 2, 5	E

CO-7	Critically compare the characters of Archaeopteryx With reptiles and birds	PSO 2	An
CO-8	Compare and contrast Prototheria, Metatheria and Eutheria.	PSO 2	An

Text Books:

- Kotpal , R.L. (2001)Modern Textbook of Zoology Chordates. Rastogi publications, Meerut.
- Miller, A.S. and John P. Harvley, (1996). Zoology. Latest Edition. Wm. C.Brown Publishers.
- EkambaranathaAyyar, M. and Anantha Krishnan, T. N. (1994). A Manual of Zoology Part I
- (Chordata). S.ViswanathanPvt.Ltd.
- Arnold, G. Kluge, (1971) Chordate structure and function. Latest Edition. Macmillan.
- Harvey, P.F., Christine, M.J., John,B.H(2006)Vertebrate Life, Latest edition. Pearson Education Pvt.Ltd.
- Jordan, E.L. and Verma,P.S. (2008). Chordate Zoology S. Latest Edition Chand & Co. New Delhi.

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I B.Sc. ZOOLOGY (Specialization in Biotechnology)

(For candidates admitted from 2020 onwards)

First Year - Semester I

Course Title	MAJOR CORE – 3: MAIN PRACTICAL I - ANIMAL DIVERSITY 1 & 2
Total Hours	75
Hours/Week	5
Code	U20ZO2MCP03
Course Type	Practical
Credits	3
Marks	100

General Objective:

The student will learn to classify animal specimens and the art of mounting the mouth parts of cockroach, body setae of earthworm and placoid scales of shark, dissect the digestive, nervous and reproductive system of Earthworm, Cockroach and Frog through virtual lab.

Course Objectives:

The student will be able to:

CO 1	understand the concepts of taxonomy, levels of organization, phylogeny of invertebrata and the classification of different phyla
CO 2	understand the structural organization of insect mouth parts and correlate them to their feeding habit
CO 3	mount the body setae, placoid scales, and mouth parts of insects
CO 4	analyze the structural organization of the different systems in Earthworm, Cockroach and Frog

CO 5	apply knowledge of classification in the identification of specimens of biological importance
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1. Concepts, Methods of grouping, Methods and Significance of Taxonomy
2. Coral Wealth of India, Phylogeny of Invertebrata, Levels of organization
3. **Classification of the following phyla/class up to orders with examples:**
Invertebrata: Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Hemichordata **Prochordates,**
Chordata: Pisces, Amphibia, Reptilia, Aves and Mammalia.
4. Cockroach, House fly, Head Louse and Mosquito– Mount and labeling of Mouth parts.
5. Cockroach – Flag labelling of Digestive system, Nervous system and Reproductive system.
6. Earthworm- Nervous system, Reproductive system using virtual class study and Mounting of Body setae.
7. Shark – Mounting of Placoid scales
8. Frog- Digestive system, Circulatory system (Arterial and Venous system), Urinogenital system using virtual class study. Nervous system – Flag labeling of Brain V, VII, IX and X cranial nerves and I spinal nerve study.

9. Spotters: Animal Diversity I and II

10. Identification of prepared slides and specimens of Biological importance.

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Apply the concepts of taxonomy in the classification of invertebrata and chordata	PSO 1, 2	Ap
CO-2	Demonstrate and illustrate the structural organization of mouth parts in insects	PSO 2,3	U
CO-3	Compare, contrast and interpret the organization of mouth parts to their feeding habit	PSO 2,3,6	An
CO-4	Dissect and mount the body setae, placoid scales, and mouth parts of insects	PSO 2,3	U
CO-5	Compare and examine the structure and function of the different systems in Earthworm, Cockroach and Frog	PSO 2,3,6	Ap
CO-6	Identify and utilize the knowledge of classification in the identification of specimens of biological importance	PSO 2,3,6	Ap

A Record of the work done is to be submitted at the time of examination

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI - 2

SCHOOL OF LIFE SCIENCES

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B.Sc. ZOOLOGY (Specialization in Biotechnology)

(For Students Admitted from 2020 onwards)

First Year - Semester II

Course Title	MAJOR CORE - 4: CELL AND MOLECULAR BIOLOGY
Total Hours	75
Hours/Week	5
Code	U20ZO2MCT04
Course Type	Theory
Credits	4
Marks	100

General Objective:

The student will learn the ultra-structure and functions of cells and cellular organelles and the molecular mechanisms involved in various cellular processes.

Course Objectives:

The student will be able to

CO 1	Understand the ultra structure and functions of plasma membrane, mitochondria and lysosome
CO 2	Understand the role of cell organelles in various cellular functions
CO 3	Understand the organization of nuclear components and cell cycle events
CO 4	Understand the structure, replication and transcription of DNA

CO 5	Analyse the characteristics of Genetic code, structure - functions relationship of RNA and process of protein synthesis
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UNIT I

(15hrs)

Plasma Membrane: Ultra structure unit membrane and fluid mosaic models, modifications, cell-cell junctions-basic structure and functions, permeability functions- passive, facilitated, active, exo- and endocytosis

Mitochondria: Ultra structure, chemistry and functions.

Lysosome: Polymorphic forms, cytochemistry – functions.

Extra Reading/Key words: *Extra cellular matrix, Endosymbiont theory*

UNIT II

(15hrs)

Ribosomes: Structural composition, assembly and functions.

Endoplasmic Reticulum: Ultra structure types and functions.

Golgi Complex: Ultra structure, functions and role in cell secretion.

Centrosome: Ultra structure and Functions.

Extra Reading/Key words: *Cytoskeleton, Microfilaments, Transport vesicles*

UNIT III

(15hrs)

Chromosomes: Organization - Chemistry- Functions

Giant Chromosomes – Polytene and Lampbrush – Organization and functions

Nucleus: Ultra structural Organization- nuclear membrane and nuclear pore complex, and functions

Cell division: Mitosis – Stages, Spindle mechanics, mitotic inhibitors, **Meiosis** – Stages, Significance

Extra Reading/Key words: *Checkpoints, Recombination*

UNIT IV

(15hrs)

DNA Structure and Replication: Nitrogenous bases, nucleosides, nucleotides. DNA - Watson and Crick double helix, types of DNA. Central dogma of molecular biology. DNA replication and semi-conservative method.

Transcription: Eukaryotic transcription, mechanism, transcription unit, transcription factors, RNA polymerase-type.

Post-transcriptional modification: Processing of mRNA-;capping, poly adenylation, splicing –introns and exons

Extra Reading/Key words: *Junk DNA, DNA sequencing*

UNIT V

(15hrs)

Structure and functions - mRNA, tRNA, rRNA and other RNA's

Translation: Genetic code and its characteristics; Protein synthesis– initiation, elongation, termination in eukaryotes; difference between prokaryotic and eukaryotic translation. **Post-translational modifications:** Polypeptide to functional proteins (Glycosylation and, Phosphorylation)

Extra Reading/Key words: *Unnatural amino acids, unusual tRNA bases*

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explains the structure and functions of plasma membrane, mitochondria and lysosomes.	PSO 1,2	U

CO-2	Describes the structure and functions of ribosome and endoplasmic reticulum.	PSO 1,2	U
CO-3	Describe the structure of Golgi apparatus and explain its importance in cell secretion.	PSO 1,2	U
CO-4	Relates the ultra structure of centrosome and analyze its role in cell division and other function	PSO 1,2	Ap
CO-5	Explains the detailed structure and functions of nucleus	PSO 1,2	U
CO-6	Describes the stages of cell division and distinguish between mitosis and meiosis	PSO 1, 2	An
CO-7	Explains the structure of DNA, its replication, RNA structures and Recall the Central Dogma	PSO 2	An
CO-8	Elucidates the mechanism of information transfer processes and its significance - transcription, translation and post – transcriptional and post – translational modifications in eukaryotes.	PSO 2	E

Text Books:

- Agarwal, V.K., (2010). Molecular Biology, S. Chand and Company Ltd., New Delhi
- Verma P.S. & Agarwal V.K. (2016). Cell Biology, S.Chand and Company Ltd, New Delhi.

- Rastogi R C., (2016). Cell and Molecular Biology, New Age International Publishers, NewDelhi.
- Gerald Karp. 2013. Cell Biology. Wiley's Publications.
- George M. Malacinski ., (2015). Freifelder's Essentials of Molecular Biology 4th Edition. Jones & Bartlett Learning Publishers. Burlington, Massachusetts, United States.
- James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael, Losick Richard., (2017). Molecular Biology of the Gene. Pearson Publications. UK.
- Geoffrey M. Cooper., 2018. The Cell: A Molecular Approach. Oxford University Press,UK.
- Harvey F. Lodish, Berk Lodish (Zipursky, Matsudaria, Baltimore, Darnell), Arnold Berk, James E. Darnell, S. Lawrence Zipursky, David Baltimore, (2018). Molecular Cell Biology. W.H.Freeman & Co Ltd.,USA.
- Bruce Alberts.,(2014). Molecular Biology of the Cell,6th Edition. Taylor & Francis (Garland Science), UK.
- De Robertis E.D.P. & De Robertis E.M.F. (2017).Cell and Molecular Biology, 8th Edition, Saunders College, PA.

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I B.Sc. ZOOLOGY (Specialization in Biotechnology)

(For the candidates admitted from 2020 onwards)

First Year - Semester II

Course Title	MAJOR CORE – 5: BIOLOGICAL TECHNIQUES
Total Hours	60
Hours/Week	4
Code	U20ZO2MCT05
Course Type	Theory
Credits	4
Marks	100

General Objective:

The student will be able to understand the basic principles and analyze the applications of units of measurement, microscopy, radioactivity spectrophotometers, centrifugation, chromatography & electrophoresis techniques.

Course Objectives:

The student will be able to

CO No.	Course Objectives
CO 1	Understand the units of measurements in the preparation of solutions and acquire knowledge on the principles of histological techniques.
CO 2	Understand the principle and analyze the applications of various microscopy and pH meter.

CO 3	Understand the principle and applications of spectrophotometry and acquire knowledge on detection and measurement of radioactivity.
CO 4	Acquire knowledge on the principle, types and applications of centrifugation and chromatography.
CO 5	Analyze the types and applications of electrophoresis techniques.

UNIT I

(12hrs)

Units of measurement and Preparation of solutions: Percentage, Normality, Molarity, Molality ppm, buffers, stock and working solution,

Microtechnique – Principle and methods of fixation, types of fixatives; tissue processing - block making and sectioning; Principle of staining and types of stains; Haematoxylin and Eosin staining method for histology and Permanent mounting.

Extra Reading/Key words: *Interpretation of histological sections taking one as example*

UNIT II

(12hrs)

Microscopy - Principle and applications of Light microscope, Phase contrast, Confocal scanning light microscopy, Fluorescence and Electron (TEM, SEM and STEM) microscopy.

pH meter- principle and application.

Extra Reading/Key words: *Repair and rectification of microscope*

UNIT III

(12hrs)

Spectrophotometry

Electromagnetic spectrum and its properties

Principle and applications – Colorimeter, UV –Vis Spectrophotometer, Flame Photometer, FTIR, Flow cytometer and Nuclear magnetic resonance

Radioactivity- Detection and measurement of radioactivity: autoradiography; Geiger Muller and Scintillation counter and types.

Extra Reading/Key words: *Interpretation of spectrophotometric results*

UNIT IV

(12 hrs)

Centrifugation –concepts of relative centrifugal force and sedimentation coefficient. Principle and applications of Analytical centrifugation - Ultra centrifuge, Differential centrifugation - Gradient centrifuge

Chromatography - Principle and applications of Paper, Thin layer, Column, HPLC, Gas-liquid, Ion- exchange and GC-MS

Extra Reading/Key words: *Hierarchy of chromatography and their applications, taking a case study*

UNIT V

(12 hrs)

Electrophoresis – Principle and applications of Paper and Agarose gel electrophoresis (AGE), Immunoelectrophoresis and Isoelectric focussing, PolyAcrylamide Gel Electrophoresis -- SDS - PAGE

Extra Reading/Key words:

Note: Texts given in the Extra reading/Key words must be tested only through Assignment and Seminars.

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Experiment with different types of solutions and histology	PSO 4	Ap
CO-2	Classify and compare the types of microscopes and pH meters.	PSO 4	An, E
CO-3	Explain the principle and applications of spectrophotometer and radioactive counters	PSO 4	U

CO-4	Illustrate the working mechanism of centrifugation and chromatography	PSO 4	U
CO-5	Classify and distinguish the types of electrophoresis	PSO 4	An

Text Books

- Upadhyay, A., Upadhyay, K. and Nirmalendu, N. (2002), Biophysical Chemistry. Himalayan Publishing House, Mumbai.
- P K Banerjee Introduction to Biophysics / 3rd edition S. Chand Publishing/2008

Books for Reference:

- P.R. Yadav., Biological Techniques, Discovery Publishing House/ 2006
- P. Narayanan, Essentials of Biophysics, New Age International Publishers/2007
- Kiran Singh, Manish Sharma, Vinay Oraon, Concepts of Laboratory Techniques in Biology, Brillion Publishing/2018
- Casey, E. J., (1962). Biophysics - Concepts and Mechanisms. East West Press Pvt., Ltd., New Delhi.
- Daniel, M., (2005). Basic Biophysics for Biologist. Agro Botanical Publishers, Bihaner, India.

- Narayanan, P., (2007). Essentials of Biophysics. New Age International (P) Ltd. Publishers. Plummer T. D., (1978).
- An introduction to Practical Biochemistry. Tata McGraw Hill Publishing Company Limited, New Delhi.
- Skoog, A. D. and James, J. L. (1992). Principles of Instrumental Analysis. Saunders Golden Sunburst Series
- Vasanthan, P. and Gautham, N. (2002). Biophysics. Narosa Publishing House, New Delhi. Veeralakumari, I., (2006). Bioinstrumentation. MJP Publishers, Chennai.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-2

SCHOOL OF LIFE SCIENCES

PG & RESEARCH DEPARTMENT OF ZOOLOGY

(For the candidates admitted from 2020 onwards)

FIRST YEAR - SEMESTER II

Course Title	MAJOR ELECTIVE - 1: DEVELOPMENTAL BIOLOGY
Total Hours	60
Hours/Week	4
Code	U20ZO2MET01
Course Type	Theory cum Lab
Credits	4
Marks	100

General Objective:

To enable the students to understand the process of fertilization, development of the individual organism, metamorphosis, the concept of organizer and regeneration in animals.

Course Objectives:

The student will be able to

CO 1	understand the process of fertilization and parthenogenesis .
CO 2	understand the cleavage and gastrulation process
CO 3	understand the development of organs in chordates and placentation in mammals
CO 4	understand the concept of organizer, induction and metamorphosis
CO 5	understand post embryonic development and regeneration in invertebrates and vertebrates.

UNIT I

(12hrs)

Gametogenesis – Structure of sperm and egg, types of egg.

Fertilization: Physico-chemical aspects of fertilization and its significance.

Parthenogenesis: Natural and artificial – significance.

Practical: smear preparation and observation of sperm suspension

Extra Reading/Key words: *Fertilization in sea urchin, Induced ovulation.*

UNIT II

(12hrs)

Cleavage: Types (Holoblastic & meroblastic) and patterns of cleavage (radial, spiral, bilateral, rotational, determinate and indeterminate cleavage).

Gastrulation: Fate map, morphogenetic movements – Gastrulation in frog, chick and mammals.

Practical: Observation of slides pertaining to development of frog and chick.

Extra Reading/Key words: *Development of ear, fetal membranes in mammals.*

UNIT III

(12hrs)

Organogenesis - Ectodermal derivatives – Development of brain of frog.
Mesodermal derivatives – Heart of mammals.

Extra-embryonic membranes in chick.

Placentation in mammals – Types and functions.

Practical: Types of placenta (Sheep, Pig & human)

Extra Reading/Key words: *Development of ear, fetal membranes in mammals.*

UNIT IV**(12hrs)****Metamorphosis**
in Amphibia**Organizer** – Spemann’s embryonic induction

Development of immune system in vertebrates

Practical: Metamorphosis in insects/Amphibia**Extra Reading/Key words:** *Nuclear transplantation in Amphibia***UNIT V****(12hrs)****Post embryonic developments** -insects and amphibians.**Regeneration** - invertebrates and vertebrates.**Aging** – concepts and Models.**Practical: Observation of regeneration potential in zebra fish tail fin****Extra Reading/Key words:** *Metamorphosis, Asexual reproduction.***Note: Texts given in the Extra reading/Key words must be tested only through Assignment and Seminars.**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Illustrate the events that occur during fertilization.	PSO 4	U
CO-2	Outline the types and patterns of cleavage.	PSO 4	U
CO-3	Summarize the ectodermal and mesodermal derivatives.	PSO 4	U
CO-4	Analyse the Spemann’s embryonic induction.	PSO 4, 6	An
CO-5	Analyse the process of regeneration and causes of aging	PSO 1, 2, 3	An

Text Book:

Arumugam, N. (2014) A Text Book of Embryology. Saras Publication, Nagercoil.

Books for Reference:

- Gilbert, S. F., (2010) Developmental Biology, IX Ed. Sinaur Associates Inc. Publishers, Sunderland, Massachusetts USA.
- Sastry, K.V., Shukal,V(2010) Developmental Biology, Rastogi Publications,Meerut,India
- Subramaniam, T. (2010) Molecular Developmental Biology, Narosa Publishing House, New Delhi.
- VasundaraRao (1994). Developmental Biology – A Modern Synthesis. Oxford IBH, New Delhi.
- Balinsky, B.I., (1981). Introduction to Embryology. V Ed., Saunders, Toppan. Lewis
- Berril, R. (1979) Developmental Processes in Higher Vertebrates. Logos Press.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-2

SCHOOL OF LIFE SCIENCES

PG & RESEARCH DEPARTMENT OF ZOOLOGY

(For the candidates admitted from 2020 onwards)

First Year - Semester II/III/IV

Course Title	MAJOR ELECTIVE - 1: GENETIC COUNSELING
Total Hours	60
Hours/Week	4
Code	U20ZO2MET02
Course Type	Theory
Credits	4
Marks	100

General Objective:

The student will be able to acquire basic knowledge of genetics in terms of clinic and genetic guidance, to be aware about when and how patients should be referred further to genetic investigations and/or to be able to be participation in genetic investigations.

Course Objectives

The student will be able to

CO 1	understand the theory and pattern of inheritance.
CO 2	understand the characteristics, genetic basis, distribution and management of genetic disorders.
CO 3	understand the pattern of autosomal and sex chromosomal inheritance.
CO 4	understand the ethical concerns of Genetic counselling and Prenatal diagnosis
CO 5	understand the consanguinity and Management of genetic disorders.

UNIT I: Theory and Pattern of inheritance

Chromosome theory of inheritance. (12 hrs)

Human chromosome complement and karyotype.

Common Mendelian traits and inheritance in human.

Human pedigrees and inheritance pattern. (autosomal dominant and recessive, sex-linked recessive).

Blood groups – genetic basis, incompatibilities and management.

Extra Reading/Key words: *Mechanism of inheritance (Mendelian theory)*

UNIT II: Genetic disorders and Management

(12 hrs)

Genetic basis and management of diabetes and hypertension. Sickle cell anemia, Thalassemia and Haemophilia- Characteristics, genetic basis, distribution in India and management.

Extra Reading/Key words: *Inborn errors of metabolism –One gene one enzyme hypothesis concept.*

UNIT III: Chromosomal Abnormalities

(12 hrs)

Autosomal aneuploidy – Down syndrome.

Sex chromosomal aneuploidy – Turner and Klinefelter's syndrome.

Chromosomal abnormalities and spontaneous abortions, still births and neonatal deaths.

Critical developmental periods in humans and congenital defects – teratogens in brief.

Extra Reading/Key words: *Teratogens - Birth defects.*

UNIT IV: Genetic counselling and Prenatal diagnosis**(12 hrs)**

Objective and ethical concerns.

Procedures: medical diagnosis, pedigree analysis, estimating risk- the age 35 threshold, sexes prediction and genetic screening.

Prenatal diagnosis: Fetoscopy, radiography, ultrasonography; obtaining foetal sample-amniocentesis, chorionic villus sampling; Triplet test, AFP test and FISH.

Extra Reading/Key words: *What diseases can be detected through prenatal genetic testing?***UNIT V: Management of genetic disorders****(12hrs)**

Consanguinity and genetic disorders – prevalence in India – effects.

Management of genetic disorders: surgical, drug therapy, dietary restriction, Replacement therapy, organ and tissue transplantation and gene therapy. Legal issues and DNA finger printing. Social dimensions of human genome project.

Extra Reading/Key words: *Human Genome Project and gene therapy.***Note: Texts given in the Extra reading/Key words must be tested only through Assignment and Seminars.**

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	Constructs the pedigrees and analyses the pattern of inheritance.	PSO 1,2,3,4,6	U, An
CO-2	Access historical and current knowledge regarding genetic disorders and understand how such knowledge has influenced	PSO 2,3,6	U, An
CO-3	Apply to real life situations and one's life the principles of human heredity.	PSO 1,2,3,4,6	U, An
CO-4	Employs the scientific method to generate new knowledge, and to solve problems, regarding human heredity.	PSO 2,3,6	U, An
CO-5	Synthesize and incorporate the fundamentals of genetic disorders in order to understand how such disorder impacts humans and management of such conditions.	PSO 2,3,6	E, C

Text Book:

Bhatnagar *et al.*, 2020. Essentials of human genetics, Orients Longman Ltd

Books for Reference:

3. Alice Marcus. 2009. Genetics, MJP Publishers, Chennai.
4. Holland, B. and Kyriacou, C. 1993 .Genetics and society, Addison – Wesley.
5. Mange,E. J and Mange, A.P. 2018. Basic human genetics II.ED, Sinaues associates,Inc. Sunderland, Massachusetts.
6. Ricki, L.2019. Human Genetics, WCB Publishers.
7. Salil Basu, 1994. Genetic disorders and health care, Shree Kala Prakashan, Delhi.
8. Sam Singer, 2018. Human Genetics. An Introduction to the Principles of Heredity, Freeman and Company, New York.

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-2

SCHOOL OF LIFE SCIENCES

PG & RESEARCH DEPARTMENT OF ZOOLOGY

I B.Sc. ZOOLOGY (Specialization in Biotechnology)

(For the candidates admitted from 2020 onwards)

First Year - Semester II

Course Title	MAJOR SKILL BASED ELECTIVE – 1: ANIMAL BEHAVIOUR AND CHRONOBIOLOGY
Total Hours	30
Hours/Week	2
Code	U20ZO2SBT01
Course Type	Theory cum Lab
Credits	1
Marks	100

General Objective:

The student will be able to understand and appreciate different types of animal behaviours, interactions, basics of chronobiology and their practical significance.

Course Objectives:

The student will be able to

CO 1	Understand the different animal behaviours
CO 2	Understand the importance of different types of social behaviours and communication signals

CO 3	Understand chronobiology and biological clocks
CO 4	Understand the types and control of biological rhythms
CO 5	Perform activities to study the behavior and biological rhythms in selected animals

Unit I: Principles of Animal Behaviour (6hrs)

Behavior; Types of behavior: **Innate behavior** – Reflexes, Kinesis, Taxis, Fixed action

patterns; **Learned behavior - Simple learned behaviors:** Habituation, Imprinting;

Conditioned behaviors: classical conditioning, Operant conditioning, Cognitive learning.

Lab Activity: To study geotaxis behaviour in earthworm/ phototaxis behaviour in insect larvae.

Extra Reading/Key words: *Methods used in studying animal behaviour, Bird song development-an example of imprinting*

Unit II: Behavioural interactions (6hrs)

Social Behaviours: courtship, mating, parental care, territorial behavior, foraging.

Lab Activity: 1. Study of social and courtship behaviour in birds, dogs and insects

2. To study nests and nesting behaviour of the birds and social insects.

Extra Reading/Key words: *Kinship, Sexual conflict in parental care, concept of society in Honey bee*

Unit III: Communication (6hrs)

Communication and the senses; Need for communication; Types of signals – chemical, auditory, visual and tactile

Lab Activity: Visit to Forest/Wild life Sanctuary/Biodiversity Park/Zoological Park to study and record the behavioural activities of animals and prepare a short report

Extra Reading/Key words: *Inclusive fitness, Altruism, “Super normal” stimuli*

Unit IV: Biological rhythms (6hrs)

Chronobiology: History of chronobiology; **Biological rhythms:** exogenous rhythms, endogenous rhythms - Circadian rhythms, Ultradian rhythms, Infradian rhythms; Control of biological rhythms.

Lab Activity: To study circadian functions in humans (daily eating, sleep and temperature patterns)

Extra Reading/Key words: *Role of melatonin, concept of synchronization and masking*

Unit V: Biological Clocks (6hrs)

Biological clocks; Relevance of biological clocks; Interactions of biological clocks; circadian rhythm disorders; Applications of chronobiology

Lab Activity: To study one’s own sleep pattern and record in a journal.

Extra Reading/Key words: *Biological oscillation, Chronopharmacology, Chronomedicine, Chronotherapy*

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO -1	Explain animal behaviors, interactions, and biological rhythms	PSO 1, 2	U

CO-2	Identify and Classify behaviours and biological rhythms	PSO 2, 4	An
CO-3	Observe and infer the cause for specific behavior types and biological rhythms	PSO 2, 3	An
CO-4	relate various concepts in chronobiology taught in the classroom with their daily life	PSO 2, 3, 4	Ap
CO-5	Design experimental setup to study animal behavior and biological rhythms	PSO 2, 3, 6	Cr

Text Books:

- Alcock J. (2013). Animal Behaviour. Sinauer Associate Inc., USA.
- Lee Alan Dugatkin. Principles of animal behavior, Third edition, W. W. Norton & Company, New York, London
- Vinod Kumar (2002) Biological Rhythms. Narosa Publishing House, Delhi/ Springer-Verlag, Germany
- Dunlap J. C, Loros J. J, DeCoursey P. J. (2004) Chronobiology Biological Time keeping. Sinauer Associates, Inc. Publishers, Sunderland, MA, USA

Books for Reference:

- Chris Barnard (2004). *Animal Behaviour Mechanism, Development, Function and Evolution*, Pearson Education Limited Edinburgh Gate Harlow Essex CM20 2JE England
- Manning, A. and Dawkins, M. S. (2012). *An Introduction to Animal Behaviour*. Cambridge, University Press, UK.
- Paul W. Sherman and Alcock J. (2013). *Exploring Animal Behaviour*. Sinauer Associate Inc., Massachusetts, USA.
- Saunders D. S. (2002). *Insect Clocks*. III Edition, Barends and Noble Inc. New York, USA

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-2

SCHOOL OF LIFE SCIENCES

PG & RESEARCH DEPARTMENT OF ZOOLOGY

I B.Sc. ZOOLOGY (Specialization in Biotechnology)

(For the candidates admitted from 2020 onwards)

First Year - Semester II

Course Title	MAJOR SKILL BASED ELECTIVE - 1: APICULTURE
Total Hours	30
Hours/Week	2
Code	U20ZO2SBT02
Course Type	Theory cum Lab
Credits	1
Marks	100

General Objective

The course will help the students to understand the biology, behaviour and rearing of bees. It would also help the students to develop skills required for self-employment in the bee-keeping sector.

Course Objectives:

The student will be able to

CO 1	understand the biology of honey bee and identify its social organization patterns.
CO 2	analyze the various rearing methods and apply the knowledge in construction and management of Apiary.
CO 3	analyze the diseases and pest control in Honey Bees.

CO 4	s ummarize the processing of Honey and identifies the various properties and medicinal value of Honey.
CO 5	apply knowledge and create various products and marketing strategies of Honey products.

Unit I: Biology of Bees

(6 hrs)

Introduction to Apiculture; Origin, systematics and distribution; Different Species of honey bees. Bee identification, learning and communication. Social Organization of bee colony and behavioral patterns.

Practical: Study of natural bee hive and identification of queen cells, drone cells and brood.

Extra Reading/Key words: *Ecological and Physiological Adaptations of Bees.*

Unit II: Rearing of Bees

(6 hrs)

Queens rearing and colony multiplication: Raising honey bee queens, Bee Keeping equipment, Artificial bee rearing (Apiary), Beehives- Newton and Langstroth. Apiary management. Structural and Physiological Adaptations of Bees.

Practical : Study of artificial hive (Langstroth/Newton), its various parts and beekeeping equipment.

Extra Reading/Key words: *Migratory Bee Keeping - designing floral Calendar*

Unit III: Diseases and Enemies

(6hrs)

Enemies of bees- Wax Moth, Ants, Wasps, Microorganisms, Pest. Diagnosis and Identification. Bee diseases, control and preventive measures. Seasonal management of honey bees, Bee pasturage and pollination.

Practical: Management of natural enemies and predators of Honey Bees.

Extra Reading/Key words: *Mechanical control, Biopesticides, Chemical (synthetic pesticide) treatments.*

Unit IV : Processing of honey and its properties

(6hrs)

Honey extraction & handling - Processing of honey. Products of honey bees – Bee Wax, Bee venom & Royal Jelly extraction. Properties of Honey products, Nutrients and composition of honey. Applications - Medicinal properties, Value added honey products.

Practical : Honey testing kit - Physical and chemical methods of analysis.

Extra Reading/Key words: *Quality control and standards in testing Honey*

Unit V: Bee Economy

(6hrs)

Modern methods in employing artificial beehives for cross pollination in horticultural gardens. Economic Value of Commercial Bee keeping and marketing of bee products. **Practical :** Visit to an apiary/honey processing unit/Institute and submission of a report **Extra Reading/Key words:** *Preparing bankable bee keeping project and Steps involved in starting a beekeeping project,*

Note: Texts given in the Extra reading /Key words must be tested only through Assignment and Seminars.

CO No.	Course Outcomes	PSOs Addressed	Cognitive level
CO 1	Classify the different species of Honey bee and analyze its social organization	PSO 2, 6	Un, An
CO 2	Apply the knowledge gained in the techniques involved in bee rearing and honey production	PSO 2, 6	Ap
CO 3	Categorize and evaluate the pest, enemies and control the diseases of honey bees.	PSO 6	An, Ap
CO 4	Analyze various honey processing methods and properties of honey products	PSO 2, 6	An
CO 5	Develop entrepreneurial skills necessary for self-employment in Apiculture	PSO 6	C

Text Books:

- Mishra, R.C. (2013). Perspective in Indian Apiculture. Edition 1, Agrobios (India).
- Pradip V Jabde, 1993. Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture,
- Ghosh G.K. (1994). Bee Keeping in India. APH Publishers,India