HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd Cycle)
Uthamapalayam -625533.

DEPARTMENT OF ZOOLOGY

BACHELOR OF SCIENCE – ZOOLOGY

SYLLABUS

Choice Based Credit System – CBCS

(As per TANSCHE/MKU Guidelines)

With

Outcome Based Education (OBE)

(with effect from Academic year 2023 -2024 onwards)

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.

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 duly-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 continuous forever

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 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

REGULATIONS AND SYLLABUS for B.Sc., Zoology Major

(This will come in to force from the academic year2023-2024 onwards)

Objectives of the programme:

The B.Sc. Zoology programme is designed to help the students to:

1. To get basic skills in the observation and study of animals, plants, nature, biological techniques, chemical tech, experimental skills and scientific investigation.
2. To study the invertebrate animals and vertebrate animals with interest in and love of nature with its myriad living creatures.
3. To get basic knowledge and skills in certain applied branches to enable them for self-employment in Apiculture, Sericulture, sericulture, poultry form and aquaculture.
4. To understand the awareness of the conservation of the biosphere and wild life.
5. To understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance.
6. Impart basic knowledge of various branches of Zoology and General biology meant both for a graduate terminal course and for higher studies on M.Sc. M.Phil., and Research.

2. Out Come of the Programme:

The graduate of this programme should be able to-

1. Identify and list out common animals.
2. Explain various physiological changes in our bodies.
3. Analyse the impact of environment on our bodies.
4. Understand various genet cab formalities.
5. Develop respect for nature.
6. Explain the role and impact of different environmental conserve action programmers.
7. Identify animals beneficial to humans.
8. Identify various potential risk factors to health of humans.
9. Explain the importance of genetic engineering.
10. Use tools of information technology for all activities related to zoology.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAME WORK FORUNDER GRADUATE EDUCATION	
Programme:	**B.Sc. Zoology**
Duration:	**3years[UG]**
	PO1: Disciplinary knowledge: Capable of demon starting comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study

	PO2: Communication Skills: Ability to express thoughts and ideaseffectivelyinwritingandorally;Communicatewithothersusingappropriatemedia;confidentlyshareone'sviewsandexpressherself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
Programme Out comes:	**PO3: Critical thinking:** Capability to apply analytic thought to a bodyofknowledge;analyseandevaluateevidence,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: Problem solving: 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:Analyticalreasoning: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.
	PO6: Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognizes use-and-effect relationships, Define problems, formulate potheses, test hypotheses, analyses, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report there sults of an experiment or investigation
	PO7: Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together a sagrouporateamin the interests of a common cause and work efficiently as a member of a team
	PO8: Scientific reasoning: Ability to analyse, interpret and drawconclusionsfromquantitative/qualitativedata;andcriticallyevaluateideas, evidence and experiences from an open-minded and reasoned perspective.
	PO9:Reflectivethinking:Criticalsensibilitytolivedexperiences,with self-awareness and reflexivity of both self and society.
	PO10 Information/digital literacy: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use variety of relevant information sources; and use appropriate software for analysis of data.
	PO 11 Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
	PO 12 Multicultural competence: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
	PO 13: Moral and ethical awareness/reasoning: Ability to embrace moral/ethical values in conducting one's life, formulate apposition/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical l behaviour such as fabrication, falsification ormisre present action of data or committing

	plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
	PO 14: Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.
	PO15: Life long learning: Ability to acquire knowledge and skills, including learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directedlearningaimedatpersonaldevelopment,meetingeconomic,social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**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**.**

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	**25 Marks**
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	**75 Marks**
Total		**100 Marks**

METHODS OF ASSESSMENT	
Remembering (K1)	• Thelowestlevelofquestionsrequirestudentstorecallinformationfromthecourse content • Knowledgequestionsusuallyrequirestudentstoidentifyinformationinthetextbook.
Understanding (K2)	• Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. • Thequestionsgobeyondsimplerecallandrequirestudentstocombinedatatogether
Application (K3)	• Studentshavetosolveproblemsbyusing/applyingaconceptlearnedintheclassroom. • Students must use their knowledge to determine exacter sponse.
Analyze (K4)	• Analyzingthequestionisonethatasksthestudentstobreakdownsomethingintoits componentparts. • Analyzingrequiresstudentstoidentifyreasonscausesormotivesandreachconclus

	ionsorgeneralizations.
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. • Students are engaged in decision- making and problem–solving. • Evaluation questions do no that single right answers.
Create (K6)	• Thequestionsofthiscategorychallengestudentstogetengagedincreativeandoriginalthinking. • Developing original ideas and problem solving skills

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising statistical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced statistical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Statistics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Statistical Quality Control course is included to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting an Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest DBMS and Computer software for Analytics.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Statistics and simulating mathematical concepts to real world.	• Instill confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training to girls leads to women empowerment
		• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools
III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Students are exposed to Latest topics on Computer Science / IT, that require strong statistical background • Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of statistical models in the respective sectors
IV	DBMS and Programming skill, Biostatistics, Statistical Quality Control, Official Statistics, Operations Research	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year	Internship / Industrial	• Practical training at the Industry/ Banking Sector /

Vacation activity	Training	Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Project with Viva – voce	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Statistics for Advanced Explain' component will comprise of advanced topics in Statistics and allied fields, for those in the peer group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: **For Advanced Learners / Honors degree**		• To cater to the needs of peer learners / research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Programme SchemeEligibility

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 papers – Tamil/Arabic in semesters I, II, III and IV respectively
- Part II - Language papers - English in semesters I, II, III, IV respectively
- Part III - Core papers in semesters I, II, III, IV, V and VI respectively
- Part III - Elective papers (Discipline / Generic) in semesters I, II, III, IV, V and VI respectively
- Part IV – Skill Enhancement Course (NME) papers in semesters I and II respectively
- Part IV - Skill Enhancement Course papers in semesters I, II, III, and IV respectively
- Part IV - Skill Enhancement Course (Foundation Course) paper in semester I respectively
- Part IV - Skill Enhancement Course (Professional Competency Skill) in semester VI respectivel
- Part IV - Value Education paper in semester V respectively
- Part IV - Environmental Studies paper in semesters III and IV respectively
- Part IV – Summer Internship/Industrial Training paper in semester V respectively
- Part V - Extension activity in semester VI respectively

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 (Elective & Skill Enhancement Course Subject)

Section – A (10 X 1 = 10 Marks) Answer ALL questions.

- Questions 1 - 10
- Two questions from each UNIT
- Multiple choice questions and each question carries Four choices

Section – B (5 X 7 = 35 Marks)
Answer ALL questions choosing either A or B.

- Questions 11 - 15
- Two questions from each UNIT (either…. or…. type)
- Descriptive Type

Section – C (3 X 10 = 30 Marks)
Answer any THREE out of five questions.

- Questions 16 - 20
- One question from each UNIT
- Descriptive Type

External Examinations Question Paper Pattern for 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)
- Descriptive Type

Section – B (3 X 15 = 45 Marks)
Answer any THREE out of five questions.

- Questions 6 – 10
- One question from each UNIT
- Descriptive Type

Part V (Extension 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

Total – 100 marks

Passing minimum is **40%**

Semester-I

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part I	23UTALL11	பொதுத்தமிழ் - 1 தமிழ் இலக்கிய வரலாறு - 1	6	25	75	100	3
	23UARLL11	Paper I : Prose					
	23UMMLL11	Prose, Composition and Translation					
Part II	23UENLL11	General English - I	6	25	75	100	3
Part – III	23UZYCC11	Invertebrata	6	25	75	100	6
	23UZYCC1P	Invertebrata Lab Course	2	40	60	100	2
	23UCHGE11	Chemistry for Biological Sciences - I	4	25	75	100	3
	23UCHGE1P	Chemistry Practical for Physical and Biological Sciences – I	2	40	60	100	2
Part – IV	23UZYSE11	Ornamental Fish Farming and Management	2	25	75	100	2
	23UZYFN11	Perspectives of Biology	2	25	75	100	2
	Total		**30**				**23**

Semester-II

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – I	23UTALL21	பொதுத்தமிழ் - 2 தமிழ் இலக்கிய வரலாறு - 2	6	25	75	100	3
	23UARLL21	Paper II : Grammar					
	23UMMLL21	Office Communication Malayalam					
Part – II	23UENLL21	General English- II	6	25	75	100	3
Part – III	23UZYCC21	Chordata	6	25	75	100	6
	23UZYCC2P	Chordata Lab Course	2	40	60	100	2
	23UCHGE21	Chemistry For Biological Sciences - II	4	25	75	100	3
	23UCHGE2P	Chemistry Practical for Physical and Biological Sciences – II	2	40	60	100	2
Part – IV	23UZYSE21	Medical Laboratory Techniques.	2	25	75	100	2
	23UZYSE22	Food Nutrition and Health	2	25	75	100	2
Total			**30**				**23**

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UZYCC11	INVERTE BRATA	Core	6	6	25	75	100

Learning Objectives		
L1	To understand the basic concepts of lower animals and observe the structure and functions.	
L2	To illustrate and examine the systemic and functional morphology of various group of invertebrates.	
L3	To differentiate and classify the various groups of animal modes of life and to estimate the biodiversity.	
L4	To compare and distinguish the general and specific characteristics of reproduction in lower animals.	
L5	To infer and integrate the parasitic and economic importance of invertebrate animals	
UNIT	**Contents**	**No. of Hours**
I	**TAXONOMY** **Taxonomy:** Units of Classification, Criteria of classification –Principles of Classification-types of Coelom, types of Symmetry, Binomial nomenclature. Classification up to class level with example(Flow Chart only)- General characters of the phyla with examples:i) Protozoa ii)Porifera iii) Coelenterata iv)Platyhelminthes v) Nematoda *vi)* Annelida, vii)Arthropoda viii) Mollusca, ix) Echinodermata	18
II	**PROTOZOA AND PORIFERA** **Phylum**: **Protozoa**- Typestudy - Paramecium-General organization, cyclosis, contractile vacuole and conjugation only. Structure, Life history, pathology, prevention and control measures of i) *Plasmodium vivax* and ii) *Entamoeba histolytica.* **Phylum: Porifera**: Type study-*Leucosolenia*-general organization, histology, Spicules, reproduction and development only Canal system in Sponges.	18
III	**COELENTRATA AND HELMINTHES** **Phylum:**Coelenterata: Type study- Obelia; structure of obeliacolony, Medusa, Nematocyst, reproduction and development(metagenesis)-Polymorphism in Coelenterata. Types of Corals-Ecological and Economic importance. **Helminthes**: Type study-*Fasciolahepatica*-external characters, digestive system, excretion, reproduction and development(lifecycle). Structure, pathology and control measures of *Ascaris* and *Wuchereria*	18
IV	**ANNELIDA AND ARTHROPODA** **Phylum:Annelida**: Type study-Earth worm, External morphology, setae, nephridia, nerves system and reproductive system-Meta merism in Annelids.	18

	Phylum: Arthropoda: Type study-***Penaeusindicus***- Marine Prawn-external morphology, appendages, digestive and excretory systems,reproductive system and development – Affinities of Peripatus	
V	**MOLLUSCA AND ECHINODERMATA** **Phylum: Mollusca** : Type study–***Pilaglobosa***-external morphology, digestive system, respiratory system, osphridium only.-Cephalopods as an advanced Mollusc. **Phylum: Echinodermata;** Type study Star fish *(Asterias)*, external morphology, pedicellaria, --Water vascular system – Larval forms of Echinodermata.	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Understand the basic concepts of invertebrate animals and recall its structure and functions.	K1,K2,K3,K4
2	Illustrate and examine the systemic and functional morphology of various groups of invertebrata.	K1,K2,K3,K4, K5,K6
3	Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	K1,K2,K3,K4, K5,K6
4	To compare and distinguish the various physiological processes and organ systems in lower animals.	K1,K2,K3,K4, K5,K6
5	Infer and integrate the parasitic and economic importance of invertebrate animals.	K1,K2,K3,K4, K5

Textbooks

1	Ekambaranatha Iyer, 2000. AManual of Zoology,10thedition,Viswanathan, S., Printers & Publishers Pvt Ltd
2	Jordan, E.L .and Verma P.S, 1995.Invertebrate Zoology, 12thedn. S. Chand &Co.
3	Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.

Reference Books

1	Ruppert and Barnes, R.D.(2006).Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2	Barnes, R.S. K., Calow, P., Olive, P.J. W.,Golding, D.W.and Spicer,J.I. (2002).The Inverte brates:ANew Synthesis,III Edition ,BlackwellScience
3	Barrington, E.J.W.(1979).Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4	Parker,J. and Haswell,1978.Atext book of Zoology Vol.I – Williams and Williams.

Web Resources

1	https://www.national geographic.com/animals/invertebrates/
2	https://bit.ly/3kABzKa
3	https://www.nio.org/
4	https://greatbarrierreef.org/

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	2	3	2	1	1	2
CO 2	2	2	3	3	2	1	1	1
CO 3	3	2	2	3	2	3	1	1
CO 4	1	1	2	3	3	2	3	2
CO 5	3	2	3	1	2	2	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UZYCC1P	INVERTEBRATA LAB COURSE	Core	2	2	40	60	100

Learning Objectives		
L1	To identify the different groups of invertebrate animals by observing their external characteristics.	
L2	To understand the organs, organ system and their functions in lower animals.	
L3	To get knowledge about the different modes of life and their adaptation based on the environment.	
L4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.	
L5		
UNIT	**Contents**	**No. of Hours**
I	**Major Dissection :** Cockroach: Circulatory system, Nervous system, Reproductive system. Leech : Nervous System, Reproductive system. Earthworm: Nervous System, Reproductive system. *Pila globosa*: Nervous system. Prawn: Nervous system (including Appendages).	6
II	**Minor Dissection:** Cockroach: Digestive system. Earthworm: Viscera, Lateral hearts. *Pila globosa*: Digestive system (Including radula). Freshwater Mussel: Digestive system.	6
III	**Mounting:** Earthworm: Body setae; Pineal setae. *Pila globosa*: Radula. Freshwater muscle: Pedal ganglia.	6
IV	**Mounting :** Cockroach: Salivary apparatus, Mouth parts - Honey Bee, House fly and Mosquito mouth parts.	6
V	**Spotters :(i). Protozoa:** Amoeba, Paramoecium, Paramoecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax **(ii). Porifera:** Sycon, Spongilla, Euspongia, Sycon - T.S & L.S, Spicules, Gemmule **(iii). Coelenterata:** Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula **(iv). Platyhelminthes:** Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Echinococcus granulosus, Taenia solium, Schistosoma haematobium **(v). Nemathelminthes:** Ascaris(Male & Female), Drancunculus, Ancylostoma, Wuchereria **(vi). Annelida:** Nereis, Aphrodite, Chaetopteurs, Hirudinaria, Trochophore larva **(vii). Arthropoda:** Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male &	6

	female Anopheles and Culex, Mouthparts of Housefly and Butterfly. **(viii). Mollusca:** Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva **(ix). Echinodermata:** Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva	
	Total	**30**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Identify and label the external features of different groups of invertebrate animals.	K1,K2,K3,K4
2	Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals.	K1,K2,K3,K4,K5,K6
3	Differentiate and compare the structure, function and mode of life of various groups of animals.	K1,K2,K3,K4,K5,K6
4	To compare and distinguish the dissected internal organs of lower animals.	K1,K2,K3,K4,K5,K6
5	Prepare and develop the mounting procedure of economically important invertebrates.	K1,K2,K3,K4,K5

Textbooks

1	Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai
2	Ganguly, Sinha an d A dhikari , 2 0 11 . Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.
3	Sinha, Chatterjee and Chattopadhyay, 2 0 1 4. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 07 0 pp.
4	Lal ,S. S, 2016 . Practical Zoology Invertebrate, Rastogi Publications.
5	Verma, P. S. 2010. A Manual of Practical Zoology: Invertebates, S Chand, 4 97pp.

Reference Books

1.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science.
2.	Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition. Holt Saunders International Edition.
3.	Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson
4.	Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home.
5.	Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut

Web Resources

1.	https://nbb.gov.in/
2.	http://www.agshoney.com/training.htm
3.	https://icar.org.in/
4.	http://www.csrtimys.res.in/
5.	http://csb.gov.in/
6.	https://iinrg.icar.gov.in/
7.	https://www.nationalgeographic.com/animals/invertebrates/

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	2	1	2	3	2	2
CO 2	2	3	3	3	3	2	1	1
CO 3	2	2	2	3	3	3	3	2
CO 4	3	2	3	3	3	2	1	2
CO 5	2	2	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

\

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UCHGE11	Chemistry for Biological Sciences I	Generic Elective	3	4	25	75	100

Learning Objectives		
L1	Basics of atomic orbitals, chemical bonds, hybridization and fundamentals of organic chemistry.	
L2	Nuclear chemistry and industrial chemistry.	
L3	Importance of speciality drugs and	
L4	Separation and purification techniques.	
UNIT	**Contents**	**No. of Hours**
I	**Chemical Bonding and Nuclear Chemistry** Chemical Bonding**:** Molecular Orbital Theory- bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. **Nuclear Chemistry:** Fundamental particles - Isotopes, Isobars, Isotones and Isomers- Differences between chemical reactions and nuclear reactions-group displacement law. Nuclear binding energy-mass defect-calculations. Nuclear fission and nuclear fusion-differences–Stellar energy. Applications of radioisotopes–carbon dating, rock dating and medicinal applications.	12
II	**Industrial Chemistry** Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones**:** Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate.	12
III	**Fundamental Concepts in Organic Chemistry** Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Polar effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric, mesomeric, Hyperconjugation and steric-examples and explanation. Reaction mechanisms: Types of reactions–aromaticity (Huckel's rule) – aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.	12

IV	**Drugs and Speciality Chemicals** Definition, structure and uses: Antibiotics viz., Penicillin, Chloramphenicol and Streptomycin; Anaesthetics viz., Chloroform and ether; Antipyretics viz., aspirin, paracetamol and ibuprofen; Artificial Sweeteners viz., saccharin, Aspartame and cyclamate; Organic Halogen compounds viz., Freon, Teflon.	12
V	**Analytical Chemistry** Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques– extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.	12
	Total	**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	State the theories of chemical bonding, nuclear reactions and its applications.	K1,K2,K3,K4
2	Evaluate the efficiencies and uses of various fuels and fertilizers.	K1,K2,K3,K4,K5,K6
3	Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.	K1,K2,K3,K4,K5,K6
4	Demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.	K1,K2,K3,K4,K5,K6
5	Analyse various methods to identify an appropriate method for the separation of chemical components.	K1,K2,K3,K4,K5

Textbooks	
1	V.Veeraiyan, ***Text book of Ancillary Chemistry***; High mount publishing house, Chennai, first edition, 2009.
2	S.Vaithyanathan, ***Text book of Ancillary Chemistry***; Priya Publications, Karur,2006.
3	S.Arun Bahl, B.S.Bahl, ***Advanced Organic Chemistry***; S.Chand and Company, New Delhi, twenty third edition,2012.
4	P.L.Soni, H.M.Chawla, ***Text Book of Organic Chemistry***; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.

Reference Books	
1.	P.L.Soni, Mohan Katyal, ***Text book of Inorganic chemistry***; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
2.	B.K,Sharma, ***Industrial Chemistry***; GOEL publishing house, Meerut, sixteenth edition,2014.
3.	Jayashree Gosh, ***Fundamental Concepts of Applied Chemistry***; Sultan & Chand, Edition 2006.

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UCHGE1P	Chemistry Practical for Physical and Biological Sciences-I	Generic Elective	2	2	40	60	100

Learning Objectives	
L1	Basics of preparation of solutions.
L2	Principles and practical experience of volumetric analysis.

VOLUMETRIC ANALYSIS

- Estimation of sodium hydroxide using standard sodium carbonate.
- Estimation of hydrochloric acid using standard oxalic acid.
- Estimation of ferrous sulphate using standard Mohr's salt.
- Estimation of oxalic acid using standard ferrous sulphate.
- Estimation of potassium permanganate using standard sodium hydroxide.
- Estimation of magnesium using EDTA.
- Estimation of ferrous ion using diphenylamine as indicator.

Total Hours: 30

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Gain an understanding of the use of standard flask and volumetric pipettes, burette.	K1,K2,K3,K4
2	Design, carryout, record and interpret the results of volumetric titration.	K1,K2,K3,K4,K5,K6
3	Apply their skill in the analysis of water/hardness.	K1,K2,K3,K4,K5,K6
4	Analyze the chemical constituents in allied chemical products.	K1,K2,K3,K4,K5,K6
5	Estimate the weight of magnesium using EDTA.	K1,K2,K3,K4,K5
Reference Books		
1	V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, ***Basic Principles of Practical Chemistry***; Sultan Chand & sons, Second edition, 1997.	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UZYSE11	ORNAMENTAL FISH FARMING AND MANAGEMENT	NME	2	2	25	75	100

Learning Objectives		
L1	Thigh light the importance of ornamental fish culture in relation to entre premiership development.	
L2	To enable the identification, culture and maintenance of commercially important ornamental fishes.	
L3	To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.	
L4	To know the about artificial and live feeds for fishes and transportation of fishes.	
L5	To now breeding methods and about the fish diseases.	
UNIT	**Contents**	**No. of Hours**
I	Introduction - ornamental fish keeping as hobby and cottage industry. Scope and self-employment of ornamental fish culture. Domestic and global scenario of ornamental fish trade and export potential.	6
II	Identification of popular Ornamental fishes: Siamese fighting fish, Gold fish, Rosy barb, Blackmolly, Guppy, Koi carp, Arowana and Angel fish.	6
III	Construction of fish tank: Size and shape of fish tank, bottom settings, stocking of fish, planting with aquarium plants, Accessories of fish Tank - aerators, types of filters, nets, lights and hood.	6
IV	Transport off ishes: Oxygenpacking, Food and feeding: Cultureoflivefoodorganisms-Microworms,vinegar eel,tubifex. Artificial feed-Pelletfeed formulation	6
V	Breeding, hatchery and nursery management of Butterfly fish, Sword tails, Blue morph andAnemone fish- Common diseases and treatment of ornamental fishes:- Nutritional diseases,Whitespotdiseases,fungaldiseases,Bacterialdiseases,Dropsydiseasesandecto-parasites.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Understand the scope of the ornamental fish culture and about the trade and world market.	K1,K2,K3,K4
2	Learn about various ornamental fish species and their morphological characteristics to identify the species	K1,K2,K3,K4,K5,K6
3	Understand about the tools and techniques to setting up of fish	K1,K2,K3,K4,K5,K

	aquarium	6
4	Learn about the fish handling, feeding and transport methods of fishes	K1,K2,K3,K4,K5,K6
5	Learn the breeding methods for various species and disease control on breeding.	K1,K2,K3,K4,K5
Textbooks		
1	Manual of Ornamental fishes and forming technologies, Jameson J.D & R. Santhanam, 1996, Fisheries college & Research Institute, Tamil Nadu.	
2		
3		
Reference Books		
1.	Manual of tropical fish diseases diagnosis. Felix S. Sunderraj and S. Thilakar, Tamil Nadu Veterinary & Animal Sciences University, Chennai.	
2.	Manual of Breeding & Larval rearing of Cultivable fishes, Ramanathan, N and T,Francis, Tamil Nadu Veterinary & Animal Sciences University, Chennai. 3	
3.	Manual of Aquatic Engineering, Sampathkumar J.S. &Sundararaj.V. Tamil Nadu Veterinary & Animal Sciences University, Chennai.	
Web Resources		
1.	https://cifa.nic.in/sites/default/files/Ornamental_fish.pdf	
2.	https://ccari.icar.gov.in/Technical%20Bulletin%20No.%2069.pdf	
3.	https://prgc.ac.in/uploads/study_material/Ornamental%20fisheries-converted.pdf573.pdf	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	2	3	3	2	2	3
CO 2	3	3	2	3	3	1	2	2
CO 3	3	2	2	3	3	2	2	1
CO 4	2	3	3	2	3	2	3	3
CO 5	2	3	3	2	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UZYFN11	PERSPECTIVES OF BIOLOGY	Foundation Course	2	2	25	75	100

Learning Objectives		
L1	To understand the concepts in the branch of biological science	
L2	To understand the evolution of various branches in biological science	
L3	To understand the research activities in various branches of biological science and about the institution which are engaged in the researches	
L4	To understand the basic concepts and theories on which the biological sciences build in.	
L5	To understand the basic unit of all biological systems.	
UNIT	**Contents**	**No. of Hours**
I	Science: Definition, Major branches (Physical, Life and Earth Science); fields of science in biology–scientific methods :observation, prediction, experiment, hypothesis, consistency, theory–scientific theory, scientific law–impact of science in human life: positive and negative aspects	6
II	Life and its manifestations –History of Biology – Biology in ancient times-Landmarks in the progress of Biology-Branches of Zoology– Opportunities for zoologists	6
III	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, RajivGandhi 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 Finger printing and Diagnostics, Central Drug Research Institute.	6
IV	Origin of a earth – big bang theory- theory of special creation-theory of extra terrestrial origin theory of spontaneous generation- modern concepts of the origin of life-origin of cells: Oparins coacervate theory – proteinois and microspheres – earliest cells –origin of eukaryotic cells	6
V	Cell theory – Structure of animal cell and plant cell – types of cells: prokaryotic and eukaryotic–structure of cellular components: plasma membrane, cell wall, cytoplasm, nucleus, and sub cellular organelles	6
	Total	**30**
Course Outcomes		**Knowledge**

		Level
CO	**On completion of this course, students will**	
1	Understand the various study branches in biological science	K1,K2,K3,K4
2	Knew the important events and incidence which change the direction of science and about the origin of various branches in biological science	K1,K2,K3,K4, K5,K6
3	Knew the ongoing research activities in various research institutions.	K1,K2,K3,K4, K5,K6
4	Understand the basic concepts and important theories on which the biological sciences build in.	K1,K2,K3,K4, K5,K6
5	Understand the functional aspects of the basic unit of all biological systems.	K1,K2,K3,K4, K5
Textbooks		
1	Cell Biology – De Robertis, E.D. Nowinski and Saez. (2001 reprint) WB Saunders Co. Philadelphia.	
2	Essential Cell Biology, 3rd edition, by Alberts et al., Garland. Publishing Co., 2009.	
3	Cell and Molecular Biology – De Robertis and De Robertis. (2004 reprint)	
Reference Books		
1	Bowler Peter J and Iwan RhysMorus. (2005) Making Modern Science: A Historical Survey.2nd Edition, University of Chicago Press, Chicago, IL	
2	Ernst Myer.(1997).This is Biology : The Science of the living World.1stEdition,Harvard University Press, London	
3	Aggarwal, S.K. (2010) Foundation course in Biology. 3rdEdition, Ane Books India, NewDelhi	
	CollinsH. And Pinch,T. (1993) The Golem: What every one should know about Science. Cambridge university press.	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	3	3	3	2	2	1
CO 2	3	2	3	2	3	2	2	1
CO 3	2	2	3	2	3	3	2	1
CO 4	1	3	3	2	3	2	3	3
CO 5	3	3	2	2	3	2	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UZYCC21	CHORDATA	Core	6	6	25	75	100

Learning Objectives		
L1	To understand the structures and distinct features of PhylumChordata.	
L2	To understand and able to distinguish the characteristic features of each Sub phylum and class.	
L3	To understand the economic importance of vertebrates	
L4	To know about the adaptations of vertebrates	
L5	To understand the evolutionary position of different groups of vertebrates	
UNIT	**Contents**	**No. of Hours**
I	Cephalochordate -Amphioxus: External morphology, Digestive System and Excretory System only. Uro-chordata-Tadpole larva and Retrogressive metamorphosis in Ascidian, Hemichordate–Balanoglossus external morphology and Affinities of Hemichordate	**18**
II	**PISCES AND AMPHIBIANS** General Characters and Classification of Fishes and Amphibians up to order level with examples. Pisces-Shark: External Morphology and Digestive System only, Migration of Fishes- Agnatha – Petromyzon External morphology**,** Amphibia: General characters and classification- *Ranahexadactyla* - External Morphology and Respiratory system only, Parental Care in Amphibians.	18
III	General Characters andClassification of Reptiles upto orders with examples. Calotes: External Morphology,Heart, Arterial and Venous system only. Snakes of India - Poisonous and non-poisonous snakes –Identification and biting mechanism. Origin, Dominance and Decline of Mesozoic reptiles.	18
IV	AVES:- General Characters and Classification of Aves up to orders with examples. ***Columba livia* -Pigeon:** External Morphology, Respiratory System, Synsacrum, Pectoral and Pelvic girdles only-Flight less Birds	18
V	MAMMALS General Characters and Classification of Mammals up toorderswithexamples- GeneralCharactersofPrototherians,MetatheriansandEutherian swithexamples	18
Course Outcomes		**Knowledge Level**

CO	On completion of this course, students will	
1	Classify, Identify and recall the name and distinct features of different phylum belonging to phylum Chordata	K1,K2,K3,K4
2	Explain, and relate the origin, structural organization and Evolutionary aspects of vertebrates	K1,K2,K3,K4,K5, K6
3	Analyze, compare and distinguish the developmental stages and describe the important biological process	K1,K2,K3,K4,K5, K6
4	Correlate the different modes of life and parental care Among different vertebrates	K1,K2,K3,K4,K5, K6
5	Summarise the morphology and ecological adaptations invertebrates and list out the economic importance.	K1,K2,K3,K4,K5
Textbooks		
1	Ayyar,E.K. and T.N.Anantha krishnan, 1992 .Manual of Zoology Vol.II (Chordata),S.Viswanathan(Printers and Publishers)Pvt Ltd.,Madras,891p.	
2	Jordan, E.K. and P.S. Verma,1995. Chordate Zoology and Elements of Animal Physiology,10th edition, S.Chand &CoLtd.,RamNagar,NewDelhi,1151pp.	
3	Nigam,H.C.,1983.Zoology of Chordates, Vishal Publications, Jalandhar-144008, 942.	
4	Ganguly, Sinha,. Bharati Goswami and Adhikari,2004.Biology of animals Vol. II-New central book Agency(p) Ltd.	
5	Kotpal.R.L.A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009	
Reference Books		
1.	Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub.Co.	
2.	Hall B.K. and Hallgrimsson B.(2008).Strick berger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.	
3.	Hickman, C.P. Jr., F.M.Hickman and L.S.Roberts,1984. Integrated Principles of Zoology,7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.	
4	Newman,H.H.,1981.ThePhylumChordata,Satish Book Enterprise,Agra–282 003, 477 pp.	
5	Parker and Haswell,1964. Text Book of Zoology, Vol II(Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi-110 051,952 pp.	
6	PoughH.Vertebrate life, VIII Edition,Pearson International.	
7	Wterman. llynJ. etal.,1971. Chordte Structure and Function. MacMillan&co., Newyork. 587pp	
8	Young,J.Z. (2004).The Life of Vertebrates. III Edition .Oxford university press	
Web Resources		
1.	http://tolweb.org/Chordata/2499	
2.	https://www.nhm.ac.uk/	
3.	https://bit.ly/3Av1Ejg	
4.	https://bit.ly/3kqTfYz	
5.	https://biologyeducare.com/aves/	
6.	https://www.vedantu.com/biology/mammalia	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	2	3	3	3	2	1	2
CO 2	2	3	3	2	3	2	1	2
CO 3	2	3	3	3	3	3	2	3
CO 4	3	2	3	3	3	2	2	1
CO 5	3	2	3	2	3	2	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UZYCC2P	CHORDATA LAB COURSE	Core	2	2	40	60	100

Learning Objectives		
L1	To understand the structures and distinct features of phylum chordata.	
L2	To understand and able to distinguish the characteristic features of each sub phylum and class.	
L3	To understand and compare the structure of various internal organs in different classes of vertebrates.	
L4	To know about the classification, adaptations and affinities of chordate animals.	
UNIT	**Contents**	**No. of Hours**
I	**Dissections**: (Demo)/Fish: External features,Digestivesystem, Frog Arterial system ,Venous system, 5^{th} Cranial nerve,9^{th} and 10^{th} cranial nerves, Male and female urinogenital system.	6
II	**Mounting**: Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain (Demo).	6
III	**Osteology**:Frog: Skull and lower jaw, Vertebral column, Pectoral girdle,Pelvicgirdle,Forelimb,Hindlimb.Chelonia-Anapsidskull,Pigeon - skull and lower jaw, synsacrum.	6
IV	**Specimen and Slides**:**(i) Hemi chordata:**Balanoglossus, Tornaria larva **(ii). Protochordata:** Amphioxus, Amphioxus T.S. through pharynx **(iii). Cyclostomata:** Petromyzon, Myxine, Ammocoetus larva **(iv). Pisces:** Sphyrna Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid **(v). Amphibia:** Ichthyophis, Amblystoma, Siren, Hyla, Rachophous,Bufo,Rana, Axolotal larva **(vi). Reptilia :** Draco, Chemaeleon, Gecko, Uromastix, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas. **(vii). Aves:** Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down **(viii). Mammalia:** Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog	6
V	**Embryology**: Stages in the development of Amphioxus, Frog and Chick- Placenta in shark and mammals.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Identify and recall the name and distinct external and	K1,K2,K3,K4

	internal features of animals belonging to phylum Chordata.	
2	Explain the structural organization of various organs and systems in different classes of vertebrates.	K1,K2,K3,K4,K5,K6
3	Analyse, compare and distinguish the morphological features and developmental stages of chordates	K1,K2,K3,K4,K5,K6
4	Dissect and explain various organs and internal systems in different vertebrates and correlate its function.	K1,K2,K3,K4,K5,K6
5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	K1,K2,K3,K4,K5
Textbooks		
1	Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.	
2	VermaP.S, 2000.A Manual of Practical Zoology: Chordates, S.Chand Limited, 627pp.	
Reference Books		
1.	Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp.	
2.	Young, J,Z., 1972. The life of vertebrates. OxfordUni. London.	
Web Resources		
1.	https://www.youtube.com/watch?v=b04hc_kOY10	
2.	https://bit.ly/3CzTEy8	
3.	http://tolweb.org/Chordata/2499	
4.	https://www.nhm.ac.uk/	
5.	https://bit.ly/3Av1Ejg	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	3	2	3	2	2	1
CO 2	2	3	2	3	3	2	3	2
CO 3	3	2	3	3	3	3	2	1
CO 4	3	2	3	3	3	2	1	2
CO 5	3	3	3	2	3	2	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UCHGE21	Chemistry for Biological Sciences II	Generic Elective	3	4	25	75	100

Learning Objectives		
L1	Nomenclature of coordination compounds and carbohydrates.	
L2	Amino Acids and Essential elements of biosystem.	
L3	Understand the concepts of kinetics and catalysis.	
L4	Provide fundamentals of electrochemistry and photochemistry.	
UNIT	Contents	No. of Hours
I	**Co-ordination Chemistry and Water Technology** Co-ordination Chemistry**:** Definition of terms-IUPAC Nomenclature-Werner's theory-EAN rule-Pauling's theory–Postulates-Applications to $[Ni(CO)_4]$,$[Ni(CN)_4]^{2-}$,$[Co(CN)_6]^3$ Chelation Biological role of Hemoglobin and Chlorophyll(elementary idea)-Applications in qualitative and quantitative analysis. Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques –BOD and COD.	12
II	**Carbohydrates and Amino acids** Carbohydrates: Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose–fructose interconversion. Properties of starch and cellulose. Amino acids: Classification-preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only).	12
III	**Electrochemistry** Galvanic cells-Standard hydrogen electrode-calomel electrode-standard electrode potentials -electrochemical series. Strong and weak electrolytes- ionic product of water-pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications-electroplating-Nickel and chrome plating–Types of cells-fuel cells-corrosion and its prevention.	12
IV	**Kinetics and Catalysis**	12

	Order and molecularity, Integrated rate expression for I and II (2AProducts) order reactions. Pseudo first order reaction, methods of determining order of a reaction – Half-life period – Catalysis –homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.	
V	**Photochemistry** Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield-Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	12
	Total	**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology.	K1,K2,K3,K4
2	Explain the preparation and property of carbohydrate, amino acids and nucleic acids.	K1,K2,K3,K4,K5,K6
3	Apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.	K1,K2,K3,K4,K5,K6
4	Identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.	K1,K2,K3,K4,K5,K6
5	Outline the various type of photochemical process.	K1,K2,K3,K4,K5

Textbooks	
1	V.Veeraiyan, ***Text book of Ancillary Chemistry***; High mount publishing house, Chennai, first edition, 2009.
2	S.Vaithyanathan, ***Text book of Ancillary Chemistry***; Priya Publications, Karur, 2006.
3	Arun Bahl, B.S.Bahl, ***Advanced Organic Chemistry***; S.Chand and Company, New Delhi, twenty third edition,2012.
4	P.L.Soni, H.M.Chawla, ***Text Book of Organic Chemistry***; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.
Reference Books	
1.	P.L.Soni, Mohan Katyal, ***Text book of Inorganic chemistry***; Sultan Chand and Company, New Delhi, twentieth edition,2007.
2.	R.Puri, L.R.Sharma, M.S.Pathania, ***Text book Physical Chemistry***; Vishal Publishing Co., New Delhi, forty seventh edition,2018
3.	B.K,Sharma, ***Industrial Chemistry***; GOEL publishing house, Meerut, sixteenth edition,2014.

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UCHGE2P	**Chemistry practical for Physical and biological sciences - II**	**Generic Elective**	**2**	**2**	**40**	**60**	**100**

Learning Objectives	
L1	Identification of organic functional groups.
L2	Different types of organic compounds with respect to their properties.
L3	Determination of elements in organic compounds.

The analysis must be carried out as follows:

- Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose].
- Detection of elements (N, S, Halogens).
- To distinguish between aliphatic and aromatic compounds.
- To distinguish–Saturated and unsaturated compounds.

Total Hours: 30

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Identify different types of organic functional groups.	K1,K2,K3,K4
2	Analyze the nature of different types of organic compounds with respect to their properties.	K1,K2,K3,K4,K5,K6
3	Determine different elements present in organic compounds.	K1,K2,K3,K4,K5,K6
4	Distinguish between aliphatic and aromatic compounds.	K1,K2,K3,K4,K5,K6
5	Classify between saturated and unsaturated compounds.	K1,K2,K3,K4,K5

Reference Books

1 V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, ***Basic Principles of Practical Chemistry;*** Sultan Chand & sons,Second edition,1997.

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UZYSE21	MEDICAL LABORATORY TECHNIQUES	NME	2	2	25	75	100

Learning Objectives		
L1	To understand the different protocols and procedures to collect clinical samples.	
L2	To explain the character is tics of clinical samples.	
L3	To demonstrate skill in handling clinical equipment.	
L4	To evaluate the safety precautions while handling clinical samples.	
L5	To summarise the control measures to avoid contamination of clinical samples.	
UNIT	**Contents**	**No. of Hours**
I	**Laboratory Safety and Human Health and Hygiene :** Laboratory safety –toxic chemicals and biohazards waste- biosafety level- good laboratory practice – hygiene and health issue – physiology effect of alcohol, tobacco, smoking & junk food &its treatment-biomedical waste management.	6
II	**Haematology:** Composition of blood and their function- collection of blood & lab procedure-haemopoiesis-types of anaemia- mechanism of blood coagulation- bleeding time- clotting time-determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume-Totalcount of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis-bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytescount,Absolute Eosinophil count.	6
III	**Medical Microbiology and Instrumentation Techniques :** Definition and scopeof microbiology- structure and function of cells-parasites - Entamoeba- Plasmodium-Leishmaniaand Trypanosome-Computer tomography (CTscan) – Magnetic Resonanceimaging– flowcytometry– treadmill test – PET.	6
IV	**Medical Physiology** : Cardiovascular system- Blood pressure - Pulse – regulationof heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultrasonography-Electroencephalography(EEG).	6
V	**Diagnostic Pathology** : Handling and labelling of histology specimens - Tissueprocessing - processing of histological tissues for paraffin embedding, block preparation.Microtomes – types of microtome-sectioning, staining –staining methods- vital staining -mounting-problems encountered during section cutting and remedies - Frozen sectiontechniques-freezingmicrotome.	6
	Total	**30**
Course Outcomes		**Knowledge**

		Level
CO	**On completion of this course, students will**	
1	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.	K1,K2,K3,K4
2	Explain the characteristics of clinical samples.	K1,K2,K3,K4, K5,K6
3	Demonstrates kill in handling clinical equipment.	K1,K2,K3,K4, K5,K6
4	Evaluate the haematological and histological parameters of biological samples.	K1,K2,K3,K4, K5,K6
5	Elaborate the role of medical laboratory techniques in health care industry.	K1,K2,K3,K4, K5
Textbooks		
1	Godker,P.B.andDarshan,P,Godker,2011.TextbookofmedicalLaboratory	
2	Technology,Mumbai.	
3	GuytonandHall,2000.TextBookofmedicalPhysiology,10th edition, Elseiner,NewDelhi.	
4	Mukerjee,K.L,1999.MedicalLaboratoryTechnology-Vol,I,II,III.TataMCGrawHill, New Delhi.	
5	Sood,R,2009.MedicalLaboratorytechnology,Methodsand interpretation.	
Reference Books		
1.	Manoharan,A, andSethuraman, 2003. Essentialof Clinical Heamatology, Jeypeebrothers,New Delhi.	
2.	Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management	
3.	bylaboratorymethods,Elsevier,Philadelphia.PublishedbyTataMcGraw-HillEducationPvt.Ltd.,	
4.	chei.J.,A.Kolhatkar(2000).MedicalLaboratoryscience: Theory and practice, PublishedbyTata McGraw-HillEducation Pvt.Ltd, Firstedition.	
Web Resources		
1.	https://bit.ly/3tUs8In	
2.	https://bit.ly/2XKu7mT	
3.	https://bit.ly/3hNS1EP	
4.	https://bit.ly/2ZgrLga	
5.	https://bit.ly/3hTBO1b	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	2	3	3	2	3
CO 2	3	1	2	3	2	2	2	3
CO 3	3	3	3	2	3	2	1	2
CO 4	3	2	3	2	3	3	1	2
CO 5	3	3	2	2	3	3	2	1

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	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UZYSE22	FOOD, NUTRITION AND HEALTH	SEC	2	2	25	75	100

Learning Objectives		
L1	To know about the basic components of the Diet and dietary requirements for various age group and life conditions.	
L2	To know the various dietary components and their role in the biological system	
L3	To know about malnutrition and related ailments in Human beings.	
L4	To know about important lifestyle diseases and social health problems.	
L5	To know about the diseases related to poor food hygiene	
UNIT	**Contents**	**No. of Hours**
I	**Nutrition and dietary nutrients**: Basic concepts of Food: Components and nutrients. Concept of balanced diet, nutrient requirements and dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people	6
II	**Macronutrients and micronutrients:** Macronutrients. Carbohydrates, Lipids, Proteins- Definition, their dietary source and role. Micro nutrients. Vitamins- Water-soluble and Fat-soluble vitamins-their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions	6
III	**Malnutrition and nutrient deficiency diseases:** Definition and concept of health: Common nutritional deficiency diseases-Protein Malnutrition(e.g., Kwashiorkor and Marasmus),Vitamin A deficiency, Iron deficiency and Iodine deficiency disorders-their symptoms, treatment, prevention and government initiatives	6
IV	**Life style dependent diseases**- hypertension, diabetes mellitus, and obesity their causes and prevention. Social health problems-smoking, alcoholism, narcotics .Acquired Immuno Deficiency Syndrome (AIDS): causes, treatment and prevention.	6
V	**Diseases caused by microorganisms**: Food hygiene: Potable water- sources and methods of purification at domestic level. Food and Water-borne infections: Bacterial Diseases: typhoid fever- viral diseases: Poliomyelitis-Protozoan diseases: Giardiasis-Parasitic diseases: Taeniasis and their transmission, causative agent, sources of infection, symptoms and prevention.	6

	Total	30
Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Understand the role of food and nutrients in health and disease	K1,K2,K3,K4
2	Gain knowledge about hygiene, food safety, disease transmission.	K1,K2,K3,K4,K5,K6
3.	Perform food system management and leadership functions that consider sustainability in business, health care, community and institutional areas	K1,K2,K3,K4,K5,K6
4	Understand life style depended diseases and ailments to overcome the diseases	K1,K2,K3,K4,K5,K6
5	Under the basic hygiene and understand the mode of transmission of diseases	K1,K2,K3,K4,K5
Textbooks		
1	Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; FifthEd;; New Age International Publishers.	
2	Srilakshmi,B.(2007).Food Science;Fourth Ed; New Age International(P) Ltd.	
3	Swaminathan,M.(1986).Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.	
4	Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. PvtLtd.	
5	Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; FirstEd; Academic Excellence. Gibney,M.J.etal.(2004).Public Health Nutrition;Blackwell Publishing.	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	2	3	3	2	3
CO 2	3	2	3	1	2	2	3	2
CO 3	3	2	3	3	2	3	2	1
CO 4	3	1	3	2	3	2	2	3
CO 5	2	2	2	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1