HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd Cycle)
Uthamapalayam - 625 533.

DEPARTMENT OF ZOOLOGY

BACHELOR OF SCIENCE - ZOOLOGY

SYLLABUS

Choice Based Credit System – CBCS

With

Outcome Based Education (OBE)

(Academic Year 2026 - 2027 onwards)

HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

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College Vision and Mission

Vision

Our vision is to provide the best type of higher education to all, especially to students hailing from minority Muslim community, rural agricultural families and other deprived, under privileged sections of the society, inculcating the sense of social responsibility in them. Our college is committed to produce talented, duty-bound citizens to take up the challenges of the changing times.

Mission

Our mission is to impart and inculcate social values, spirit of service and religious tolerance as envisioned by our beloved Founder President Hajee Karutha Rowther.

The Vision beckons ..... the Mission continues forever.

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Department Vision and Mission

Vision

We aim to attain excellence through high-quality education and research pertaining to local, regional and national requirements, and through collaboration with various researchers and educators across Tamil Nadu and India We look forward to indoctrinate the highest morals of life, respect for Mother Nature and concern for ethical values among students for establishing the sustainable environment.

Mission

- To instigate an awareness of the need to explore, identify and conserve biodiversity. To create an attractive and enthusiastic department where students want to come and study.
- To train students in zoological sciences and to equip them to apply themselves in activities requiring zoological expertise (Certificate course). Ultimately, our mission is to make our students self-employable.
- Our Undergraduate level training aims to provide a clear understanding of the whole animal Kingdom, its systematics, development, physiology, evolution and conservation. At undergraduate level, we strive to maintain a high level of scientific excellence in achieving hands on experience on various techniques.
- To involve the department in community-based and outreach activities, whenever and wherever possible affordable quality education to weaker part of the society and
- To elevate the post graduate department of Zoology as the class academic and research centre of Madurai Kamaraj University

Programme Outcomes (PO)

PO1	Capable of demon starting comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study
PO2	Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
PO3	Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefson the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
PO4	Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
PO5	Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

Programme Specific Outcomes (PSO)

PSO1	Identify the major groups of organisms with an emphasis on animals and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of animals that differentiate them from other forms of life.
PSO2	Understand the basic concepts in cell and its components which are used to generate and utilize energy besides the development of various animals.
PSO3	Competence in distinguishing the anatomy of various animals and understand the physiological process**.**
PSO4	Explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flows through the environment.
PSO5	Ability to apply fundamental statistical tools and physical principles(chemistry) to the analysis of relevant biological situations**.**

Programme Scheme
Eligibility

A Pass in +2 examination conducted by Board of Higher Secondary Education, Government of Tamilnadu or equivalent with Biology/ Botany and Zoology as one of the subjects.

For Programme Completion
A Candidate shall complete:

- Part I - Language Courses – Tamil/Arabic/Malayalam in semesters I, II, III and IV respectively
- Part II - Language Courses - English in semesters I, II, III, IV respectively
- Part III - Core Courses in semesters I, II, III, IV, V and VI respectively
- Part III - Generic Elective Courses in semesters I, II, III and IV respectively
- Part III - Discipline Elective Courses in semesters IV, V and VI respectively
- Part IV - Foundation Course (Skill Enhancement Course) in Semester I
- Part IV - Entrepreneurial Skills (Skill Enhancement Course) Course in Semester III
- Part IV - Professional Competency Skill (Skill Enhancement Course) Course in Semester V
- Part IV – Non Major Elective (Skill Enhancement Course) Courses in Semesters V and VI respectively
- Part IV - Environmental Studies Course in semester I
- Part IV - Value Education Course in semester III
- Part IV - Summer Internship/Industrial Training Course in semester V
- Part V - Extension activity in semester IV

Scheme of Examinations under Choice Based Credit System

Term End Examinations (TEE)	- 75 Marks
Continuous Internal Assessment Examinations (CIAE)	- 25 Marks
Total	- 100 Marks

Pattern of Continuous Internal Assessment Examinations (CIAE)

Average of Two Internal Tests (each 20 marks)	- 20 Marks
Assignment	- 05 Marks
Total	- 25 Marks

Pattern of Term End Examinations
(Max. Marks: 75 / Time: 3 Hours)

External Examinations Question Paper Pattern for Part I & III and Part IV (Non- Major Elective & Skill based Subject)

Section – A (5 X 1 = 5 Marks)
Answer ALL questions.

- Questions 1 - 5
- One question from each unit
- Multiple choice questions and each question carries Four choices

Section – B (5 X 2 = 10 Marks)
Answer ALL questions.

- Questions 6 - 10
- One question from each unit
- Short Answer (Definition)

Section – C (5 X 6 = 30 Marks)
Answer any ALL questions (Choose either a or b).

- Questions 11 - 15
- One question from each unit
- Paragraph

Section – D (3 X 10 = 30 Marks)

Answer any THREE out of five questions.

- Questions 16 - 20
- One question from each unit
- Essay type

External Examinations Question Paper Pattern for Part IV- Foundation Course

- MCQ Pattern (1 X 75 = 75 Marks)

External Examinations Question Paper Pattern for Part IV- Environmental Studies and Value Education

Section – A: (5 X 6 = 30 Marks)

Answer ALL questions choosing either A or B.

- Questions 1 - 5
- Two questions from each unit (either…. or…. type)
- Paragraph

Section – B (3 X 15 = 45 Marks)

Answer any THREE out of five questions.

- Questions 6 – 10
- One question from each unit
- Essay type

Part V (Extension Activities) – 13 Activities

- Internal Evaluation

Passing Marks

Minimum 27 for External Exam

Eligibility for the degree – passing minimum is **40%**

Practical Examination

Internal – 40 marks
External – 60 marks (minimum 24 marks)
Total – 100 marks
Passing minimum is **40%**

Weightage

Weightage for Bloom's Taxonomy	Percentage	Marks	
		CIAE	TEE
Knowledge (Remembering) – K1	15	4	11
Understanding – K2	20	5	15
Applying – K3	25	6	19
Analyzing – K4	40	10	30
Gross Total	**100**	**25**	**75**

Assessment

Distribution of questions and marks for Continuous Internal Assessment Examinations

Bloom's Taxonomy	Section A	Section B	Section C	Section D	Total
Knowledge(K1)	2(2)	2(2)	-	-	**25 marks**
Understanding(K2)	**Assignment (5)**				
Apply(K3)	-	-	2(6)	-	
Analyzing (K4)	-	2(2)	-	1(8)	

Distribution of questions and marks for Term End Examinations.

Bloom's Taxonomy	Section A	Section B	Section C	Section D	Total
Knowledge(K1)	1(1)	2(4)	1(6)	-	**Total 75 Marks**
Understanding(K2)	1(1)	1(2)	2(12)	-	
Apply(K3)	3(3)	2(4)	2(12)	-	
Analyzing (K4)	-	-	-	3(30)	

Note: Figures in parenthesis are Marks

Credits Distribution

S. No	Part	Category	No of Courses	No of Credits
1	Part - I	Language	4	12
2	Part - II	English	4	12
3	Part - III	Core (Theory / Practical / Project)	17	69
		Discipline Elective (Theory / Practical)	4	14
		Generic Elective (Theory / Practical *)	6	16
4	Part - IV (AEC)	Foundation Course	1	2
		EVS	1	2
		Value Education	1	2
		NME	2	4
5	Part - IV (SEC)	Entrepreneurial Skills	1	2
		Professional Competency	1	2
		Internship	1	2
6	Part - V	Extension Activity	1	1
Total			**44**	**140**

* Generic Elective Practical Examinations should be Conducted only in Even Semester

B.Sc., ZOOLOGY
Details of Course Category, Code, Credits & Title

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max. Marks	Credits
Semester – I							
Part – I							
Language - I	26UTALL11	பொதுத்தமிழ் - I	6	25	75	100	3
	26UARLL11	Introduction to Arabic Language - I					
	26UMMLL11	History of Malayalam Literature					
Part – II							
English - I	26UENLL11	General English - I	6	25	75	100	3
Part – III							
Core – I	26UZYCC11	Invertebrata	5	25	75	100	5
Core – II (Lab)	26UZYCC1P	Zoology Lab - I	3	40	60	100	3
Generic Elective - I	26UCHGE11	Allied Chemistry - I	4	25	75	100	3
Generic Elective – II(Lab)	26UCHGE2P	Volumetric Analysis for Allied Chemistry	2	-	-	-	-
Part – IV							
Foundation Course (SEC)(MCQ)	26UZYFN11	Fundamentals of Zoology	2	25	75	100	2
EVS	26UGEVS11	Environmental Studies	2	25	75	100	2
TOTAL			**30**				**21**

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max. Marks	Credits
Semester – II							
Part – I							
Language – II	26UTALL21	பொதுத்தமிழ் - II	6	25	75	100	3
	26UARLL21	Introduction to Arabic Language - II					
	26UMMLL21	Prose, Composition & Translation					
Part – II							
English - II	26UENLL21	General English - II	6	25	75	100	3
Part – III							
Core – III	26UZYCC21	Chordata	5	25	75	100	5
Core – IV (Lab)	26UZYCC2P	Zoology Lab - II	2	40	60	100	2
Core – V	26UZYCC22	Cell Biology	5	25	75	100	5
Generic Elective - II	26UCHGE21	Allied Chemistry - II	4	25	75	100	3
Generic Elective – II(Lab)	26UCHGE2P	Volumetric Analysis for Allied Chemistry	2	40	60	100	2
TOTAL			**30**				**23**

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UZYCC11	**INVERTEBRATA**	**Core–I**	**5**	**5**	**25**	**75**	**100**

Course Objectives		
Visualize, analyze and observe the various types of organisms in invertebrates, their organ systems, adaptations, their diversity and behavioral patterns.		
UNIT	**Contents**	**No. of Hours**
I	**Taxonomy:** Definition- Principles of classification - Symmetry and Coelom -Units of classification - Binomial nomenclature, Outline classification of Animal kingdom up to class level with example. Flow chart only. Taxonomic keys.	15
II	**Protozoa:** General characters up to class level; Paramecium – (Type study) General organization, Cyclosis, Contractile vacuole and conjugation only. Structure, pathology, prevention and control measures of *Plasmodium vivax* and *Entamoeba histolytica*. **Porifera:** General characters up to class level-Olynthus – (Type study) General organization, histology, Spicules, Reproduction and Development only. Canal system in sponges.	15
III	**Coelenterata:** General characters up to class level Obelia – (Type study) Structure of Obelia colony, Medusa & Nematocyst, Reproduction and development (Metagenesis) Polymorphism in Coelenterata. **Helminthes:** General characters up to class level *Fasciola hepatica* (Liver Fluke) - Type study. External characters, Digestive system, Excretion, Reproduction and Development (Life cycle) **Nematode:** Pathogenic nematodes Ascaris and Wucheraria: Beneficial nematode: *Steinerneme felitae*, *Heterorhabditidae bacteriophora*	15
IV	**Annelida:** General characters up to class level-Earth worm – Type study- External morphology, Setae, Nephridia, Respiratory system, Nervous system and Reproductive system only. Metamerism in Annelids. **Arthropoda:** General characters up to class level-Cockroach- Morphology, Mouthparts, Digestive system, Nervous system, Reproductive system & Life cycle. Affinities of Peripatus.	15
V	**Mollusca:** General characters up to class level- Pila globosa – Type study- External morphology, Digestive system, Respiratory system, Osphridium only-Cephalopods as advanced molluscs. **Echinodermata:** General characters up to class level-Star fish. Type study- External Morphology, Pedicellaria, Water vascular system only- Larval forms of Echinoderms.	15
	Total	**75**
Course Outcomes		**Knowledge Level**

CO	On completion of this course, students will	
1	Relate general characteristic features, morphology and classification of Invertebrates (Protozoa –Echinoderms)	K1
2	Explain the lifecycle and adaptation of Protozoan and Porifera	K1, K2
3	Outline the lifecycle and adaptation of Coelenteratesand Helminthes	K1, K2
4	Illustrate the lifecycle and adaptation of Annelida & Arthropoda	K1, K2
5	Identify the lifecycle and adaptation of Mollusca & Echinodermata	K1, K2, K3,K4
K1-Knowledge K2-Understand K3-Apply K4-Analyze		
Textbooks		
1.	Kapoor, ***Practical Zoology***, Silver Line Publications, Allahabad, Uttrapradesh , 2014.	
2.	Pechenik, Jan A – ***Biology of the Invertebrates***, Tata Mcgraw – Hill Pub. Company Ltd., New Delhi, 2014.	
Reference Books		
1.	Vasantika Kashyap- ***Life of Invertebrates***, Second Revised Edition, Vikas Pub. House Pvt. Ltd., New Delhi, 2013.	
2.	Kotpal, R.L -***Modern Text Book of Zoology, Invertebrates*** (Animal diversity – I), Rastogi Publications, Meerut, 2012.	
3.	Barnes, R.D- ***Invertebrate Zoology, IV Edition***, Holf Saunders International edition, 2006.	
4.	Ekambaranatha Ayyar and Ananthakrishnan, T.N - A manual of Zoology, volume I, ***Invertebrate***, Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai Kotpal, R.L, Vertebrates, Rastogi Publications, 2011.	
e-Resources		
1.	https://www.national geographic.com/animals/invertebrates/	

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	3
CO2	3	1	3	3	1
CO3	3	3	3	3	2
CO4	2	3	1	3	2
CO5	3	1	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	3
CO2	3	1	3	3	1
CO3	3	3	3	3	2
CO4	2	3	1	3	2
CO5	3	1	3	3	3

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT - I	
1.1	**Taxonomy:** Definition- Principles of classification - Symmetry and Coelom.	5
1.2	Units of classification - Binomial nomenclature, Outline classification of Animal kingdom up to class level with example.	5
1.3	Flow chart only. Taxonomic keys.	5
	UNIT - II	
2.1	**Protozoa:** General characters up to class level; Paramecium – (Type study) General organization, Cyclosis, Contractile vacuole and conjugation only.	5
2.2	Structure, pathology, prevention and control measures of *Plasmodium vivax* and *Entamoeba histolytica*.	5
2.3	**Porifera:** General characters up to class level-Olynthus – (Type study) General organization, histology, Spicules, Reproduction and Development only. Canal system in sponges.	5
	UNIT - III	
3.1	**Coelenterata:** General characters up to class level Obelia – (Type study) Structure of Obelia colony, Medusa & Nematocyst, Reproduction and development (Metagenesis) Polymorphism in Coelenterata.	5
3.2	**Helminthes:** General characters up to class level *Fasciola hepatica* (Liver Fluke) - Type study. External characters, Digestive system, Excretion, Reproduction and Development (Life cycle)	5
3.3	**Nematode:** Pathogenic nematodes Ascaris and Wucheraria: Beneficial nematode: *Steinerneme felitae*, *Heterorhabditidae bacteriophora*	5
	UNIT - IV	
4.1	**Annelida:** General characters up to class level-Earth worm – Type study- External morphology, Setae, Nephridia.	5
4.2	Respiratory system, Nervous system and Reproductive system only. Metamerism in Annelids. **Arthropoda:** General characters up to class level	5
4.3	Cockroach- Morphology, Mouthparts, Digestive system, Nervous system, Reproductive system & Life cycle. Affinities of Peripatus.	5
	UNIT - V	
5.1	**Mollusca:** General characters up to class level- Pila globosa – Type study- External morphology, Digestive system, Respiratory system.	5
5.2	Osphridium only-Cephalopods as advanced molluscs.	5

	Echinodermata: General characters up to class level	
5.3	Star fish. Type study- External Morphology, Pedicellaria, Water vascular system only-Larval forms of Echinoderms.	5
Total		**75**

Course Designer

Name: Dr. M. Mohiadeen Batcha

Assistant Professor of Zoology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UZYCC1P	**ZOOLOGY LAB - I**	**Core–II**	**3**	**3**	**40**	**60**	**100**

Course Objectives		
Visualize, analyze and observe the various types of organisms in invertebrates, their organ systems, adaptations, their diversity and behavioral patterns.		
UNIT	**Contents**	**No. of Hours**
I	Invertebrates: Demonstration with Biovisual charts: Cockroach - Nervous & Reproductive system - Mounting: Mouth parts and Salivary gland. Earthworm - Digestive, Nervous systems & Reproductive system.	9
II	Minor Dissection: Cockroach: Digestive system. Pila globosa: Digestive system (Including radula). Mounting: Earthworm - Body setae and Penial setae. Honey bee – Mouthparts and sting	9
III	Spotters- Protozoa - Amoeba, Euglena, Entamoeba, Plasmodium, Paramecium: Entire, Binary fission and conjugation. Porifera- Sycon, Gemmules and Spicules.	9
IV	Spotters- Coelenterata - Obelia Colony, Medusa, Hydra, Physalia, Sea Anemone, Corallium (any one), Gorgonia. Helminthes- Planaria, Liver fluke - Entire, Redia and Cercaria larva. Taenia (Entire and Scolex).	9
V	Spotters: Nematoda - Ascaris Male and Female. Annelida - Nereis, Leech. Arthropoda – Penaeus: Zoea, Nauplius, and Mysis. Peripatus, Millipede, Centipede, Sacculina, Limulus and Scorpion. Mollusca - Chiton, Oyster, Pila, Murex, Loligo, Sepia and Octopus. Echinodermata- Starfish, Sea Urchin, Sea Cucumber, Bipinnaria, Echinopluteus and Ophiopluteus larva.	9
	Total	**45**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Develop the knowledge on the visceral organs in the representative animals in the selected organ systems.	K1,K2, K3
2	Demonstrate the mounting techniques in the representative animals in the selected organ systems.	K1,K2, K3
3	Define the microscopic organisms to explain theirsurvival skills.	K1,K2,K3
4	Classify the specific characters, identifying structures inthe preserved, stuffed and dried animals.	K1,K2,K3,K4
5	Explain the biodiversity, environment through the specimens and their habitats.	K1,K2,K3,K4

K1-Knowledge K2-Understand K3-Apply K4-Analyze

Textbooks

1.	Kapoor, ***Practical Zoology***, Silver Line Publications, Allahabad, Uttrapradesh , 2014.
2.	Pechenik, Jan A – ***Biology of the Invertebrates***, Tata Mcgraw – Hill Pub. Company Ltd., New Delhi, 2014.
Reference Books	
1.	Vasantika Kashyap- ***Life of Invertebrates***, Second Revised Edition, Vikas Pub. House Pvt. Ltd., New Delhi, 2013.
2.	Kotpal, R.L -***Modern Text Book of Zoology***, Invertebrates (Animal diversity – I), Rastogi Publications, Meerut, 2012.
3.	Barnes, R.D- ***Invertebrate Zoology***, IV Edition, Holf Saunders International edition, 2006.
4.	Ekambaranatha Ayyar and Ananthakrishnan, T.N - A manual of Zoology, volume I, Invertebrate, Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai Kotpal, R.L, Vertebrates, Rastogi Publications, 2011.
e-Resources	
1.	http://www.csrtimys.res.in/

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	2
CO2	3	2	3	1	3
CO3	3	3	1	3	3
CO4	3	2	3	3	3
CO5	3	3	3	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	2
CO2	3	2	3	1	3
CO3	3	3	1	3	3
CO4	3	2	3	3	3
CO5	3	3	3	2	2

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LAB SCHEDULE

Module No.	Topic	No. of Hours
UNIT - I		
1.1	Invertebrates: Demonstration with charts: Cockroach - Nervous & Reproductive system	3
1.2	Mounting: Mouth parts and Salivary gland.	3
1.3	Earthworm - Digestive, Nervous systems & Reproductive	3

	system.	
UNIT - II		
2.1	Minor Dissection: Cockroach: Digestive system. Pila globosa: Digestive system (Including radula).	3
2.2	Mounting: Earthworm - Body setae and Penial setae.	3
2.3	Honey bee – Mouthparts and sting	3
UNIT - III		
3.1	Spotters- Protozoa - Amoeba, Euglena, Entamoeba	3
3.2	Plasmodium, Paramecium: Entire, Binary fission and conjugation.	3
3.3	Porifera- Sycon, Gemmules and Spicules.	3
UNIT - IV		
4.1	Spotters- Coelenterata - Obelia Colony, Medusa, Hydra	3
4.2	Physalia, Sea Anemone, Corallium (any one), Gorgonia.	3
4.3	Helminthes- Planaria, Liver fluke - Entire, Redia and Cercaria larva. Taenia (Entire and Scolex).	3
UNIT - V		
5.1	Spotters: Nematoda - Ascaris Male and Female. Annelida - Nereis, Leech.	3
5.2	Arthropoda – Penaeus: Zoea, Nauplius, and Mysis. Peripatus, Millipede, Centipede, Sacculina, Limulus and Scorpion.	3
5.3	Mollusca - Chiton, Oyster, Pila, Murex, Loligo, Sepia and Octopus. Echinodermata- Starfish, Sea Urchin, Sea Cucumber, Bipinnaria, Echinopluteus and Ophiopluteus larva.	3
Total		**45**

Course Designer

Name: Dr. M. Ashiq Ur Rahman

Assistant Professor of Zoology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UCHGE11	**ALLIED CHEMISTRY - I**	**Generic Elective-I**	**4**	**3**	**25**	**75**	**100**

Course Objectives		
To understand the properties of hydrogen, oxides, water, colloids and concept of carbohydrates, chemical bonding, amino acids, proteins and dyes.		
UNIT	**Contents**	**No. of Hours**
I	**Hydrogen**: Isotopes of hydrogen – preparation, properties and uses of heavy hydrogen. **Hydrides** – definition – classification – examples. **Oxides** – Definition – classification – examples. **Water**: Hardness of water – types of hardness – removal of hardness – industrial implications of hardness in water – Units of hardness of water.	12
II	**Colloids:** Colloidal states of matter – various types – classification - Sols – dialysis - electrodialysis – electro osmosis – electrophoresis – stability of colloids – protective action – Hardy Schulze law – gold number - Emulsion: Types of emulsions – emulsifier with examples - Gels: Classification, preparation - Applications of colloids.	12
III	**Carbohydrates:** Definition – classification – monosaccharides – properties and uses of glucose and fructose – Haworth structure (glucose only) – conversion of glucose to fructose and vice versa, mutarotation - Disaccharides: Sucrose (Structure only) – distinction between sucrose, glucose and fructose - Polysaccharides: Starch and cellulose (Structure only).	12
IV	**Chemical Bonding:** Orbitals – shapes of s and p orbitals – principle of hybridization – sp, sp^2 and sp^3 hybridisation – methane, ethylene and acetylene – VSEPR theory - $BeC\ell_2$, BF_3, CH_4, $PC\ell_5$, SF_6, IF_7, H_2O and NH_3 - M.O. theory: Formation of M.O's – bonding and antibonding and non – bonding. M.O.'s – M.O. diagram for H_2, He and F_2.	12
V	**Amino acids and proteins:** Classification – synthesis - Gabriel phthalimide – Strecker – Hell-Volhard-Zelinsky synthesis – properties of amino acids – action of heat, dipolar ion, iso-electric point, and Ruhemann's purple - polypeptides – proteins – classification and biological functions. **Dyes:** Definition – theory of colour and constitution – classification based on structure and applications – preparation of methyl orange – Bismark brown, malachite green – vat dye – indigo.	12
Total		**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	

1	Describe the preparation and properties of hydrides, oxides, hardness of water and its implications.	K1, K2
2	Classify the colloidal states of matter and its applications.	K1, K2, K3, K4
3	Demonstrate the reactions of glucose, fructose and sucrose and relate their uses.	K1, K2
4	Identify the concept of orbitals, hybridization, VSEPR and MO theories.	K1, K2, K3
5	Illustrate the properties, classification and functions of proteins and dyes.	K1, K2, K3, K4
K1-Knowledge	**K2-Understand**	**K3-Apply** **K4-Analyze**
Text books		
1.	S.Vaithyanathan, ***Text book of Ancillary Chemistry***; Priya Publications, Karur,2006.	
2.	V.Veeraiyan, ***Text book of Ancillary Chemistry***; High mount publishing house, Chennai, first edition, 2009.	
Reference Books		
1.	B. S. Bahl & Arun Bahl, ***Advanced Organic Chemistry***, S. Chand & Company, New Delhi, 22nd edition, 2022.	
2.	B.R. Puri and L.R. Sharma and Madan S. Pathania, ***Principles of Physical Chemistry***, Vishal Publishing Co., Jalandhar, 50th edition, 2025.	
3.	R.D. Madan, ***Modern Inorganic Chemistry***, S. Chand, 2013.	
e-Resources		
1.	https://onlinecourses.nptel.ac.in/	
2.	https://swayam.gov.in/course/	

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	3	2	2	3
CO3	3	2	3	3	2
CO4	3	2	2	3	3
CO5	3	3	3	2	3

Strong-3 **Medium-2** **Low-1**

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2
CO2	3	3	3	2	3
CO3	3	3	2	3	3
CO4	3	2	3	3	2
CO5	3	3	3	2	3

Strong-3 **Medium-2** **Low-1**

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT - I	
1.1	Isotopes of hydrogen – preparation, properties and uses of heavy hydrogen	2
1.2	Hydrides – definition – classification – examples	2
1.3	Oxides – Definition – classification – examples	2
1.4	Hardness of water – types of hardness - Removal of hardness - industrial implications of hardness in water - Units of hardness of water.	6
	UNIT - II	
2.1	Colloidal states of matter – various types – classification	2
2.2	Sols – dialysis – electro osmosis – electrophoresis	2
2.3	Stability of colloids – protective action – Hardy Schulze law – gold number	2
2.4	Types of emulsions – emulsifier with examples	3
2.5	Classification, preparation - Applications of colloids	3
	UNIT - III	
3.1	Carbohydrates: Definition – classification – monosaccharides – properties and uses of glucose and fructose	4
3.2	Haworth structure of glucose-mutarotation- Conversion of glucose to fructose and vice versa.	4
3.3	Sucrose – structure – distinction between sucrose, glucose and fructose	2
3.4	Polysaccharides: Starch and cellulose (Structure only).	2
	UNIT - IV	
4.1	Chemical Bonding: Orbitals – shapes of s and p orbitals – principle of hybridization.	3
4.2	sp, sp^2 and sp^3 hybridisation – methane, ethylene and acetylene.	3
4.3	VSEPR theory - $BeC\ell_2$, BF_3, CH_4, $PC\ell_5$, SF_6, IF_7, H_2O and NH_3.	3
4.4	M.O. theory: Formation of M.O's – bonding and antibonding and non – bonding. M.O.'s – M.O. diagram for H_2, He and F_2.	3
	UNIT - V	
5.1	Amino acids and proteins: Classification – synthesis - Gabriel phthalimide – Strecker – Hell-Volhard-Zelinsky synthesis.	2
5.2	Properties of amino acids – action of heat, dipolar ion, iso-electric point, and Ruhemann's purple.	3
5.3	Polypeptides – proteins – classification and biological functions.	2
5.4	Dyes: Definition – theory of colour and constitution – classification based on structure and applications.	2
5.5	Preparation of methyl orange – Bismark brown, malachite green – vat dye – indigo.	3
	Total	**60**

Course Designer

Name: Dr. M. Jannathul Firdhouse

Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UZYFN11	**FUNDAMENTALS OF ZOOLOGY**	**Foundation Course (SEC)(MCQ)**	**2**	**2**	**25**	**75**	**100**

Course Objectives		
This course provides an introduction to the fundamental concepts, scope, and branches of Zoology, along with basic laboratory practices, scientific methods, and awareness of major zoological institutions, forming a foundation for biological studies.		
UNIT	**Contents**	**No. of Hours**
I	Introduction to Zoology- Father of Zoology Scope of zoology - Explain in brief account on Structural Zoology (Morphology, Anatomy, Histology, Cytology) -Developmental Zoology- Functional Zoology(Animal Physiology, Ethology)- Systemic Zoology (Protozoology, Entomology, Conchology, Malacology, Ichthyology. Herpetology, Ornithology, Mammalogy, Helminthology, Apiculture, Anthropology, Carcinology)- Distributional Zoology- Historical Zoology (Palaeontology, Phylogeny, Evolution) -Medical Zoology and Economic Zoology	6
II	Steps for the preservation of specimens for scientific study- both microscopic and macroscopic in formalin, study skins, mounted specimens, skeletal material, casts, pinned insects, dried material, animals preserved in liquid-preservatives, models and microscope slides.	6
III	Laboratory and Safety Rules Animal Care in lab, safety protocols for microbes study in the laboratory safety preparations for Field Activities -safety precautions for demonstration of animal dissections	6
IV	Scientific methods steps observation, prediction, experiment, hypothesis, consistency, theory scientific theory, scientific law impact of science in human life: positive and negative aspects	6
V	Institutes of Zoological and Scientific importance in India Location, major achievements and present activities of following academic and scientific organizations: Zoological Survey of India, Central Marine Fisheries Research Institute, Central Institute of Fisheries Technology, Rajiv Gandhi Centre for Biotechnology, Bioinformatics Centre and Library, Indian Institute of Science, Stem Cell Institute, National Institute of Immunology, Centre for Cellular & Molecular Biology, Centre for DNA Fingerprinting and Diagnostics, Central Drug Research Institute	6
	Total	**30**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	To understand the **scope, branches, and applications of Zoology** in biological and human welfare.	K1, K2

2	To explain the basic techniques of preservation and preparation of zoological specimens for scientific study.	K2, K3
3	To follow ethical practices, animal care principles, and laboratory safety protocols in zoological studies.	K2, K3
4	To apply the scientific method and scientific reasoning to understand biological processes and their societal impact..	K2, K3, K4
5	To identify major zoological and scientific institutions in India and understand their research contributions.	K1, K2
K1-Knowledge K2-Understand K3-Apply K4-Analyze		
Textbooks		
1.	Hickman, C.P., Jr., Roberts, L.S., & Larson, A. ***Integrated Principles of Zoology***, 16th Edition, McGraw-Hill Education.	
2.	Agarwal, V.K.S. ***Zoology for Degree Students*** (B.Sc. Hons. 1st Semester, as per UGC CBCS), Chand Publishing, 2017.	
Reference Books		
1.	Kotpal, R.L. ***Modern Text Book of Zoology***: Invertebrates & Vertebrates, Rastogi Publications.	
2.	Barnes, R.D. ***Invertebrate Zoology***, 6th Edition, Saunders.	

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	2	2
CO2	2	3	2	2	1
CO3	1	3	2	3	1
CO4	2	2	3	2	1
CO5	1	1	2	1	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	2
CO2	2	3	2	2	1
CO3	1	3	2	3	1
CO4	2	2	3	2	1
CO5	1	1	2	1	3

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
UNIT - I		
1.1	Introduction to Zoology- Father of Zoology Scope of zoology - Explain in brief account on Structural Zoology	2

	(Morphology, Anatomy, Histology, Cytology)	
1.2	Developmental Zoology- Functional Zoology(Animal Physiology, Ethology)- Systemic Zoology (Protozoology, Entomology, Conchology, Malacology, Ichthyology. Herpetology, Ornithology, Mammalogy.	2
1.3	Helminthology, Apiculture, Anthropology, Carcinology)- Distributional Zoology- Historical Zoology (Palaeontology, Phylogeny, Evolution) -Medical Zoology and Economic Zoology.	2
UNIT - II		
2.1	Steps for the preservation of specimens for scientific study- both microscopic and macroscopic in formalin.	2
2.2	Study skins, mounted specimens, skeletal material, casts, pinned insects, dried material.	2
2.3	Animals preserved in liquid-preservatives, models and microscope slides.	2
UNIT - III		
3.1	Laboratory and Safety Rules Animal Care in lab, safety protocols for microbes	2
3.2	Study in the laboratory safety preparations for Field Activities	2
3.3	Safety precautions for demonstration of animal dissections	2
UNIT - IV		
4.1	Scientific methods steps observation, prediction.	2
4.2	Experiment, hypothesis, consistency, theory scientific theory	2
4.2	Scientific law impact of science in human life: positive and negative aspects.	2
UNIT - V		
5.1	Institutes of Zoological and Scientific importance in India Location, major achievements and present activities of following academic.	2
5.2	Scientific organizations: Zoological Survey of India, Central Marine Fisheries Research Institute, Central Institute of Fisheries Technology, Rajiv Gandhi Centre for Biotechnology, Bioinformatics Centre and Library.	2
5.3	Indian Institute of Science, Stem Cell Institute, National Institute of Immunology,	1
5.4	Centre for Cellular & Molecular Biology, Centre for DNA Fingerprinting and Diagnostics, Central Drug Research Institute.	1
Total		**30**

Course Designer

Name: Dr. M. Mohiadeen Batcha.

Assistant Professor of Zoology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UZYCC21	**CHORDATA**	**Core–III**	**5**	**5**	**25**	**75**	**100**

Course Objectives		
To enable the students acquire knowledge on general features, classification and evolution of chordates and study of organs and organ systems to understand their functional aspects		
UNIT	**Contents**	**No. of Hours**
I	**Prochordates:** Chordate characteristics, Outline classification up to classlevel with examples. Type study: Amphioxus External morphology, feedingand digestion. General topics: Retrogressive metamorphosis in Ascidian, Affinities of Balanoglossus.	15
II	**Pisces & Amphibia:** Classification of Fishes & Amphibians upto class level with examples. Type study: Shark-External morphology, feeding and digestion. Type study: Frog-External morphology Respiratory system. General topics: Migration of Fishes-Parental care in Amphibia	15
III	**Reptiles:** Classification of Reptiles upto class level with examples. Type study: Calotes- External, Reproduction and life cycle. General essay: Poisonous and non-poisonous snakes – Identification and Biting mechanism. Origin -dominance and decline of Mesozoic reptiles-Temporal Fossae & Arcades	15
IV	**Aves:** Classification of Aves upto orders level with examples. Type study: Pigeon– External morphology, Respiratory system, Pectoral and Pelvic girdles only. General essay: Flight adaptations in birds-Archraeopteryx and its Evolutionary importance.	15
V	**Mammals:** Classification of Mammals upto order level with examples. Type study: Rabbit - External morphology, Digestive system, Nervous system and Urinogenital system only. General topics: Dentition in mammals-Adaptation of aquatic mammals.	15
	Total	**75**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Learn the general characteristics, classification with common examples of chordates, Prochordates specialized characters and peculiar development	K1, K2
2	Understand the comparative external features of various vertebrates	K2
3	Knowledge on morphological and anatomical features of vertebrates	K2, K3
4	Acquire knowledge on organs of communicative and sensory systems of vertebrates	K1, K3,K4

5	Understand the structural organization of skeletal system in vertebrates	K1, K2, K3,K4
K1-Knowledge K2-Understand K3-Apply K4-Analyze		
Textbooks		
1.	Jordan, E.I. and Verma, P.S. – ***Chordate Zoology***, Chand & Co Limited, New Delhi. 2013.	
Reference Books		
1.	Ekambaranatha Ayyar and Ananthakrishnan, T.N. ***A manual of Zoology, volume II, Chordata***, Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai. 2013.	
2.	Kotpal, R.L. ***Modern Text Book of Zoology***, Vertebrates, Rastogi Publications, Meerut, 2014.	
3.	Gupta R.C and Girish Chopra, ***Comparative Anatomy of Chordates***–R.Chand & Co, New Delhi. 2003.	
4.	Harvey Pough F., Heifer ,J.B. and Mc Farland, W.N. Vertebrate life, Macmillan Pub. Co. NewYork. 1985.	
e-Resources		
1.	http://tolweb.org/Chordata/2499	

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	3	1
CO2	2	2	1	3	1
CO3	3	1	2	1	1
CO4	2	3	1	2	1
CO5	3	2	1	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	1
CO2	2	2	1	3	1
CO3	3	1	2	1	1
CO4	2	3	1	2	1
CO5	3	2	1	2	2

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
UNIT - I		
1.1	Chordata characteristics, Outline classification upto class level with examples.	5

1.2	Type study: Amphioxus - External morphology, feeding and digestion.	5
1.3	Retrogressive metamorphosis in Ascidian, Affinities of Balanoglossus.	5
UNIT - II		
2.1	Classification of Fishes & Amphibians upto class level with examples.	5
2.2	Type study: Shark - External morphology, feeding and digestion.	5
2.3	Type study :Frog - External & Respiration. Migration of Fishes- Parental care in Amphibia.	5
UNIT - III		
3.1	Classification of Reptiles upto class level with examples Type study: Calotes- External, Reproduction & life cycle.	5
3.2	Circulatory system only. Poisonous and non-poisonous snakes, Identification and Biting mechanism.	5
3.3	Origin -dominance and decline of Mesozoic reptiles-Temporal Fossae & Arcades	5
UNIT - IV		
4.1	Classification of Aves upto orders level with examples. Type study: Pigeon – External morphology,	5
4.2	Respiratory system, Pectoral and Pelvic girdles only.	5
4.3	General topics: Flight adaptations in birds- Archraeopteryx and its Evolutionary importance.	5
UNIT - V		
5.1	Classification of Mammals upto orders level with examples. **Type study: Rabbit -** External morphology,	5
5.2	Digestive system, Nervous system, Urinogenital system only	5
5.3	**General topics:** Dentition in mammals, Adaptation of aquatic mammals.	5
Total		**75**

Course Designer

Name: Dr. M. Mohiadeen Batcha.

Assistant Professor of Zoology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UZYCC2P	**ZOOLOGY LAB - II**	**Core–II**	**2**	**2**	**40**	**60**	**100**

Course Objectives

Visualize, analyze and observe the various types of organisms in chordate, their organ systems, adaptations, their diversity and behavioral patterns besides the basics of cell biology.

UNIT	Contents	No. of Hours
I	**Chordates:** Demonstration with Biovisual charts: Fish: Shark Cranial nerves - 5th Cranial nerve, 9th and 10th cranial nerves, Frog: External features, Digestive system, Arterial system, Venous system, Male and female urinogenital system.	6
II	**Mounting:** Fish: Cycloid, Ctenoid and Placoid scales. Osteology: Frog: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvic girdle, Forelimb, Hindlimb. Pigeon - skull and lower jaw, synsacrum.	6
III	**Spotters:** Amphioxus, Balanoglossus, Ascidian, Petromyzon, Narcine, Hippocampus, Eel, Echieneis, Labeo, Catla, Rohu, Channa, Bufo, Rana, Axolotl larva, Krait, Cobra, Viper, Enhydrina, and Chameleon.	6
IV	**Spotters:** Aves: Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, and Down feathers. Mammalia: Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Rabbit.	6
V	**Cell Biology** (Bio visual charts/ Models): Bacterial Cell, Plant Cell and Animal Cell. Nucleus, Mitochondria, Golgi apparatus, Endoplasmic reticulum, Ribosome.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Develop the knowledge on the visceral organs in the representative animals in the selected organ systems.	K1,K2, K3
2	Demonstrate the mounting techniques in the representative animals in the selected organ systems.	K1,K2, K3
3	Define the microscopic organisms to explain theirsurvival skills.	K1,K2,K3
4	Classify the specific characters, identifying structures inthe preserved, stuffed and dried animals.	K1,K2,K3,K4
5	Explain the structure of cell and its organelles	K1,K2,K4

K1-Knowledge K2-Understand K3-Apply K4-Analyze

Textbooks

1.	Kapoor, ***Practical Zoology***, Silver Line Publications, Allahabad, Uttrapradesh , 2014.
2.	Dr. Renu Gupta, ***Cell biology practical manual***, Prestige publication, ISBN-108193651219, Jan 2018.
Reference Books	
1.	***Practical Zoology vertebrates***, by SS Lal, Rastogi Publications.
2.	***Chordate Zoology***, PS Dhami and JK Dhami, S Chand & Co., Delhi.
3.	***A Manual of Practical Zoology Chordates***, by Dr. P. S. Verma, S Chand and Co. 2010.
4.	Kotpal, R.L, ***Modern Text Book of Zoology*** : VERTEBRATES, Rastogi Publications, 2011.

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	2
CO2	3	2	3	1	3
CO3	3	3	1	3	3
CO4	3	2	3	3	3
CO5	3	3	3	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	2
CO2	3	2	3	1	3
CO3	3	3	1	3	3
CO4	3	2	3	3	3
CO5	3	3	3	2	2

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LAB SCHEDULE

Module No.	Topic	No. of Hours
UNIT - I		
1.1	Chordates: Demonstration with charts: Fish: Shark Cranial nerves - 5th Cranial nerve, 9th and 10th cranial nerves	2
1.2	Frog: External features, Digestive system, Arterial system	2
1.3	Venous system, Male and female urinogenital system.	2
UNIT - II		
2.1	Mounting: Fish: Cycloid, Ctenoid and Placoid scales.	2
2.2	Osteology: Frog: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvic girdle, Forelimb, Hindlimb.	2

2.3	Pigeon - skull and lower jaw, synsacrum.	2
UNIT - III		
3.1	Spotters: Amphioxus, Balanoglossus, Ascidian	2
3.2	Petromyzon, Narcine, Hippocampus, Eel, Echieneis, Labeo, Catla, Rohu, Channa,	2
3.3	Bufo, Rana, Axolotl larva, Krait, Cobra, Viper, Enhydrina, and Chameleon.	2
UNIT - IV		
4.1	Spotters: Aves: Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo;	2
4.2	Collection and study of different types of feathers: Quill, Contour, Filoplume, and Down feathers.	2
4.3	Mammalia: Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Rabbit.	2
UNIT - V		
5.1	Cell Biology (Bio visual charts/ Models) : Bacterial Cell, Plant Cell and Animal Cell.	2
5.2	Nucleus, Mitochondria, Golgi apparatus,	2
5.3	Endoplasmic reticulum, Ribosome.	2
Total		**30**

Course Designer

Name: Dr. M. Ashiq Ur Rahman

Assistant Professor of Zoology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UZYCC22	**CELL BIOLOGY**	**Core–V**	**5**	**5**	**25**	**75**	**100**

Course Objectives		
Cell biology explains the fundamental concepts of cell organelles and its function.		
UNIT	**Contents**	**No. of Hours**
I	**Discovery and History of cell**-Cell theory- Salient features of cell theory, Ultrastructure of plant-bacterial and animal cells; Microscopy and its types-Staining-types of staining and Cyto-chemical staining methods; Centrifugation-Ultra centrifuge-Sedimentation co-efficient.	15
II	**Plasma membrane:** Ultrastructure– Chemical composition-Functions-modifications of Plasma membrane- Physical properties of plasma membrane; Endoplasmic reticulum: Origin-Morphology-Ultrastructure-chemical composition functions; Golgi complex: Origin- Ultrastructure-chemical composition and functions.	15
III	**Lysosomes:** Origin-Ultra structure and polymorphism-chemical composition and functions: Peroxisomes- Glyoxysomes. Mitochondria: Ultrastructure-chemical composition-enzyme systems- functions-Centrosome- Structure and Function.	15
IV	**Ribosomes:** Ultra structure- types- chemical composition-functions. Biogenesis of 80S and 70S ribosome. Nucleus and Nucleolus: Ultra structure and functions. Nucleic Acids: DNA- Ultra structure replication-transcription- RNA- Types-Genetic code and protein synthesis.	15
V	**Chromosomes:** Ultra structure of Chromosomes Special types of Chromosomes and functions- Cell division- mitosis and meiosis. Cancer: Characteristics and types. Aging of cells, Apoptosis and Stemcells.	15
	Total	**75**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Tell the fundamentals of cell structures and organelles	K1
2	Explain the role, structure and functions of plasma membrane	K1,K2
3	Identify various enzymes present inside the cell and calculate the amount of energy generated after cell respiration	K1,K2,K3
4	Summarize the role of nucleic acids, genetic code and protein synthesis	K1,K2,K4
5	Collect knowledge on different phases of cell cycle and experiment with mitosis and meiosis besides understanding cancer cells and stem cells	K1,K2,K3,K4

K1-Knowledge	K2-Understand	K3-Apply	K4-Analyze

Textbooks	
1.	Powar, C.B., ***Cell Biology***, Himalayan Publishing House, New Delhi, 2009.
2.	Rastogi, Veer Bala. ***Introductory Cytology***. Revised ed., Kedar Nath Ram Nath, 2018.
Reference Books	
1.	Verma, P. S., and V. K. Agarwal. Cell Biology, Genetics, ***Molecular Biology***, Evolution and Ecology. S. Chand Publishing, 2022.
2.	De Roberties E.D.P and E.M.F. De Roberties, ***Cell and Molecular Biology***, B.I. Publi cations Pvt. Ltd., India, 2011, 8th edition.
3.	Verma, P.S. and V. K. Agarwal, 1995. ***Cell and Molecular Biology***, 8th Edition, S.Chand & co., New Delhi - 110 055.
4.	Paul, A. , ***Cell and Molecular Biology***, Books and Allied (P) Ltd, NewDelhi, 2009.
e-Resources	
1.	http://www.microscopemaster.com/organelles.html

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	3
CO2	3	1	3	3	1
CO3	3	3	3	3	2
CO4	2	3	1	3	2
CO5	3	1	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	3
CO2	3	1	3	3	1
CO3	3	3	3	3	2
CO4	2	3	1	3	2
CO5	3	1	3	3	3

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT - I	
1.1	Discovery and history of cell and cell theory-Salient features of cell theory.	3
1.2	Ultra structure of plant-bacterial and animal cells. Microcopy and its types.	3
1.3	Staining-types of staining and	3

1.4	Cyto-chemical staining methods	2
1.5	Centrifugation-Ultra centrifuge	2
1.6	Sedimentationco-efficient	2
UNIT - II		
2.1	Functions- modifications of Plasma membrane: Ultra structure. Chemical compositions	2
2.2	Physical Properties of Plasma membrane.	2
2.3	Endoplasmic reticulum: Origin-Morphology-Ultra structure	2
2.4	Chemical composition-functions of ER	2
2.5	Golgi complex: Ultrastructure	2
2.6	Chemical composition of Golgi apparatus	2
2.7	Functions of Golgi apparatus	3
UNIT - III		
3.1	Lysosomes: Origin, and Ultra structure polymorphism	3
3.2	Chemical composition and functions.	3
3.3	Peroxisomes- Glyoxysomes	3
3.4	Mitochondria: Ultrastructure- chemical composition	2
3.5	Enzyme systems- functions	2
3.6	Centrosome- Structure and Function	2
UNIT - IV		
4.1	Ribosomes: Ultra structure- types-chemical composition- functions.	5
4.2	Nucleus and Nucleolus: Ultra structure and functions Biogenesis of 80 S and 70SRibosome.	5
4.3	Nucleic Acids: DNA- Ultra structure replication- transcription- RNA- Types- Genetic code and protein synthesis.	5
UNIT - V		
5.1	Chromosomes: Ultra structure of Chromosomes- Special types of Chromosomes and functions.	3
5.2	Cell division- mitosis and meiosis	5
5.3	Cancer: Characteristics and types.	3
5.4	Aging of cells, Apoptosis and	2
5.5	Stemcells	2
Total		**75**

Course Designer

Name: Dr. M. Ashiq Ur Rahman

Assistant Professor of Zoology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UCHGE21	**ALLIED CHEMISTRY - II**	**Generic Elective -II**	**4**	**3**	**25**	**75**	**100**

Course Objectives

To identify the concept of photochemistry, coordination compounds, chromatographic technique, chemotherapy and nuclear chemistry.

UNIT	Contents	No. of Hours
I	**Photochemistry:** Comparison of thermal and photochemical reactions – definition of photochemical reactions – laws of photochemistry – Grotthus-Draper law – Einstein law – quantum efficiency – reasons for low and high quantum yield with examples – consequence of light absorption by atoms and molecules – Jablonski diagram – fluorescence – phosphorescence – photosensitization - mechanism – chemiluminescence – bioluminescence – applications of photochemistry.	12
II	**Coordination compounds:** Definition – nomenclature – definition of various terms involved in coordination chemistry – classification of ligands - Werner's theory, Valence Bond theory (VBT) - EAN rule – Nickel carbonyl – chelates.	12
III	**Chromatographic technique:** Principle – classification -adsorption and partition chromatography- thin layer chromatography – column chromatography (adsorption) – paper Chromatography – gas-solid and gas-liquid chromatography- applications of each type - ion exchange chromatography.	12
IV	**Sulpha drugs:** Sulphadiazine – Sulphanilamide – Preparation and applications. **Antimalarials:** Chloroquine and Plasmoquine. **Arsenical drugs:** Salvarasan – 606 and Neosalvarasan. **Antibiotics:** Definition – classification – Penicillin - Amoxicillin – Ampicillin – Tetracyclin– Streptomycin – mode of application – uses only.	12
V	**Nuclear Chemistry:** Composition of the nucleus – nuclear forces – mass defect – binding energy – nuclear stability – Soddy and Fajan's group displacement law – Nuclear fission: Overview – application of fission – principle of atom bomb - Nuclear fusion: Emission of energy – Stellar energy – hydrogen bomb - Applications of radioactive isotopes.	12
Total		**60**
Course Outcomes		

CO	On completion of this course, students will	Knowledge Level
1	Describe the physical concepts of photochemistry.	K1, K2
2	Explain the basic terms, isomerism and theories involved in coordination compound.	K1, K2
3	Apply the column, thin layer and paper chromatographic techniques to separate and identify the components present in a mixture.	K1, K2, K3
4	Classify the chemotherapy drugs such as sulpha, antimalarials, antibiotics and arsenical drugs.	K1, K2, K3, K4
5	Examine the concept of nuclear chemistry and its applications.	K1, K2, K3, K4

K1-Knowledge K2-Understand K3-Apply K4-Analyze

Text books	
1.	P.L.Soni, Mohan Katyal, ***Text book of Inorganic chemistry***; Sultan Chand and Company, New Delhi, twentieth edition,2007.
2.	S.Vaithyanathan, ***Text book of Ancillary Chemistry***; Priya Publications, Karur, 2006.
Reference Books	
1.	B. S. Bahl & Arun Bahl, ***Advanced Organic Chemistry***, S. Chand & Company, New Delhi, 22nd edition, 2022.
2.	B.R. Puri and L.R. Sharma and Madan S. Pathania, ***Principles of Physical Chemistry***, Vishal Publishing Co., Jalandhar, 50th edition, 2025.
3.	R.D. Madan, ***Modern Inorganic Chemistry***, S. Chand Publishers, 2013.
e-Resources	
1.	https://onlinecourses.nptel.ac.in/
2.	https://swayam.gov.in/course/

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	3	3	3	2	2
CO3	3	2	2	3	3
CO4	3	2	3	3	3
CO5	3	3	3	3	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	3	3	3	2	3
CO3	3	2	3	3	3
CO4	3	3	2	3	3
CO5	3	3	3	2	3

Strong-3 Medium-2 Low-1

COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
	UNIT - I	
1.1	Comparison of thermal and photochemical reactions – definition of photochemical reactions	2
1.2	Laws of photochemistry – Grotthus-Draper law – Einstein law	2
1.3	Quantum efficiency – reasons for low and high quantum yield with examples	2
1.4	Consequence of light absorption by atoms and molecules – Jablonski diagram – fluorescence – phosphorescence	3
1.5	Photosensitization – chemiluminescence – bioluminescence – applications of photochemistry	3
	UNIT - II	
2.1	Coordination compounds: nomenclature – definition of various terms involved in coordination chemistry	4
2.2	Classification of ligands-Werner's theory, EAN rule	4
2.3	Valence Bond theory – Nickel carbonyl – chelates	4
	UNIT - III	
3.1	Chromatographic technique: Principle – classification - adsorption and partition Chromatography	4
3.2	Thin layer chromatography – column chromatography (adsorption) – paper Chromatography	4
3.3	Gas-solid and gas-liquid chromatography- ion exchange chromatography- applications.	4
	UNIT - IV	
4.1	Sulpha drugs – sulphadiazine – sulphanilamide –preparation and applications	3
4.2	Antimalarials: chloroquine and plasmoquine –preparation and applications	3
4.3	Arsenical drugs: Salvarasan – 606 and neosalvarasan-preparation and applications	3
4.4	Antibiotics: Definition – classification – penicillin - amoxicillin – ampicillin – tetracyclin– streptomycin – mode of application – uses only	3
	UNIT - V	
5.1	Nuclear Chemistry: Composition of the nucleus – nuclear forces – mass defect – binding energy – nuclear stability - Soddy's group displacement law – illustration.	4
5.2	Nuclear fission: Definition – application of fission – principle of atom bomb - Nuclear fusion: Definition – emission of energy – Stellar energy – hydrogen bomb	4
5.3	Applications of radioactive isotopes.	4
	Total	**60**

Course Designer
Name: Dr. M. Jannathul Firdhouse
Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UCHGE2P	**VOLUMETRIC ANALYSIS FOR ALLIED CHEMISTRY**	**Generic Elective –II (Lab)**	**2**	**2**	**40**	**60**	**100**

Course Objectives		
To enable the students to acquire the quantitative skills in volumetric analysis and to calibrate burette, pipette and standard flask.		
UNIT	**Contents**	**No. of Hours**
I	The essential apparatus used in the volumetric analysis. Concepts of molecular weight, equivalent weight, normality and calculation. A double titration involving the making up of the given solution to be estimated and the preparation of a primary standard solution.	12
II	**Laboratory hygiene and safety:** Handling of concentrated acids, bases and hazardous chemicals, Carcinogenic chemicals, Safety precautions, fire hazards and first aid procedures for laboratory accidents - poisoning – universal antidote.	12
III	**Acidimetry and Alkalimetry** 1. Titration between a strong acid and strong base. 2. Titration between a strong acid and weak base. 3. Titration between a weak acid and strong base.	12
IV	**Permanganometry** 1. Titration between $KMnO_4$ and oxalic acid 2. Titration between $KMnO_4$ and ferrous sulphate 3. Titration between $KMnO_4$ and Mohr's salt (Ferrous ammonium sulphate)	12
V	**Iodometry** 1. Titration between sodium thiosulphate and potassium dichromate 2. Titration between sodium thiosulphate and copper sulphate	12
Total		**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Simplify basic quantitative skills in volumetric analysis with the use of burette, pipettes and standard flasks.	K1, K2, K3, K4
2	Inspect the laboratory hygiene and safety.	K1, K2, K3, K4
3	Apply acidimetric and alkalimetric method for the quantitative volumetric estimation of acids and bases.	K1, K2, K3

4	Estimate the amount of oxalic acid, ferrous sulphate and Mohr's salt permanganometrically.	K1, K2, K3
5	Analyze quantitatively the potassium dichromate and copper sulphate iodometrically.	K1, K2, K3, K4
K1-Knowledge	**K2-Understand**	**K3-Apply** **K4-Analyze**
Text books		
1.	**O. P. Pandey, D. N. Bajpai & S. Giri, *Practical Chemistry*** *(For B.Sc.)* – S. Chand Publishing, 2010.	
2.	Sundaram, Krishnan, Raghavan, ***Practical Chemistry*** *(Part II),* S. Viswanathan Co. Pvt., 1996.	
Reference Books		
1.	Basset, *J.* Mendham, R.C. *Denney*, ***Vogel's* Textbook of *Quantitative Chemical Analysis***, *Longman Scientific* & *Technical*, New York, 1989, 5th Edition.	
2.	V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, ***Basic Principles of Practical Chemistry***, Sultan Chand & Sons, New Delhi, 2004, 2nd Edition.	
e-Recourses		
1.	http://www.federica.unina.it/agraria/analyticalchemistry/volumetric-analysis	
2.	https://chemdictionary.org/titration-indicator/	

Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
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CO3	3	3	3	3	3
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CO5	3	3	3	3	2

Strong-3 **Medium-2** **Low-1**

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
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CO2	3	3	3	3	3
CO3	3	3	2	3	2
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 **Medium-2** **Low-1**

COURSE CONTENTS AND LAB SCHEDULE

Module No.	Topic	No. of Hours
UNIT - I		
1.1	The essential apparatus used in the volumetric analysis.	4

1.2	Concepts of molecular weight, equivalent weight, normality and calculation.	4
1.3	A double titration involving the making up of the solution to be estimated and the preparation of a primary standard.	4
UNIT - II		
2.1	Handling of concentrated acids, bases and hazardous chemicals and Carcinogenic chemicals.	4
2.2	Safety precautions, fire hazards and first aid procedures for laboratory accidents	4
2.3	Poisoning – universal antidote.	4
UNIT – III		
3.1	Titrations between a strong acid versus strong base.	4
3.2	Titrations between a strong acid versus weak base.	4
3.3	Titrations between a weak acid versus strong base.	4
UNIT – IV		
4.1	Titration between $KMnO_4$ against oxalic acid	4
4.2	Titration between $KMnO_4$ against ferrous sulphate	4
4.3	Titration between $KMnO_4$ against Mohr's salt (Ferrous ammonium sulphate)	4
UNIT - V		
5.1	Titration between sodium thiosulphate versus potassium dichromate	6
5.2	Titration between sodium thiosulpate versus copper sulphate	6
Total		**60**

Course Designer
Name: Ms. A. Ismath Raihana
Assistant Professor of Chemistry