



**ROYAL SCHOOL OF LIFE SCIENCES
(RSLSC)**

DEPARTMENT OF ZOOLOGY

**COURSE STRUCTURE & SYLLABUS
(BASED ON NATIONAL EDUCATION POLICY 2020)**

FOR

**B.SC. IN ZOOLOGY
(4 YEARS SINGLE MAJOR)**

W.E.F

AY - 2023- 2024

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1. PREAMBLE

The National Education Policy (NEP) 2020 conceives a new vision for India's higher education system. It recognizes that higher education plays an extremely important role in promoting equity, human as well as societal well-being and in developing India as envisioned in its Constitution. It is desired that higher education will significantly contribute towards sustainable livelihoods and economic development of the nation as India moves towards becoming a knowledge economy and society.

If we focus on the 21st century requirements, the higher education framework of the nation must aim to develop good, thoughtful, well-rounded, and creative individuals and must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and twenty-first-century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education should be capable enough to enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. Overall, it should focus on preparing students for more meaningful and satisfying lives and work roles and enable economic independence.

Towards the attainment of holistic and multidisciplinary education, the flexible curricula of the University will include credit-based courses, projects in the areas of community engagement and service, environmental education, and value-based education. As part of holistic education, students will also be provided with opportunities for internships with local industries, businesses, artists, crafts persons, and so on, as well as research internships with faculty and researchers at the University, so that students may actively engage with the practical aspects of their learning and thereby improve their employability.

The undergraduate curriculums are diverse and have varied subjects to be covered to meet the needs of the programs. As per the recommendations from the UGC, introduction of courses related to Indian Knowledge System (IKS) is being incorporated in the curriculum structure which encompasses all of the systematized disciplines of Knowledge which were developed to a high degree of sophistication in India from ancient times and all of the traditions and practices that the various communities of India—including the tribal communities—have evolved, refined and preserved over generations, like for example Vedic Mathematics, Vedangas, Indian Astronomy, Fine Arts, Metallurgy, etc.

At RGU, we are committed that at the societal level, higher education will enable each student to develop themselves to be an enlightened, socially conscious, knowledgeable, and skilled citizen who can find and implement robust solutions to its own problems. For the students at the University, Higher education is expected to form the basis for knowledge creation and innovation thereby contributing to a more vibrant, socially engaged, cooperative community leading towards a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.”

The new curriculum of BSc in Zoology under The Assam Royal Global University will be more flexible, multi-disciplinary and holistic. Overall, the revamped BSc in Zoology curriculum at The Assam Royal Global University will empower students with a well-rounded education, preparing them to tackle the dynamic and complex challenges of the modern world while fostering a lifelong passion for zoological sciences.

2. INTRODUCTION

The National Education Policy (NEP) 2020 clearly indicates that higher education plays an extremely important role in promoting human as well as societal well-being in India. As envisioned in the 21st-century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. According to the new education policy, assessments of educational approaches in undergraduate education will integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) that will lead to positive learning outcomes. This will lead to develop creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning, and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. and more in-depth learning.

The NEP highlights that the following fundamental principles that have a direct bearing on the curricula would guide the education system at large, viz.

- i. Recognizing, identifying, and fostering the unique capabilities of each student to promote her/his holistic development.
- ii. Flexibility, so that learners can select their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests.
- iii. Multidisciplinary and holistic education across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world.
- iv. Emphasis on conceptual understanding rather than rote learning, critical thinking to encourage logical decision-making and innovation; ethics and human & constitutional values, and life skills such as communication, teamwork, leadership, and resilience.
- v. Extensive use of technology in teaching and learning, removing language barriers, increasing access for Divyang students, and educational planning and management.
- vi. Respect for diversity and respect for the local context in all curricula, pedagogy, and policy.

vii. Equity and inclusion as the cornerstone of all educational decisions to ensure that all students can thrive in the education system and the institutional environment are responsive to differences to ensure that high-quality education is available for all.

viii. Rootedness and pride in India, and its rich, diverse, ancient, and modern culture, languages, knowledge systems, and traditions.

2.1 Credits in Indian Context:

Choice Based Credit System (CBCS) By UGC

Under the CBCS system, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be earned by the students. This framework is being implemented in several universities across States in India. The main highlights of CBCS are as below:

- The CBCS provides flexibility in designing curriculum and assigning credits based on the course content and learning hours.
- The CBCS provides for a system wherein students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.
- CBCS also provides opportunity for vertical mobility to students from a bachelor's degree programme to masters and research degree programmes.

2.2 Definitions

2.2.1 Academic Credit:

An academic credit is a unit by which a course is weighted. It is fixed by the number of hours of instructions offered per week. As per the National Credit Framework [2];

$$1 \text{ Credit} = 30 \text{ NOTIONAL CREDIT HOURS (NCH)}$$

$$\text{Yearly Learning Hours} = 1200 \text{ Notional Hours (@40 Credits x 30 NCH)}$$

30 Notional Credit Hours		
Lecture/Tutorial	Practicum	Experiential Learning
1 Credit = 15 -22 Lecture Ho	10-15 Practicum hour	0-8 Experiential Learning Hou

Looking at all these new concepts and progress, the detailed syllabus of B.Sc. in Zoology has

been designed and decided to be implemented. Zoology deals with the study of animal kingdom specially the structural diversity, biology, embryology, evolution, habits and distribution of animals, both living and extinct. As it covers a fascinating range of topics, the modern zoologists need to have insight into many disciplines. The learning outcomes-based curriculum framework for a B.Sc. in Zoology is designed to cater to the needs of students in view of the evolving nature of animal science as a subject. The present framework is intended to allow for flexibility and innovation in programme design and syllabi development, teaching-learning process, assessment of student learning levels.

3. APPROACH TO CURRICULUM PLANNING

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications such as a Bachelor's programmes are earned and awarded on the basis of (a) demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and (b) academic standards expected of graduates of a programme of study.

The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery, and review of academic programmes. Learning outcomes-based frameworks in any subject must specify what graduates completing a particular programme of study are (a) expected to know, (b) understand and (c) be able to do at the end of their programme of study. To this extent, the course content of Zoology is committed to allowing for flexibility and innovation in (i) programme design and syllabi development by higher education institutions (HEIs), (ii) teaching-learning process, (iii) assessment of student learning levels, and (iv) periodic programme review within institutional parameters (v) generating framework(s) of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes.

The key outcomes that underpin curriculum planning and development at the undergraduate level include Graduate Attributes, Qualification Descriptors, Programme Learning Outcomes, and Course Learning Outcomes. The undergraduate education is based on specific learning outcomes and academic standards expected to be attained by graduates of a programme of study. However, an outcome-based approach identifies moves way from the emphasis on what is to be taught to focus on what is learnt by way of demonstrable outcomes. This approach provides greater flexibility to the teachers to develop—and the students to accept and adopt—different learning and teaching

pedagogy in an interactive and participatory ecosystem. The idea is to integrate social needs and teaching practices in a manner that is responsive to the need of the community. HEIs, on their turn, shall address to the situations of their students by identifying relevant and common outcomes and by developing such outcomes that not only match the specific needs of the students but also expands their outlook and values.

B.Sc. in Zoology is a recognized and structured undergraduate degree in tertiary education. It offers specialized knowledge, skills, and values that students can use to pursue professional opportunities or continue their studies at the postgraduate level. The purpose of the present curriculum of B.Sc. Zoology is to prepare students for professional careers or further studies in various job fields. Graduates can pursue a wide range of jobs or continue their education at an advanced level.

3.1 Course of Study:

Course of study indicate pursuance of study in a particular discipline/programme. Discipline/Programmes shall offer Major Courses (Core), Minor Courses, Skill Enhancement Courses (SEC), Value Added Courses (VAC), Ability Enhancement Compulsory Courses (AECCs) and Interdisciplinary courses.

3.2 Disciplinary Major:

The major would provide the opportunity for a student to pursue in-depth study of a particular subject or discipline. Students may be allowed to change major within the broad discipline at the end of the second semester by giving her/him sufficient time to explore interdisciplinary courses during the first year. Advanced-level disciplinary/interdisciplinary courses, a course in research methodology, and a project/dissertation will be conducted in the seventh semester. The final semester will be devoted to seminar presentation, preparation, and submission of project report/dissertation. The project work/dissertation will be on a topic in the disciplinary programme of study or an interdisciplinary topic.

3.3 Disciplinary/interdisciplinary minors:

Students will have the option to choose courses from disciplinary/interdisciplinary minors and skill-based courses. Students who take a sufficient number of courses in a discipline or an interdisciplinary area of study other than the chosen major will qualify for a minor in that discipline or in the chosen interdisciplinary area of study. A student may declare the choice of the minor at the end of the second semester, after exploring various courses.

3.4 Courses from Other Disciplines (Interdisciplinary):

All UG students are required to undergo 3 introductory-level courses relating to any of the broad disciplines given below. These courses are intended to broaden the intellectual experience and form part of liberal arts and science education. Students are not allowed to choose or repeat courses already undergone at the higher secondary level (12th class) in the proposed major and minor stream under this category.

- ***Natural and Physical Sciences:*** Students can choose basic courses from disciplines such as Natural Science, for example, Biology, Botany, Zoology, Biotechnology, Biochemistry, Chemistry, Physics, Biophysics, Astronomy and Astrophysics, Earth and Environmental Sciences, etc.
- ***Mathematics, Statistics, and Computer Applications:*** Courses under this category will facilitate the students to use and apply tools and techniques in their major and minor disciplines. The course may include training in programming software like Python among others and applications software like STATA, SPSS, Tally, etc. Basic courses under this category will be helpful for science and social science in data analysis and the application of quantitative tools.
- ***Library, Information, and Media Sciences:*** Courses from this category will help the students to understand the recent developments in information and media science (journalism, mass media, and communication)
- ***Commerce and Management:*** Courses include business management, accountancy, finance, financial institutions, fintech, etc.
- ***Humanities and Social Sciences:*** The courses relating to Social Sciences, for example, Anthropology, Communication and Media, Economics, History, Linguistics, Political Science, Psychology, Social Work, Sociology, etc. will enable students to understand the individuals and their social behaviour, society, and nation. Students be introduced to survey methodology and available large-scale databases for India. The courses under humanities include, for example, Archaeology, History, Comparative Literature, Arts & Creative expressions, Creative Writing and Literature, language(s), Philosophy, etc., and interdisciplinary courses relating to humanities. The list of Courses can include interdisciplinary subjects such as Cognitive Science, Environmental Science, Gender Studies, Global Environment & Health, International Relations, Political Economy and Development, Sustainable Development, Women's, and Gender Studies, etc. will be useful

to understand society.

3.5 Ability Enhancement Courses (AEC): Modern Indian Language (MIL) & English language focused on language and communication skills. Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic writing skills, that help students articulate their arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity. They would also enable students to acquaint themselves with the cultural and intellectual heritage of the chosen MIL and English language, as well as to provide a reflective understanding of the structure and complexity of the language/literature related to both the MIL and English language. The courses will also emphasize the development and enhancement of skills such as communication, and the ability to participate/conduct discussion and debate.

3.6. Skill Enhancement Course (SEC): These courses are aimed at imparting practical skills, hands-on training, soft skills, etc., to enhance the employability of students and should be related to Major Discipline. They will aim at providing hands- on training, competencies, proficiency, and skill to students. SEC course will be a basket course to provide skill-based instruction. For example, SEC of English Discipline may include Public Speaking, Translation & Editing and Content writing. A student shall have the choice to choose from a list, a defined track of courses offered from 1st to 3rd semester.

3.7 Value-Added Courses (VAC):

- ***Understanding India:*** The course aims at enabling the students to acquire and demonstrate the knowledge and understanding of contemporary India with its historical perspective, the basic framework of the goals and policies of national development, and the constitutional obligations with special emphasis on constitutional values and fundamental rights and duties. The course would also focus on developing an understanding among student-teachers of the Indian knowledge systems, the Indian education system, and the roles and obligations of teachers to the nation in general and to the school/community/society. The course will attempt to deepen knowledge about and understanding of India's freedom struggle and of the values and ideals that it represented to develop an appreciation of the contributions made by people of all sections and regions of the country, and help learners understand and cherish the values enshrined in the Indian Constitution and to prepare them for their roles and responsibilities as effective citizens of a

democratic society.

- ***Environmental science/education:*** The course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes, and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living. The course will also deepen the knowledge and understanding of India's environment in its totality, its interactive processes, and its effects on the future quality of people's lives.

- ***Digital and technological solutions:*** Courses in cutting-edge areas that are fast gaining prominences, such as Artificial Intelligence (AI), 3-D machining, big data analysis, machine learning, drone technologies, and Deep learning with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

- ***Health & Wellness, Yoga education, sports, and fitness:*** Course components relating to health and wellness seek to promote an optimal state of physical, emotional, intellectual, social, spiritual, and environmental well-being of a person. Sports and fitness activities will be organized outside the regular institutional working hours. Yoga education would focus on preparing the students physically and mentally for the integration of their physical, mental, and spiritual faculties, and equipping them with basic knowledge about one's personality, maintaining self-discipline and self-control, to learn to handle oneself well in all life situations. The focus of sports and fitness components of the courses will be on the improvement of physical fitness including the improvement of various components of physical and skills-related fitness like strength, speed, coordination, endurance, and flexibility; acquisition of sports skills including motor skills as well as basic movement skills relevant to a particular sport; improvement of tactical abilities; and improvement of mental abilities. These are a common pool of courses offered by different disciplines and aimed towards embedding ethical, cultural and constitutional values; promote critical thinking. Indian knowledge systems; scientific temperament of students.

3.8 Summer Internship /Apprenticeship:

The intention is induction into actual work situations. All students must undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the ***summer term***. Students should take up opportunities for internships with local industry, business organizations, health and allied areas,

local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability. Students who wish to exit after the first two semesters will undergo a 4-credit work-based learning/internship during the summer term to get a UG Certificate.

3.9 Community engagement and service: The curricular component of ‘community engagement and service’ seeks to expose students to the socio- economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity or part of a major or minor course depending upon the major discipline.

3.10 Field-based learning/minor project: The field-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain a first- hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community, and innovative practices required to generate solutions to the identified problems. This may be a summer term project or part of a major or minor course depending on the subject of study.

3.11 Indian Knowledge System:

In view of the importance accorded in the NEP 2020 to rooting our curricula and pedagogy in the Indian context all the students who are enrolled in the four-year UG programmes should be encouraged to take an adequate number of courses in IKS so that the ***total credits of the courses taken in IKS amount to at least five per cent of the total mandated credits (i.e. min. 8 credits for a 4 yr. UGP & 6 credits for a 3 yr. UGP)***. The students may be encouraged to take these courses, preferably *during the first four semesters of the UG programme*. At least half of these mandated credits should be in courses in disciplines which are part of IKS and are related to the major field of specialization that the student is pursuing in the UG programme. They will be included as a part of the total mandated credits that the student is expected to take in the major field of specialization. The rest of the mandated credits in IKS can be included as a part of the mandated Multidisciplinary

courses that are to be taken by every student. All the students should take a Foundational Course in Indian Knowledge System, which is designed to present an overall introduction to all the streams of IKS relevant to the UG programme. The foundational IKS course should be broad-based and cover introductory material on all aspects. Wherever possible, the students may be encouraged to choose a suitable topic related to IKS for their project work in the 7/8th semesters of the UG programme.

3.12 Experiential Learning:

One of the most unique, practical & beneficial features of the National Credit Framework is assignment of credits/credit points/ weightage to the experiential learning including relevant experience and professional levels acquired/ proficiency/ professional levels of a learner/student. Experiential learning is of two types:

- ***Experiential learning as part of the curricular structure*** of academic or vocational program. E.g., projects/OJT/internship/industrial attachments etc. This could be either within the Program- internship/ summer project undertaken relevant to the program being studied or as a part time employment (not relevant to the program being studied- up to certain NSQF level only). In case where experiential learning is a part of the curricular structure the credits would be calculated and assigned as per basic principles of NCrF i.e., 40 credits for 1200 hours of notional learning.
- ***Experiential learning as active employment*** (both wage and self) post completion of an academic or vocational program. This means that the experience attained by a person after undergoing a particular educational program shall be considered for assignment of credits. This could be either Full or Part time employment after undertaking an academic/ Vocation program.

In case where experiential learning is as a part of employment the learner would earn credits as weightage. The maximum credit points earned in this case shall be double of the credit points earned with respect to the qualification/ course completed. The credit earned and assigned by virtue of relevant experience would enable learners to progress in their career through the work hours put in during a job/employment.

4. AWARD OF DEGREE

The structure and duration of undergraduate programmes of study offered by the University as per NEP 2020 include:

Undergraduate programmes of either 3 or 4-year duration with Single Major, with multiple entry

and exit options, with appropriate certifications:

UG Certificate: Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

UG Diploma: Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

3-year UG Degree: Students who will undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits and satisfying the minimum credit requirement.

4-year UG Degree (Honours): A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 160 credits and have satisfied the credit requirements as given in Table 6 in Section 5.

4-year UG Degree (Honours with Research): Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a Faculty Member of the University. The research project/dissertation will be in the major discipline. The students who secure 160 credits, including 12 credits from a research project/dissertation, will be awarded UG Degree (Honours with Research).

(Note: **UG Degree Programmes with Single Major:** A student must secure a minimum of 50% credits from the major discipline for the 3-year/4-year UG degree to be awarded a single major. For example, in a 3-year UG programme, if the total number of credits to be earned is 120, a student of Mathematics with a minimum of 60 credits will be awarded a B.Sc. in Mathematics with a single major. Similarly, in a 4-year UG programme, if the total number of credits to be earned is 160, a student of Chemistry with a minimum of 80 credits will be awarded a B.Sc. (Hons./Hon. With Research) in Chemistry in a 4-year UG programme with single major. Also the **4-year Bachelor's degree programme with Single Major** is considered as the preferred option since it would allow the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.)

Award	Year	Credits to earn	Additional Credits	Re-entry allowed within (yrs)	Years to Complete
UG Certificate	1	40	4	3	7
UG Diploma	2	80	4	3	7
3-year UG Degree (Major)	3	120	x	X	x
4-year UG Degree (Honours)	4	160	x	X	x
Award	Year	Credits to earn	Additional Credits	Re-entry allowed within (yrs)	Years to Complete
4-year UG Degree honors with Research	4	160	Students who secure cumulative 75% marks and above in the first six semesters		

5. GRADUATE ATTRIBUTES & LEARNING OUTCOMES

As per the NHEQF, each student on completion of a programme of study must possess and demonstrate the expected *Graduate Attributes* acquired through one or more modes of learning, including direct in-person or face-to-face instruction, online learning, and hybrid/blended modes. The graduate attributes indicate the quality and features or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study.

Table: The Learning Outcomes Descriptors and Graduate Attributes

Sl.no.	Graduate Attribute	The Learning Outcomes Descriptors (The graduates should be able to demonstrate the capability to:)
GA1	Disciplinary Knowledge	acquire knowledge and coherent understanding of the chosen disciplinary/interdisciplinary areas of study.
GA 2	Complex problem solving	solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.
GA 3	Analytical & Critical thinking	apply analytical thought including the analysis and evaluation of policies, and practices. Able to identify relevant assumptions or implications.

GA 4	Creativity	create, perform, or think in different and diverse ways about the same objects or scenarios and deal with problems and situations that do not have simple solutions. Think ‘out of the box’ and generate solutions to complex problems in unfamiliar contexts by adopting innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence.
GA 5	Communication Skills	listen carefully, read texts and research papers analytically, and present complex information in a clear and concise manner to different groups/audiences. Express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media.
GA 6	Research-related skills	develop a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions. Should acquire the ability to problematize, synthesize and articulate issues and design research proposals, define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships. Should develop the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work.
GA 7	Collaboration	work effectively and respectfully with diverse teams in the interests of a common cause and work efficiently as a member of a team.
GA 8	Leadership readiness/qualities	plan the tasks of a team or an organization and setting direction by formulating an inspiring vision and building a team that can help achieve the vision.
GA 9	Digital and technological skills	use ICT in a variety of learning and work situations. Access, evaluate, and use a variety of relevant information sources and use appropriate software for analysis of data.
GA 10	Environmental awareness and action	mitigate the effects of environmental degradation, climate change, and pollution. Should develop the technique of effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.

The graduate profile/attributes are acquired incrementally through development of cognitive levels and describe a set of competencies that are transferable beyond the study of a particular

subject/disciplinary area and programme contexts in which they have been developed.

Graduate attributes include,

- *learning outcomes that are specific to disciplinary areas* relating to the chosen field(s) of learning within broad multidisciplinary/interdisciplinary/ transdisciplinary contexts.
- *generic learning outcomes* that graduate of all programmes of study should acquire and demonstrate.

6. PROGRAMME LEARNING OUTCOMES

PO-1: Knowledge of Zoology

Upon completion of the Zoology program, graduates will demonstrate a comprehensive understanding of core principles and theories in zoology, enabling them to analyze and interpret diverse aspects of animal life, behavior, and ecology.

PO-2: Complex problem solving of Zoology

Upon completion of the Zoology program, graduates will possess advanced skills in complex problem-solving, enabling them to address intricate challenges in animal conservation, population dynamics, and ecological management.

PO-3: Analytical and critical thinking in Zoology

Graduates will exhibit advanced capabilities in analytical and critical thinking, allowing them to assess scientific data, conduct rigorous research, and evaluate complex ecological issues with precision and insight.

PO-4: Creativity in Zoology

Graduates will demonstrate innovative and creative thinking, fostering novel approaches to address zoological challenges and contribute to advancements in animal research and conservation..

PO-5: Communication skills in Zoology

Graduates will possess strong communication skills, effectively conveying complex scientific concepts and findings to diverse audiences, fostering collaboration and promoting public awareness of Zoological issues.

PO-6: Research related skills in Zoology

Upon completion of the Zoology program, graduates will demonstrate proficiency in research-related skills, including data collection, analysis, and interpretation, enabling them to contribute to the advancement of zoological knowledge and scientific discovery.

PO-7: Collaboration in Zoology

The students will exhibit strong collaboration skills, effectively working with multidisciplinary teams to address complex zoological challenges and promote collective efforts towards animal conservation and research.

PO-8: Leadership qualities in Zoology

Upon completion of the Zoology program, graduates will demonstrate exceptional leadership qualities, inspiring and guiding teams in the field of zoology to foster innovation, conservation, and sustainable practices in the study and management of animal life.

PO-9: Digital and technological skills in Zoology

Graduates will possess proficient digital and technological skills, utilizing cutting-edge tools and methodologies to enhance research, data analysis, and communication in the field of zoology, promoting advancements and efficiency in their work.

PO-10: Environmental awareness and action in Zoology

Upon completion of the Zoology program, graduates will display a heightened environmental awareness, incorporating ecological principles into their work, and taking proactive actions to promote sustainability and conservation efforts in the realm of zoology.

7. PROGRAMME SPECIFIC OUTCOMES

PSO1: Ability to apply knowledge of Zoology to realize and explain notions and complexities of animal sciences.

PSO2: Ability to comprehend the relationship of organisms at all levels: molecular, cellular, and organismal

PSO3: Ability to conduct empirical studies for scientific research as well as to validate, analyze and interpret them.

8. TEACHING LEARNING PROCESS

Teaching and learning in this programme involve classroom lectures, tutorials, hands-on practical's, field-based work, immersive experiences such as visits to protected areas, eco-tourism ventures, etc. The various aspects are shown below-

- Written assignments and projects submitted by students
- Project-based learning, Group discussion, Home assignments, Quizzes and Class tests
- Reflective learning and Flipped classrooms
- PPT presentations, Seminars, interactive sessions, Co-curricular activity etc
- Socio-economic survey and Industrial Tour or Field visit

9. ASSESSMENT METHODS

Methods	Weightage
Semester End Examination	70%
Internal Assessment	30%
Total	100%

Internal assessment is based on –

25%- Mid-semester Examination, Class test, Assignment, Project, Viva-voce, Seminar, etc.

5%- Attendance of the student

2. Learning Outcomes of different types of courses for BSc (Honours) in Zoology

BSc (H) Zoology				
Programme Structure				

1st semester				
Sl. No.	Subject Code	Names of subjects	Course Level	Credit
Major				
1	ZOO142M101	Non-Chordates	100	3
2	ZOO142M102	Non-Chordates (Practical)		3
Minor				
3	ZOO142N101	Animal Diversity- Non-Chordates	100	3
Interdisciplinary				
4	ZOO142I-101	Introduction to Indian Knowledge System –	100	3
Ability Enhancement Courses (AEC)				
5	AEC982A101	Communicative English-I	100	2
Skill Enhancement Courses (SEC)				
6	ZOO142S-121	Vermiculture	100	3
Value Added Courses (VAC)				
7	VAC992V-103	Basket Course	100	3
			Total credits	20
2nd Semester				
Sl. No.	Subject Code	Names of subjects	Course Level	Credit
Major				
1	ZOO142M103	Chordates	100	3
2	ZOO142M104	Chordates (Practical)		3
Minor				
3	ZOO142N102	Animal Diversity- Chordates	100	3
Interdisciplinary				
4	ZOO142I-201	Introduction to Indian Knowledge System –	100	3
Ability Enhancement Courses (AEC)				

5	AEC982A201	Communicative English-II	100	2
Skill Enhancement Courses (SEC)				
6	ZOO142S-221	Sericulture	100	3
Value Added Courses (VAC)				
7	VAC992V-203	Basket Course	100	3
Total credits				20
3rd Semester				
Sl. No.	Subject Code	Names of subjects	Course Level	Credit
Major				
1	ZOO142M301	Comparative Anatomy of Animals	200	4
2	ZOO142M312	Comparative Anatomy of Animals (Practical)		4
Minor				
3	ZOO142N301	Human Biology	200	4
Interdisciplinary				
4	IKS142I301	Basket Course	200	3
Ability Enhancement Courses (AEC)				
5	CEN982A301	Communicative English-III	200	1
6	BHS982A302	Behavioral Science-III	200	1
Skill Enhancement Courses (SEC)				
6	ZOO142S321	Wildlife Photography & Ecotourism	200	3
Total credits				20
4th Semester				
Sl. No.	Subject Code	Names of subjects	Course Level	Credit
Major				
1	ZOO142M401	Cell Biology	200	4
2	ZOO142M402	Animal Physiology and Endocrinology		4
3	ZOO142M413	Cell Biology & Animal Physiology and Endocrinology (Practical)	200	4
Minor				
4	ZOO142N401	Aquatic Biology	200	3
5	ZOO142N402	Economic Zoology		3

Ability Enhancement Courses (AEC)				
6	CEN982A401	Communicative English-IV	200	1
7	BHS982A402	Behavioral Science-IV	200	1
		Total credits		20
5th Semester				
Sl. No.	Subject Code	Names of subjects	Course Level	Credit
Major				
1	ZOO142M301	Biochemistry	300	4
2	ZOO142M302	Evolutionary Biology		4
3	ZOO142M303	Biochemistry and Evolutionary Biology (Practical)		4
Minor				
4	ZOO142N301	Animal Parasites	300	4
Internship				
5		Internship (Mandatory after 4 th Semester)	300	4
		Total credits		20
6th Semester				
Sl. No.	Subject Code	Names of subjects	Course Level	Credit
Major				
1	ZOO142M304	Molecular Biology	300	4
2	ZOO142M305	Endocrinology		4
3	ZOO142M306	Ecology		4
4	ZOO142M307	Molecular Biology, Endocrinology & Ecology (Practical)		4
Minor				
5	ZOO142N302	Entomology	300	4
		Total credits		20
7th Semester				
Sl. No.	Subject Code	Names of subjects	Course Level	Credit
Major				
1	ZOO142M401	Genetics and Genomics	400	4

2	ZOO142M402	Immunology		4
3	ZOO142M403	Biostatistics and Bioinformatics		4
4	ZOO142M404	Genetics and Genomics, Immunology, Biostatistics and Bioinformatics (Practical)		4
Minor				
5	ZOO142N401	Ecology and Wildlife	400	4
		Total credits		20
8th Semester				
Sl. No.	Subject Code	Names of subjects	Course Level	Credit
Major				
1	ZOO142M405	Developmental Biology	400	4
Minor				
2	ZOO142N402	Research Methodology	400	4
Dissertation				
3			400	12
OR				
4	ZOO142M407	Biotechnology	400	4
5	ZOO142M408	Animal Behaviour		4
6	ZOO142M409	Parasitology		4
		Total credits		20

Semester-I		
Subject Name: Non-Chordates		
Type of course: Major	Paper Code: ZOO142M101	
Course Level: 100	Credit: 3	L-T-P-C- 3-0-0-3
Scheme of Evaluation: Theory		

Course Objective: This course is designed to introduce the students to the diversity of non-Chordates, their systemic classification, phylogeny, characteristics, affinities and significance.

Course Learning Outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall and list the major characteristics that distinguish non-chordate animals from chordates, including absence of a notochord.	BT 1
CO 2	Explain the diversity of non-chordate animals and their adaptations to different environments and ecological niches.	BT 2
CO 3	Apply knowledge of non-chordate anatomy and physiology to identify and classify different non-chordate species based on shared features.	BT 3
CO 4	Analyze invertebrate relationships and anatomical comparisons.	BT 4

Detailed syllabus:

Modules	Course contents	Periods
I	<p>Introduction to Invertebrates- Diversity, general characteristics and phylogeny of invertebrates.</p> <p>Protozoa: General characters and outline classification up to class. Protozoa– nutrition, locomotion and diseases associated with Protozoans.</p> <p>Metazoa: Origin of metazoa, metamerism and coelom.</p> <p>Porifera: General characters and outline classification up to classes. Porifera- canal system and affinities.</p>	15
II	<p>Cnidaria: General characters and outline classification up to class. Polymorphism, alternation of generation, nematocysts and locomotion in Cnidarians.</p> <p>Platyhelminthes: General characters and outline classification up to class. General discussion on parasitic Platyhelminthes. Phylogenetic significance.</p> <p>Aschelminthes: General characters and outline classification up to</p>	15

	class. Discussion of phylogenetic position of aschelminthes. Parasitic nematodes and diseases caused by them.	
III	<p>Ctenophora: General characteristics and affinities</p> <p>Annelida: General characters and outline classification up to class. Metamerism and nephridia. Adaptive radiations in Annelida.</p> <p>Arthropoda: General characters and outline classification up to class. Larval forms of crustacea; social life, metamorphosis in Insecta. Onychophora: Affinities of Onychophora.</p>	15
IV	<p>Mollusca: General characters and outline classification up to class. Torsion in Gastropods; pearl formation.</p> <p>Echinodermata: General characters and outline classification up to class. Affinities of Echinodermata. Water-vascular system and larval forms.</p> <p>Brief discussion on minor phyla of non-chordates.</p> <p>Economic and ecological significance of non-chordates.</p>	15
Total		60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	30 hrs
		Field work, Assignment, Reflective thinking, case study, seminar, quiz

Textbooks:

1. Ruppert, E.E., Fox R.S., and Barnes R. (2004). Invertebrate Zoology. (7th ed), Holt Saunders International Edition. Thompson- brooks/ Cole
2. Kotpal, R.L. (2015). Modern textbook of Zoology: Invertebrates. (11th ed). Rastogi publications.

References:

1. Solomon, E.P., Martin, E.C., Martin, D.W., Berg, L. R. (2019). Biology. (11th Ed). Cengage.
2. Miller, S.A., & Harley, J.P. (2016). Zoology. (10th ed). Mcgraw-Hill.
3. Campbell, N.A., & Reece, J.B. (2005). Biology. (7th ed). Pearson Benjamin Cummings.

Semester-I	
Subject Name: Non-Chordates (Practical)	
Type of course: Major	Paper Code: ZOO142M102
Course Level: 100	Credit: 3 L-T-P-C- 0-0-6-3
Scheme of Evaluation: Practical	

Course Objective: The objective of the course is to help students learn and identify the invertebrate species based on their morphological and anatomical characteristics and the behavioural patterns exhibited by different invertebrate species.

Course Outcomes: After completion of the course the students will be able to:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall and identify the major characteristics of non-chordate animals, including their body plans, locomotion methods, and feeding strategies.	BT 1
CO 2	Demonstrate an understanding of the diversity of non-chordate organisms and their adaptations to different environments through practical observations.	BT 2
CO 3	Apply knowledge of non-chordate anatomy and morphological features to identify and classify specimens collected during fieldwork and lab exercises.	BT 3
CO 4	Analyze invertebrate relationships and anatomical comparisons.	BT 4

Detailed syllabus:

Modules	Course contents	Periods
I	1. Study of Museum Specimens Identification and classification up to order- <i>Spongilla</i> , <i>Physalia</i> , <i>Metridium</i> (<i>Seaanemone</i>). <i>Pennatula</i> , (Sea-pen) <i>Gorgonia</i> , <i>Fasciola</i> . <i>Taenia</i> , <i>Echiurus</i> , <i>Limulus</i> , <i>Scolopendra</i> (Centipede) <i>Julus</i> (Millipede), <i>Carausius</i> (stick insect), <i>Lepisma</i> , <i>Mantis</i> , Termite queen, <i>Belostoma</i> (Giant water bug), <i>Peripatus</i> , <i>Chiton</i> , <i>Achatina</i> , <i>Pinctada</i> (Pearl oyster), <i>Loligo</i> , <i>Mytilus</i> , <i>Limax</i> , <i>Cucumaria</i> (Sea Cucumber), <i>Echinus</i> (Seaurchin).	24
II	1. Identification of prepared slides – <i>Polystomella</i> , Sponge spicules, T.S of <i>Ascaris</i> , <i>Miracidium</i> , <i>Cercaria</i> larvae of Liver fluke, T.S. of Leech (Through crop	22

	region). T.S. of Earth worm (through pharynx, gizzard and intestine). Mouth parts of mosquitoes, Larvae of <i>Glochidium</i> and Echinodermata (<i>Bipennaria</i>)	
III	<p>1. Demonstration/ dissection of the following systems of invertebrate animals (any one)</p> <p>a) Digestive system of Cockroach</p> <p>b) Nervous system of Pila</p> <p>c) Nervous system of Prawn</p> <p>d) Urogenital system of Leech</p> <p>2. Mounting temporary slide of the following organ/parts- Setae of Earthworm, Salivary gland of Cockroach, Redulla of Pila, Mouthparts of Mosquito and honey bee.</p>	22
IV	<p>1. To examine the nematode diversity from soil sample collected from different places.</p> <p>2. To study the social behaviours of ants/honey bee/termites/wasp.</p> <p>3. To study about two ecto and endo parasites</p>	22
TOTAL		90

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
-	90 hrs	-

Textbooks:

1. Young, J. Z. (2004). The Life of Vertebrates. 3rd Edition. Oxford University Press.
2. Lal, S. S. (2020). Practical Zoology Invertebrates. (12th Ed), Rastogi Publications

References:

1. Barnes, R. S. K., Calow, P. P., Olive, P. J., Golding, D. W., & Spicer, J. I. (2009). The invertebrates: a synthesis. (3rd Ed). John Wiley & Sons.
2. Practical, Sukla, J. P., & Pandey, K. (2017). Non-Chordates (Invertebrate) Zoology. Himalaya publishing House.
3. Das, D. (2017). Essential practical handbook of cell biology & genetics, biometry & microbiology: a laboratory manual. (1st Ed). Academic Publishers.

4. Gupta, A., Sati, B. K., & Lambert, L. A. P. Practical laboratory Manual- Cell Biology. Academic Publishing

SEMESTER-I		
Subject Name: Animal Diversity- Non-Chordates		
Type of course: Minor	Paper Code: ZOO142N101	
Course Level: 100	Credit: 3	L-T-P-C- 3-0-0-3
Scheme of Evaluation: Theory		

Course Objectives: This course is designed to introduce the students to the diversity of Chordates, their systemic classification, phylogeny, characteristics, affinities and significance.

Course Outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall and identify the diverse invertebrate life forms	BT 1
CO 2	Demonstrate an understanding of the major phyla with respect to their general characteristics	BT 2
CO 3	Apply knowledge of non-chordate anatomy and morphological features to identify the relationships between various phyla and their distinct features.	BT 3
CO 4	Analyze taxonomic keys and classification techniques for identification.	BT 4

Detailed syllabus:

Module	Course Contents	Periods
I	General characters and outline classification up to class: Protozoa, Porifera, Cnidaria Annelida, Arthropoda	15
II	Locomotion in Protozoans; Canal system in Porifera; Excretion in Annelida; Vision in Arthropoda.	15
III	General characters and outline classification up to class: Platyhelminthes, Aschelminthes, Life cycle of <i>Fasciola hepatica</i> and <i>Ascaris lumbricoides</i> .	15
IV	General characters and outline classification up to class: Molluscs, Echinodermata. Pearl formation in Molluscs. Brief introduction on Protochordates and Agnatha,	15
	TOTAL	60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	30 hrs
		Assignment, case study, critical analysis, quiz

Textbooks:

1. Ruppert, E.E., Fox R.S., and Barnes R. (2004). Invertebrate Zoology. (7th ed), Holt Saunders International Edition. Thompson- Brooks/ Cole
2. Parker, T.J. and Haswell, W.A. (2021). Textbook of Zoology: Invertebrates. (8th Ed), Vol. I. Macmillan education, U.K.

References:

1. Solomon, E.P., Martin, E.C., Martin, D.W., Berg, L.R. (2019). Biology. (11th Ed). Cengage.
2. Miller, S.A., & Harley, J.P. (2016). Zoology. (10th ed). Mcgraw-Hill.
3. Royston, A. (2015). Invertebrates. Heinemann
4. Kardong, K.V. (2008). Vertebrates: Comparative Anatomy, Function, Evolution. (5th Ed). McGraw-Hill

Semester-I
AEC-1/Subject Name: Communicative English- I: Developing Oral Communication and Listening Skills
Subject Code: CEN982A101
L-T-P-C – 2-0-0-2
Credit Units: 2
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech Continuous Evaluation: 30 Marks Semester End Examination: Component A – Written Examination = 30 Marks Component B +C – Viva-Voce + Extempore speech = 40 Marks

Course Objective:

The objective of the course is to introduce students to oral communication skills in English by engaging them to meaningful discussion and interactive activities.

Course Outcomes: On completion of this course students will be expected to -

- Have a knowledge of Communication process, verbal, and non-verbal communication
- Improve the skill of listening processes
- Develop a life skill on oral group communication- group discussion leadership skills, team management.
- Have a basic idea of language styles – oral and written communication.

Detailed Syllabus:

Modules	Course Contents	Periods
I.	<p>Basics of Communication- Introduction Communication - definition – meaning – elements - basics of communication - communication process - importance of communication Components of Communication Types/forms of Communication (Oral-written, Formal- Informal (Grapevine), Interpersonal- Intrapersonal, Mass- Group, Verbal- Non Verbal External communication, Organizational Communication- Upward, Downward, horizontal, Diagonal) Non-verbal Communication - Introduction; Body language- Personal Appearance, Postures, Gestures, Eye Contact, Facial expressions Paralinguistic Features- Rate, Pause, Volume, Pitch/ Intonation/ Voice/ modulation Proxemics, Haptics, Artifacts, Chronemics</p>	15
II.	<p>The Listening Process Types of Listening – Superficial, Appreciative, Focused, Evaluative, Attentive, Emphatic, Listening with a Purpose, Barriers to Communication, Barriers to Listening</p>	15
III.	<p>Focus on Oral Group Communication Nature of group communication, Characteristics of successful Group Communication Selection of group discussion- subject knowledge, leadership skills, team management Group Discussion Strategies</p>	15
IV	<p>Language Styles- Oral and Written Communication Technical Style, ABC of technical communication- accuracy, using exact words and phrases, brevity, clarity, Objectivity of Technical Writing - Impersonal language, Objectivity in professional speaking.</p>	15

TOTAL	60
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Textbooks:

Rizvi, M. Ashraf. (2008). *Effective Technical Communication* (11 reprint). New Delhi: Tata McGraw Hill.

Reference Books:

- Koneru, Aruna. (2017) *Professional Communication*. New Delhi: Tata McGraw Hill ISBN-13: 978-0070660021
- Hair, Dan O., Rubenstein, Hannah and Stewart, Rob. (2015). *A Pocket Guide to Public Speaking*. (5th edition). St. Martin's. ISBN-13:978-1457670404

Semester I
Subject Name: Vermiculture Type of course: SEC Paper Code: ZOO142S121 Course Level: 100 Credit: 3 L-T-P-C- 0-0-6-3 Scheme of Evaluation: Practical

Course Objective: This course is designed to introduce the students to the basic processes and practice of vermiculture, its scope and economic advantages.

Course Outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall and describe the basic principles of vermicomposting, including the role of earthworms in the decomposition process.	BT 1
CO 2	Explain the importance of vermicomposting in organic waste management and its benefits for soil health and plant growth.	BT 2
CO 3	Apply vermicomposting techniques to set up and maintain a functional vermicompost system, selecting suitable earthworm species.	BT 3
CO 4	Analyze the impact of vermicompost on soil quality and plant growth	BT 4

Detailed Syllabus:

Modules	Course Contents	Periods
I	Introduction: Definition, Choosing the right worm. Useful species of earthworms. Maintenance of soil structure.	12
II	Scope of Vermiculture: Advantages of vermiculture; scope of sericulture in India employment potential and income generation;	12
III	Vermicomposting: Method and techniques of preparing vermicompost,	12
IV	Application and advantages of vermiculture, Vermicomposting for Organic Farming - an Eco-Friendly	12
Total		48

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
-	60 hrs	30 hrs
		Project, Assignment, hands-on, quiz

Textbooks:

1. Edwards, Norman and Rhonda. (2010). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management.
2. Sultan (2005). The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.

Reference:

1. Bhatnagar & Patla (2007). Earthworm vermiculture and vermin-composting. Kalyani Publishers, New Delhi

Semester-II		
Subject Name: Chordates		
Type of course: Major	Paper Code: ZOO142M201	
Course Level: 100	Credit: 3	L-T-P-C- 3-0-0-3
Scheme of Evaluation: Theory		

Course Objective: This course is designed to acquaint students on comparative anatomy of higher Chordates- their systemic classification, phylogeny, characteristics, affinities and significance and provide a detailed account of the mechanisms behind different physiological processes.

Course Outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Identify and describe the major characteristics that define chordates, such as the presence of a notochord.	BT 1
CO 2	Explain the evolutionary significance of notochords and dorsal nerve cords in the development of chordates.	BT 2
CO 3	Apply knowledge of chordate characteristics to classify different chordate species based on shared features.	BT 3
CO 4	Analyze evolutionary behaviour, taxonomic hierarchy, Chordate relationships and anatomical comparisons.	BT 4

Detailed syllabus:

Modules	Course contents	Periods
I	Introduction to Chordates: Evolution and phylogeny of chordates; Defining characteristics of chordates: notochord, dorsal nerve cord, pharyngeal slits, and post-anal tail; Chordates and Protochordates- characters and classification.	15
II	General features and classification of some major classes such as Pisces, Amphibia, Reptiles, Aves and Mammals.	15
III	Origin and evolution of terrestrial species- ectotherms. parental care in higher animals, poison apparatus and biting mechanism in snakes. Flight adaptations. Mechanism of flight and migration of birds. Ecological and economic significance of chordates	15

IV	Ecology and behaviour of Chordates- Chordate habitats and ecological roles. behaviour patterns: feeding, mating, and social behaviour in chordates. Threats to chordate species: habitat destruction, climate change, pollution	15
Total		60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	30 hrs
		Field visit in Zoo, Assignment, Reflective thinking, case study, seminar, quiz

Textbooks:

1. Kardong, K.V. (2019). *Vertebrates: Comparative Anatomy, Function, Evolution*. (8th ed). McGraw-Hill.
2. Jordan, E. L. & Verma, P.S. (2013). *Chordate Zoology*. S. Chand Publishers.

References:

1. Solomon, E.P., Martin, E.C., Martin, D.W., Berg, L.R. (2019). *Biology* (11th Ed). Cengage.
2. Miller, S.A. & Harley, J.P. (2016). *Zoology*. (10th ed). Mcgraw-Hill.
3. Campbell, N.A., & Reece, J.B. (2005). *Biology*. (7th ed). Pearson Benjamin Cummings.
4. Leiem, C.F., Bermis, Walker, W.E, W.F., & Grande, L. (2001). *Functional anatomy of vertebrates: An evolutionary perspective*. (3rd Ed). Brookes/Cole, Cengage Learning.

Semester-II	
Subject Name: Chordates (Practical)	
Type of course: Major	Paper Code: ZOO142M204
Course Level: 100	Credit: 3 L-T-P-C- 0-0-6-3
Scheme of Evaluation: Practical	

Course Objective: This syllabus is designed to provide a comprehensive understanding of the biology of chordates, including their evolution, anatomy, physiology, behavior, ecology, and conservation. It encourages students to apply their learning through practical laboratory work and field observations.

Course outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Identify and label the major external anatomical features of various chordate specimens.	BT 1
CO 2	Describe the functional significance of specific anatomical structures in chordate organisms.	BT 2
CO 3	Apply dissection techniques to examine the internal organ systems of chordate specimens and compare them.	BT 3
CO 4	Analyze Chordate relationships by comparing anatomical differences between various phyla	BT 4

Detailed Course:

Modules	Course Contents	Periods
I	<p>Protochordata:</p> <ol style="list-style-type: none"> To study characteristic features of <i>Balanoglossus</i>, <i>Herdmania</i>, <i>Branchiostoma</i>, <i>Ciona</i>, <i>Salpa</i>, <i>Doliolum</i>. To study characteristic features of <i>Balanoglossus</i> sections through Probosis, Collar, branchiogenital & hepatic region. To study characteristic features of <i>Amphioxus</i>- oral hood, Whole Mount sections through pharyngeal, intestinal & caudal regions. 	24
II	<p>Pisces:</p> <ol style="list-style-type: none"> To study characteristic features of <i>Petromyzon</i>, <i>Scoliodon</i>, <i>Sphyrna</i>, <i>Pristis</i>, <i>Trygon</i>, <i>Torpedo</i>, <i>Chimaera</i>, <i>Notopterus</i>, <i>Labeo</i>, <i>Catla</i>, <i>Cirrihina</i>, <i>Heteropneustes</i>, <i>Mystus</i>, <i>Exocoetus</i>. To study characteristic features of Afferent branchial system, V, VII, IX and Xth Cranial nerves of <i>Scoliodon</i> and weberian ossicles of <i>Mystus</i> through models To prepare temporary mounting for the following scales of fishes: placoid, cycloid ctenoid, <p>Amphibia:</p> <ol style="list-style-type: none"> To study characteristic features of <i>Uraeotyphlus</i>, <i>Necturus</i>, 	22

	<i>Salamander, Bufo, Hyla, Rhacophorus.</i>	
III	<p>Reptiles:</p> <p>1. To study characteristic features of <i>Chelone, Testuda, Kachuga, Hemidactylus, Varanus, Uromastix, Ophiosaurus, Chameoleon, Draco, Hydrophis, Bungarus, Viper, Krait, Coral snakes, Crocodiles.</i></p> <p>Aves:</p> <p>3. To study characteristic features of six common birds from different orders.</p> <p>4. To study different types of beaks and claws.</p> <p>Mammals:</p> <p>5. To study characteristic features of Sorex, Shrew, Hedgehog, Bat through models</p>	22
IV	<p>1. Demonstration/ dissection of the following systems-</p> <p>i. Digestive system of Cockroach</p> <p>ii. Nervous system of Pila or Prawn</p> <p>iii. Urogenital system of Leech</p> <p>2. Mounting temporary slide of the following organ/parts- Setae of Earthworm, Salivary gland of Cockroach, Redulla of Pila, Mouthparts of Mosquito and honey bee.</p> <p>3. To examine the nematode diversity from soil sample collected from different places.</p>	22
TOTAL		90

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
-	90 hrs	

Textbooks:

1. Mali, R.P. (2015). A Practical Manual on Innovative Animal Physiology. (1st Ed), Oxford Book Company
2. Lal, S. S. (2020). Practical Zoology- Vertebrates, (12th Ed). Rastogi Publications

Reference:

1. McGowan, C. (1999). A practical guide to vertebrate mechanics. Cambridge University Press.

Semester-II		
Subject Name: Animal Diversity: Chordates		
Type of course: Minor	Paper Code: ZOO142N201	
Course Level: 100	Credit: 3	L-T-P-C- 3-0-0-3
Scheme of Evaluation: Theory		

Course Objective: The objective of the course is to briefly equip students who opt this minor paper with a basic knowledge of chordates. The aim is to provide students with a fair understanding of chordate biology and its significance in the broader field of zoology.

Course Outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall and list the major characteristics that define chordates	BT 1
CO 2	Explain the evolutionary significance of notochords and dorsal nerve cords in the development of chordates.	BT 2
CO 3	Apply knowledge of chordate characteristics to identify and classify different chordate species.	BT 3
CO 4	Analyze taxonomic hierarchy and chordate relationships	BT 4

Detailed syllabus

Modules	Course Contents	Periods
1	Introduction to Vertebrates: Overview of vertebrate diversity and classification; Evolutionary history of vertebrates; Characteristics and adaptations of vertebrates	12
2	An overview of primitive chordates: General characters and classification up to order level for Hemichordate, Urochordate, Cephalochordate and Cyclostomata	12
3	Behaviour and Ecology of Vertebrates: Observing and documenting vertebrate behaviour in their natural habitats. Behavioural adaptations and social structures in different vertebrate species	12

4	<p>Lower and Higher Chordates- General characters and classification up to order level for Fishes, Amphibians, Reptiles, Aves and Mammals.</p> <p>Adaption in mammals: What's so special about mammals? Are mammals the most successful animal group on earth?</p>	12
Total		48

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	30 hrs
		Field work, Assignment, Reflective thinking, case study, seminar, quiz

Textbooks-

1. Gerald, K., Janet, I., & Wallace, M. (2020). Karp's Cell and Molecular Biology (9th ed). Wiley.
2. Hardin J & Bertoni G (2018). Becker's World of the Cell. 9th Ed, Pearson Education.

References-

1. Stephen R. Bolsover S.R, Jeremy S. Hyams J.S, Elizabeth A. Shephard E.A & Hugh A. White H.A (2011). Cell Biology: A Short Course. 3rd Ed, John Wiley & Sons.
2. Cooper G.M (2019). The Cell: A Molecular Approach. 8th Ed, Sinauer Associates.

Semester II
AEC- 2/ Subject Name: Communicative English- II: Conversation and Public Speaking
Subject Code: CEN982A201
L-T-P-C – 2-0-0-2
Credit Units: 2
<p>Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech</p> <p>Continuous Evaluation: 30 Marks</p> <p>Semester End Examination:</p> <p>Component A = Written Examination = 30 Marks</p> <p>Component B + C= Viva-Voce + Extempore speech = 40 Marks</p>

Course Objective: The objective of the course is to give students a platform to enhance their speaking and conversational skills in English by engaging them in meaningful discussions and interactive activities.

Course Outcomes: On completion of this course students will be expected to -

- Improve speaking skill.
- Develop a life skill on conversation.
- Improve the skill of public speaking.

Detailed Syllabus:

Modules	Course Contents	Periods
I	<p>Speaking Skills Speaking – The Art of Speaking, Goals, Speaking Styles, The Speaking Process Importance of Oral Communication, Choosing the form of Communication, Principles & Guidelines of Successful Oral Communication, Barriers to Effective Oral Communication Three aspects of Oral Communication – Conversing, Listening and Body Language Intercultural Oral Communication</p>	15
II	<p>Conversational Skills : Listening and Persuasive Speaking Conversation – Types of Conversation, Strategies for Effectiveness, Conversation Practice, Persuasive Functions in Conversation, Telephonic Conversation and Etiquette Dialogue Writing, Conversation Control</p>	15
III	<p>Transactional Analysis The Role of Intonation , Strokes, Psychological Characteristics of Ego States (The Parent, The Adult, The Child), Structure and Aspects of Human Personality Analysing Transactions – Complementary Transactions, Crossed Transactions, Duplex or Ulterior Transactions, How to Identify the Ego States of Interacting Individuals, How to Manage Conversations, Structural Analysis, Certain Habits of Ineffective Conversationalists</p>	15
IV	<p>Public Speaking Business Presentation and Speeches – Difference Elements of a Good Speech – Planning, Occasion, Audience, Purpose, Thesis, Material Organising and Outlining a Speech Outline, Types of Delivery Guidelines for Delivery – Verbal Elements, Non-Verbal Elements, Vocal Elements, Visual Elements, Controlling Nervousness and Stage Fright</p>	15
TOTAL		60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	-

1. Mehra, Payal. (2012). *Business Communication for Managers*: Dorling Kindersley (India) Pvt. Ltd. Page 75 – 83. ISBN 978-81-317-5865-6
2. Raman, Meenakshi and Singh, Prakash. (2012). *Business Communication* (2nd Edition): Oxford University Press. Page 123 – 165. ISBN-13:978-0-19-807705-03

References

1. Raman, Meenakshi and Sharma, Sangeeta. (2011). *Technical Communication: Principles and Practice* (2nd Edition): Oxford University Press. Page 137 – 148 ISBN-13:978-0-19-806529-6
2. Sengupta, Sailesh. (2011) *Business and Managerial Communication*. New Delhi: PHI Learning Pvt. Ltd. Page 136-153. ISBN-978-81-203-4435-8

Semester II		
Subject Name: Sericulture		
Type of course: SEC		Paper Code: ZOO142S221
Course Level: 100	Credit: 3	L-T-P-C- 0-0-6-3
Scheme of Evaluation: Practical		

Course Objective: The objective of the course is to introduce the students to the entrepreneurial scope, economic advantages and basic practices involved in sericulture.

Course Outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall and describe the basic principles of sericulture, including the life cycle of silkworms.	BT 1
CO 2	Explain the significance of sericulture in the textile industry and its economic importance.	BT 2
CO 3	Apply sericulture techniques to raise and manage silkworms, and harvest silk for silk production.	BT 3
CO 4	Analyze the factors influencing silk quality and the economic impact of sericulture.	BT 4

Detailed Syllabus:

Modules	Course Contents	Periods
I.	Introduction: Insect and non-insect fauna producing silk; types of silk produced in India; host plants of mulberry and non-mulberry silkworms	15
II.	Scope of Sericulture: Advantages of sericulture; scope of sericulture in India employment potential and income generation; role of women in sericulture	15
III.	Concepts of Moriculture: Host plants of mulberry and non-mulberry silkworms. Mulberry cultivation.	15
V.	Concepts of Sericulture: Life cycle of Bombyx mori; rearing houses and equipment's; disinfection and hygiene. Rearing operations and cocoon harvesting. Diseases in silkworms.	15
Total		60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
-	60 hrs	30 hrs
		Field visit to Sericulture farm, assignment, quiz, project, hand-on rearing of silkworm

Textbooks:

1. Charsley, S.R. (1982). Culture and Sericulture. Academic Press Inc., New York, U.S.A
2. Masood, M. A., and Kamili, A. S. (2000). Principles of Temperate Sericulture. Kalyani Publisher.

References:

1. Devaiah, M.C et al. (2001); Advances in Mulberry Sericulture. Dept. of Sericulture, UAS, Bangalore.
2. Rao, M.M. (1999) Comprehensive Sericulture Manual. P.S Publications, Hyderabad.

SEMESTER-III
Subject Name: Comparative Anatomy of Animals Course Code: Major Subject Code: ZOO142M301

L-T-P-C: 3-1-0-4

Credit Units: 4

Scheme of Evaluation: Theory

Course Objective: This course is designed to enhance the comprehension of anatomical characteristics of different organs, their function and elucidate their comparative study in different classes of vertebrates concerning skeletal system, digestive system, cardiovascular system, respiratory system, excretory system and nervous system.

Course Outcomes:

On completion of the course the students will be able to:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall the fundamental structure and significance of integument and their derivatives. Skeletal arrangement of pectoral girdle and pelvic girdle of vertebrates.	BT 1
CO 2	Brief account of gastro intestinal tract, digestive glands and their function. Respiratory apparatus, their physiology in different vertebrates.	BT 2
CO 3	Brief knowledge of blood vascular system Evolution of heart, aortic arches, kidney and urinogenital ducts.	BT 3
CO 4	Concept of nervous system, brain and sense organs and receptors in different vertebrates.	BT 4

Detailed Syllabus:

Module	Topics (if applicable) & Course Contents	Periods
I	Integumentary System: General structure of skin, Function of skin. Comparative study of integument in different classes of vertebrates, Derivatives of integument in different vertebrates. Skeletal System in vertebrates: Comparative study of pectoral girdle and pelvic girdle of vertebrates	15
II	Digestive System: Brief account of alimentary canal, Stomach, intestine and digestive glands in different vertebrates Respiratory System in different vertebrates: Brief account of Gills, lungs, air sacs and swim bladder	15

III	Circulatory System: Evolution of heart and aortic arches in different vertebrates Urinogenital System in different vertebrates: Succession of kidney, Evolution of urinogenital ducts	15
IV	Nervous System: Comparative account of brain in different vertebrates Sense Organs: Ear, Eye in different vertebrates, Types of receptors in different vertebrates	15
	Total	60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	60 hrs
		Field work, Assignment, Reflective thinking, case study, seminar, quiz

TEXT BOOK AND REFERENCES

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
4. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
5. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
6. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
7. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.

III	1. Comparative study of blood cells in vertebrates 2. Comparative study of brain in different classes of vertebrates. 3. Comparison of herbivorous teeth and carnivorous teeth.	30
IV	1. Preparation of permanent slides of placoid, cycloid and ctenoid scales of fishes. 2. Study of beaks of different birds. 3. Study of claws of different birds.	30
Total		120

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
120 hrs	-	-

Textbooks:

1. Textbook of Practical Zoology, S.S. Lal.

Semester-III		
Subject Name: Human Biology		
Type of course:		Paper Code: ZOO142N301
Course Level: 100		Credit: 4 L-T-P-C- 4-0-0-4
Scheme of Evaluation: Theory		

Course Objectives:

1. Understand the basic principles of human biology.
2. Learn about the structure and function of the human body.
3. Develop an understanding of the relationship between the human body and its environment.
4. This course provides a basic understanding of the human body, its structure, functions, and the biological processes that govern it.

Course outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall and list the major characteristics that define	BT 1

	various aspects of Human Biology	
CO 2	Explain the evolutionary significance of Human Biology and dorsal nerve cords in the development of chordates.	BT 2
CO 3	Apply knowledge of chordate characteristics to identify and classify different chordate species.	BT 3
CO 4	Analyze taxonomic hierarchy and chordate relationships	BT 4

Detailed syllabus

Module	Course Content	Periods
I	Introduction to Human Biology <ul style="list-style-type: none"> Overview of Human Biology: Basic biological principles, Levels of Organization: Levels of organization in the human body Overview of homeostasis, Glucose homeostasis and thermoregulation, Mechanism of homeostasis. 	15
II	Cell Biology and Genetics <ul style="list-style-type: none"> Cell Structure and Function Cellular components: DNA, genes, and chromosomes. Cell Division and Growth, Overview of cell cycle. 	15
III	Human Anatomy and Physiology <ul style="list-style-type: none"> Basics of Human Anatomy (Skeletal System, Muscular System, Nervous System, Digestive System). Basics of Human Physiology (Respiratory Physiology, Digestive Physiology). 	15
IV	Human Health and Disease <ul style="list-style-type: none"> Nutrition and Health Common Diseases and Disorders Immunity and Vaccination 	15
Total		60

Credit Distribution		
Lecture/	Practicum	EL

	history. Reevaluation of Cameras. Basic settings of Camera. Types of cameras used in wildlife photography (underwater, drone, camera trap, GoPro, etc.).	
II	Tools and Technique of Photography: Still & Video Photography. To develop expertise in Photography. Photography in different periods (Light and Dark), seasons and places (Wetlands, Wildlife sanctuaries, National parks, Industrial sites etc.). Camera trapping method for wildlife conservation and management.	25
III	Eco-tourism: Introduction of Eco-tourism. Scope of Eco-tourism with special reference to Northeast region of India. Management of Eco-tourism & hospitality	20
IV	Wildlife Photography and Ecotourism: Nature guides as a profession with reference to bird tourism. Development of Eco-tourism with innovative, Eco-restoration ideas. Submission of a photography and report.	25
	Total	90

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
-	60 hrs	30 hrs
		Field visit to, assignment, quiz, project

Textbooks:

1. Ken Milburn & Ron Rockwell (2002). Digital photography bible (2nd Ed), Wiley.
2. Julie Adair King (2003). Shoot Like a Pro! Digital Photography Techniques (1st Ed), McGraw-Hill Osborne Media.

References:

1. Ballantyne R. & Packer J (2013). International Handbook on Ecotourism. Edward Elgar Publishing Limited, UK.
2. Fennell DA (2014). Ecotourism. An Introduction. Routledge, London, UK.
3. Joshi, R. (2010). Eco-tourism as a viable option for wildlife conservation: need for policy initiative in Rajaji National Park, North-West India. Global Journal of Human Social Science Research, 10(5), 19-30.
4. Basnet, D., Jianmei, Y., Dorji, T., Qianli, X., Lama, A.K., Maowei, Y., Ning, W., Yantao, W., Gurung, K., Rujun, L. and Gupta, N., 2021. Bird photography tourism, sustainable livelihoods, and biodiversity conservation: a case study from China. Mountain Research and Development, 41(2), p.D1.
5. Dixit, S. (2018). An assessment of wildlife tourism photography in nature and ecotourism destination - a case of India. Amity Journal of Management, Vol. VI, No. 1, 1-13.
6. Hanisch, E., Johnston, R., & Longnecker, N. (2019). Cameras for conservation: wildlife photography and emotional engagement with biodiversity and nature. Human Dimensions of Wildlife, 24(3), 267-284.

SEMESTER-IV	
Subject Name: Cell Biology	
Course Code: Major	Subject Code: ZOO142M401
L-T-P-C: 3-1-0-4	
Credit Units: 4	
Scheme of Evaluation: Theory	

Course Objective:

To help the students learn and develop an understanding of the cell as a basic unit of life, the functions of cellular organelles, how a cell carries out and regulates cellular functions and their role in disease condition due to malfunctioning of cellular processes.

Course Outcomes:

Upon completion of the course, students should be able to:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Identify the different structural and functional components of the cell.	BT 1
CO 2	Explain the structure and functions of cell organelles	BT 2

	involved in diverse cellular processes.	
CO 3	Apply the knowledge of cellular process and its regulation in understanding the process of cancer and microbial physiology.	BT 3
CO 4	Point out the roles of various genes responsible for various kinds of cell signalling processes.	BT 4

Course Outline

Modules	Topics (if applicable) & Course Contents	Periods
I	<p>Structure and differences between prokaryotic and eukaryotic cells.</p> <p>Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps.</p> <p>Chromatin structure- Euchromatin and Heterochromatin- Constitutive and Facultative heterochromatin.</p> <p>Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.</p>	15
II	<p>Cytoskeleton: Molecular organization of microtubules, microfilaments and intermediary filaments.</p> <p>Cellular communication: General principles of cell communication, Cell junction and cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission.</p>	15
III	<p>Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle in yeast and multicellular organism, apoptosis.</p> <p>Cancer: Introduction to normal and cancerous cell, tumor suppressor genes and oncogenes, cancer causing viruses.</p>	15
IV	<p>Basics of Cell signaling: Autocrine, endocrine, paracrine and juxtracrine signaling, signaling molecules and receptors.</p>	15

	Cell signaling: Hormones and receptors, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of GPCR signaling pathways.	
TOTAL		60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	60 hrs
		Field work, Assignment, Reflective thinking, case study, seminar, quiz

Textbooks:

- Lodish H, Berk A, Kaiser C.A, Krieger M, Bretscher A, Ploegh H, Amon A, Martin K.C (2016). Molecular Cell Biology, 8th Ed, W. H. Freeman.
- Alberts B, Johnson A, Lewis J, Morgan D, Raff M, Roberts K, Walter P (2018). Molecular biology of the cell. 6th Ed, Garland Science.
- Hardin J & Bertoni G (2018). Becker's World of the Cell. 9th Ed, Pearson Education.

References:

- Stephen R. Bolsover S.R, Jeremy S. Hyams J.S, Elizabeth A. Shephard E.A & Hugh A. White H.A (2011). CELL BIOLOGY: A Short Course. 3rd Ed, John Wiley & Sons.
- Cooper G.M (2019). The Cell: A Molecular Approach. 8th Ed, Sinauer Associates.
- Iwasa J & Marshall W (2016). Karp's Cell and Molecular Biology: Concepts and Experiments. 8th Ed, John Wiley & Sons.

Semester-IV	
Paper I/Subject Name: Animal Physiology and Endocrinology	
Course Code: Major	Subject Code: ZOO142M402
L-T-P-C- 3-2-0-4	
Credit Units: 4	

Scheme of Evaluation: Theory

Course Objective: This course is designed to enhance comprehension of the anatomical characteristics of organs and elucidate their functioning at the organ level concerning processes such as nervous, respiratory, cardiovascular, excretory, and digestive systems, among others.

Course Outcomes:

On completion of the course the students will be able to:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall different procedures that are crucial for grasping the fundamental principles of physiology	BT 1
CO 2	Interpret the diverse approaches that regulate essential life functions including nervous, respiratory, cardiovascular, excretory, and digestive processes, among others.	BT 2
CO 3	Utilize fundamental understanding to analyse the diverse life processes, including the operations of the nervous system, respiratory system, cardiovascular system, excretory system, and digestive system.	BT 3
CO 4	Compare and contrast between different biological system.	BT 4

Detailed syllabus:

Modules	Topics (if applicable) & Course content	Periods
I	<p>Digestive system: Comparative account of physiology of digestive system in herbivores and carnivores. Digestion and absorption of various nutrients; Hormonal control of secretion of enzymes in Gastrointestinal tract in humans. Disorders of the digestive system.</p> <p>Excretory system: Comparative account of physiology of excretory system; Structure of kidney and its functional unit; Micturition; Urine formation; Disorders of the excretory system.</p>	15
II	<p>Cardiovascular System: Comparative account of circulation; Lymphatic system; Components of blood and their functions; Haemopoiesis; Structure of mammalian heart; Origin and conduction of cardiac impulses; ECG – its principle and significance. Disorders of the cardiovascular system.</p>	15

	<p>Nervous System:</p> <p>Comparative account of nervous system; Structure of neuron; Types of neurons, Resting membrane potential, Origin of action potential and its propagation; Synaptic transmission; Reflex action and its types. Disorders of nervous system.</p>	
III	<p>Respiratory system:</p> <p>Structural components of respiratory system; Mechanism of respiration, Gaseous exchange: CO₂ and O₂ transport, Disassociation curve, respiratory volumes; Comparative account of respiratory systems in animals; Disorders of nervous system. High altitude respiratory adaptations.</p>	15
IV	<p>General endocrinology:</p> <p>Structure and functions of: Pituitary, thyroid, pancreas and adrenal and their mechanism of action; Classification of hormones; Mode of hormone action; Disorders of endocrine system.</p> <p>Reproductive endocrinology:</p> <p>Components of reproductive system; Physiology of male and female reproductive system; Hormonal regulation of reproduction; Disorders of reproductive system; and basics of assisted reproductive technologies.</p>	15
Total		60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	60 hrs
		Field work, Assignment, Reflective thinking, case study, seminar, quiz

Textbooks:

- Guyton, A.C. & Hall, J.E. (2015). Textbook of Medical Physiology. XIII Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.

- Tortora, G.J. & Grabowski, S. (2017). Principles of Anatomy & Physiology. XI Edition John Wiley & Sons
- Marieb E.N & Hoehn K.N (2022). Human Anatomy & Physiology. 12th Ed, Pearson Education.

References:

- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, Mcgraw Hills
- Dr Ian Kay (1998). Introduction to Animal Physiology. 1st Ed, Garland Science.

SEMESTER-IV		
Subject Name: Cell Biology & Animal Physiology and endocrinology (Practical)		
Course Code: Major		Subject Code: ZOO142M413
L-T-P-C- 0-0-8-4		
Credit Units: 4		
Scheme of Evaluation: Practical		

Course Objective:

To help the students learn and develop an understanding of the cell as a basic unit of life, the functions of cellular organelles, how a cell carries out and regulates cellular functions and their role in disease condition due to malfunctioning of cellular processes.

Course Outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Identify the different structural and functional components of the cell.	BT 1
CO 2	Explain the structure and functions of cell organelles involved in diverse cellular processes.	BT 2
CO 3	Apply the knowledge of cellular process and its regulation in understanding the process of cancer and microbial physiology.	BT 3
CO 4	Point out the roles of various genes responsible for various kinds of cell signalling processes.	BT 4

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	1. Staining of buccal epithelial cells and blood cell using methylene	30

	<p>blue and Leishman stain respectively</p> <ol style="list-style-type: none"> Effect of hypotonic and hypertonic solution on mammalian RBC Staining of nucleus and nucleolus in mammalian cell Staining of mitochondria using Vital stain Study of eukaryotic and prokaryotic cells and their comparison. 	
II	<ol style="list-style-type: none"> To study replication, transcription, and translation using photographs. Study of various stages of mitosis in onion root tip. Study of different stages of meiosis using grass hopper/Sand hopper testes Preparation of polytene chromosome from salivary gland of Chironomus / drosophila larvae 	30
III	<ol style="list-style-type: none"> Study of permanent slides of mammalian skin, cartilage, bone, spinal cord, liver, lung, kidney, and nerve cell. Demonstration of mammalian internal systems (digestive, circulatory, nervous, reproductive, and excretory) of Frog/ rat. Determination and comparison of RBC count in different vertebrates (human, fish, and frog). Estimation of haemoglobin using Sahli's haemocytometer. Preparation of haemin crystals. 	30
	<ol style="list-style-type: none"> Recording of blood pressure of human using a sphygmomanometer. To determine the rate of oxygen consumption by terrestrial animal (rat) Study of permanent slides of Pituitary, Pancreas, Testes, Ovary, Adrenal, Thyroid and Parathyroid glands Dissection and display of endocrine glands in albino mice. To study the estrous cycle in mammals. 	30
Total		120

Credit Distribution

Lecture/ Tutorial	Practicum	EL
	120 hrs	-

Textbooks:

1. Das, D. (2017). Essential practical handbook of cell biology & genetics, biometry & microbiology: a laboratory manual. (1st Ed). Academic Publishers.
2. Gupta, A., Sati, B. K., & Lambert, L. A. P. Practical laboratory Manual- Cell Biology. Academic Publishing

Semester-IV
Subject Name: Aquatic Biology Type of course: Minor Paper Code: Z00142N401 Course Level: 200 L-T-P-C- 2-1-0-3 Credit: 3 Scheme of Evaluation: Theory

Course Objectives: This course provides a comprehensive understanding of the biology of aquatic organisms and the ecosystems they inhabit.

Course outcomes:

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Recall and understanding of various aquatic biomes, including freshwater ecosystems, estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone, and coral reefs.	BT 1
CO 2	Explain and understand the origin, classification, and ecosystem of lakes, their morphometry, and physico-chemical characteristics. Learn about nutrient cycles in lakes and the adaptation of hill-stream fishes.	BT 2
CO 3	Apply and Learn about the salinity and density of seawater, the continental shelf, adaptations of deep-sea organisms, coral reefs, and seaweeds.	BT 3
CO 4	Analyze the causes of pollution, including agricultural, industrial, sewage, thermal, and oil spills. Learn about eutrophication, management and conservation strategies, legislations, sewage treatment, and water quality assessment methods like BOD and COD.	BT 4

Detailed Syllabus

Module	Course Content	Periods
I	Aquatic Biomes: Brief introduction of the aquatic biomes: Freshwater ecosystem; lakes, wetlands, streams and rivers, estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs, artificial ecosystem (ponds).	15
II	Freshwater Biology: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases; Oxygen, Carbon dioxide. Nutrient Cycles in Lakes- Nitrogen, Sulphur and Phosphorous. Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes	15
III	Marine Biology: Salinity and density of Sea water, Continental shelf, Adaptations of deep-sea organisms, Coral reefs, Sea weeds.	15
IV	Management of Aquatic Resources: Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation; legislations, Sewage treatment Water quality assessment - BOD and COD	15
	Total	60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	30 hrs
		Field work, Assignment, Reflective thinking, case study, seminar, quiz

Textbooks:

1. Freshwater Ecology: Concepts and Environmental Applications by Walter K. Dodds and Matt R. Whiles. This book provides an in-depth understanding of freshwater ecosystems, how they work, and how to protect and manage them.
2. Marine Biology: Function, Biodiversity, Ecology by Jeffrey S. Levinton. It's a comprehensive book that covers various aspects of marine biology including the function and biodiversity of marine ecosystems.

Reference Books:

1. Aquatic Ecosystems: Interactivity of Dissolved Organic Matter” by Stuart Findlay and Robert L. Sinsabaugh. This book provides information on the role of dissolved organic matter in aquatic ecosystems.
2. Biology of Freshwater Pollution by C.F. Mason. This is a comprehensive guide to the biological aspects of water pollution.

SEMESTER-IV	
Subject Name: Economic Zoology	
Course Code: Minor	Subject Code: ZOO142N402
L-T-P-C: 2-1-0-3	
Credit Units: 3	
Scheme of Evaluation: Practical	

Course Objective:

1. To disseminate information on economic aspects of zoology like apiculture, sericulture, dairy science etc.
2. To encourage young learners for self-employment.
3. To impart the practical knowledge and working skill to the students on various aspects of Zoology and to train them for their livelihood.

Course Outcome: Post learning this course, we can expect following outcomes-

Course Outcome	Course Outcome	Bloom's Taxonomy Level
CO 1	Understands the importance of earthworms in maintaining soil quality and learns that the vermicomposting is an effective organic solid waste management method. Best opportunity for self-employment and lifelong learning with farmers	BT 1
CO 2	Gives knowledge of silk worm rearing, Mulberry cultivation and Various process involved in silk production	BT 2
CO 3	Understands about honey bee and bee rearing. Knowing methods of extraction of honey and implication of Bee economy and entrepreneurship in apiculture	BT 3
CO 4	Understands concepts of Aqua culture systems, prawn	BT 4

	culture, pearl culture and induced breeding techniques. Provides knowledge of ornamental fish breeding which is highly professional and attractive avenue for youth	
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Detailed Syllabus:

Module	Topics (if applicable) & Course Contents	Periods
I	Vermiculture: Scope of Vermiculture, Types of earthworms, Habit categories - epigeic, endogeic and anecic; indigenous and exotic species. Methodology of vermicomposting: containers for culturing, raw materials required, preparation of bed, environmental pre-requisites, feeding, harvesting and storage of Vermicompost. Advantages of vermicomposting. Diseases and pests of earthworms.	15
II	Sericulture: History and present status of sericulture in India, Mulberry and non-mulberry species in Assam and India, Mulberry cultivation, Morphology and life cycle of <i>Bombyx mori</i> , Structure of silk gland and secretion of silk, Silkworm rearing techniques: Spinning, harvesting and storage of cocoons, Processing of cocoon, reeling, Silkworm diseases-pests and their control	15
III	Apiculture: Introduction and present status of apiculture, Species of honey bees in India, life cycle of <i>Apis indica</i> , Colony organization, division of labour and communication, Bee keeping as an agro based industry; methods and equipment's: indigenous methods, extraction appliances, extraction of honey from the comb and processing, Bee pasturage, honey and bees wax and their uses, Pests and diseases of bees and their management.	15
IV	Aquaculture: Aquaculture in India: An overview and present status and scope of aquaculture, Types of aquacultures: Pond culture: Construction, maintenance and management, composite fish culture and pearl culture. Culture of fresh and marine water prawns. Ornamental fish culture: Fresh water ornamental fishes- biology, breeding techniques, Construction and maintenance of fish aquarium, Modern techniques of fish seed production; Induced breeding of fish.	15
	Total	60

Credit Distribution		
Lecture/ Tutorial	Practicum	EL
60 hrs	-	30 hrs
		Field work, Assignment, Reflective thinking, case study, seminar, quiz

Textbooks:

1. Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.
3. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers
4. YadavManju (2003). Economic Zoology, Discovery Publishing House.
5. Jabde Pradip V (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi.
10. Cherian & Ramachandran Bee keeping in-South Indian Govt. Press, Madras.